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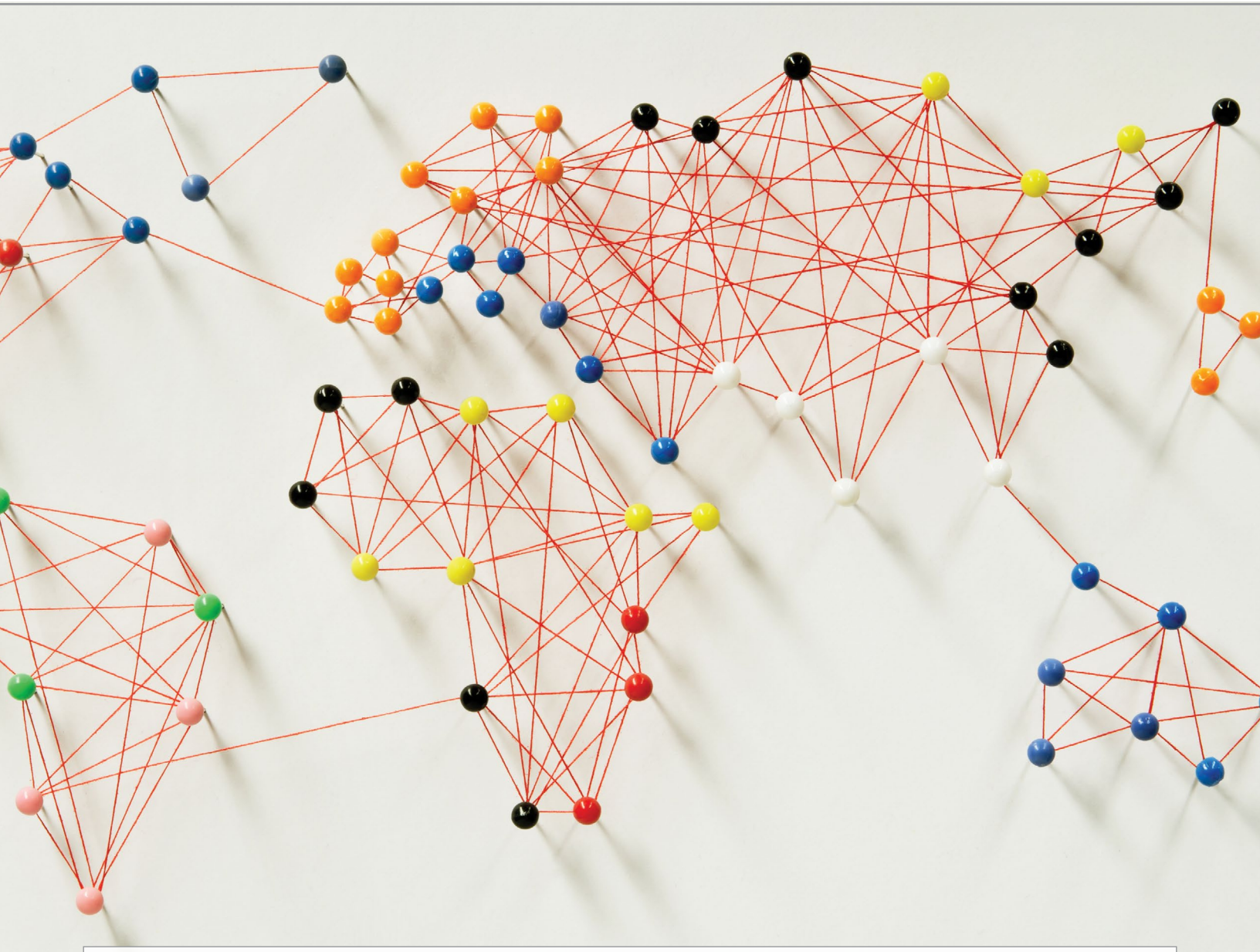

DATA FOR PEACEBUILDING AND PREVENTION

Ecosystem Mapping

The State of Play and the Path to Creating a Community of Practice

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ABOUT THE CENTER ON INTERNATIONAL COOPERATION

The Center on International Cooperation (CIC) is a non-profit research center housed at New York University. Our vision is to advance effective multilateral action to prevent crises and build peace, justice, and inclusion. Our mission is to strengthen cooperative approaches among national governments, international organizations, and the wider policy community to advance peace, justice, and inclusion.

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Contents

Summary

This report is part of the new initiative on **Data for Peacebuilding and Prevention**, hosted at the NYU Center on International Cooperation in New York. Inspired by practical applications presented at Data for Peace and Security Workshops in 2019 and 2020, it aims to analyze the state of play of an existing global ecosystem in the field of "**data for peace and prevention,**" in order to better inform existing actors and those about to enter the field.

Our specific objective is to map information on organizations and projects using cutting-edge approaches to the use of data in peacebuilding. In particular, these include the use of advanced data science methods, quantitative methods, predictive analytics, artificial intelligence (AI), machine learning (ML), natural language processing (NLP), and other techniques employed to address ground-level problems in the peacebuilding field. Our methodology includes desk review research of key documents, complemented by a set of stakeholder interviews with peace and conflict experts, data scientists, ethicists, and peace advocates.

Our method to mapping innovative data science approaches to peace and violence prevention employs the metaphor of an **ecosystem** to refer to complex, dynamic environments in which innovative approaches are implemented. To create positive change in an ecosystem we first need to understand its broader environment. There are two major trends shaping the system: first, **deterioration of peace, security, and human rights;** and second, advancement in data science methods followed by the **development of exponential technologies**. We examine data principles, regulatory and policy documents, and various national and international initiatives that make up the development framework of this ecosystem. Although there are many positive applications of exponential technologies, considerable mistrust of advanced data solutions still exists among the general population, creating an obstacle to favorable cultural and social conditions necessary for the ecosystem to flourish. We also look at COVID-19 as an example of an **external force** influencing advanced data science applications in the field. Through mapping the ecosystem, we identify relevant global **actors**, looking across academia, civil society organizations, governmental and intergovernmental organizations, and the private sector. We also present some of their projects, initiatives, and partnerships that utilize different technologies and a combination of data science methods in shaping their peacebuilding work.

This research highlights multiple examples of relevant initiatives throughout the world utilizing big data, data visualization, AI, ML, image recognition, and social media listening. Many of these examples can serve as an inspiration to other practitioners. Accordingly, we provide an overview of several cutting-edge examples and their real-life utilization: **NLP and ML for online hate speech monitoring**; **ML for early warning and conflict**

prevention; computer vision tools for human rights protection; AI for fighting transnational criminal networks (like human trafficking); NLP for public sentiment analysis; AI to support mediation and peacemaking; crisis mapping for violence prevention; civilian protection and accountability; and satellite imagery for human rights protection, among many others. This selection is not intended to be comprehensive, and some initiatives may be in the early stages. However, all represent the potential of exponential technologies and advanced data approaches to enable the creation of a more peaceful, just, and free society. Although we recognize their positive potential, we also emphasize that each of these technologies comes with possible risks of misuse or unintended negative consequences. Therefore, they should always be researched with caution, applying necessary ethical standards and frameworks to safeguard privacy, security, and protect human rights.

We also map **technical challenges** impacting all actors, such as the lack of data or lack of high-quality data, lack of access due to security reasons, and data colonialism. As data becomes more available and widely applied, more concerns are raised about protecting privacy and often personal security in conflict-affected settings. Even with traditional data-gathering techniques such as interviews and polls, many organizations are facing **capacity constraints**. Advanced data science techniques require special skills that are in high demand, which only amplifies this problem. Additional challenges are posed by conflict and violence, impacting continuous access on the ground.

The latest advancements in technologies and big data are creating transformational change, while at the same time raising **complex ethical questions**. Our research highlights some of the general ethical considerations brought on by exponential technologies (security, accessibility, transparency, safety, trust, bias, and justice), and some specific challenges for data-driven approaches to peacebuilding. This list is not a complete effort, but rather an attempt to start a discussion and advocate for more in-depth research of ethical challenges in using data in peacebuilding.

There is still more to be done to allow the field to reach its potential. To promote growth of this ecosystem, we suggest five sets of recommendations:

1. **Strengthen the ecosystem through building trust and human-centered approaches.** Trust is essential for harnessing the potentials of advanced technologies and enabling the ecosystem's development. Positive examples of new technologies that utilize human-centered approaches and protect human rights, safety, security, and privacy are another tool for building trust and opening pathways for more organizations to enter the field.

2. **Strengthen the ecosystem through capacity building.** As advanced data-driven approaches are still novel in the peacebuilding field, capacity building has to start with raising awareness and building knowledge on the potential of new technologies. We additionally recommend opening pathways for partnership with data scientists, creating the platform for a community to emerge, and discussing challenges and opportunities of using technologies in peacebuilding.

3. **Strengthen the ecosystem through innovation.** Innovation comes in many forms, whether through creating new advanced technologies to collect the data, or through using new methods and tools as AI and ML for processing, analyzing, or predictive modeling. However, innovation does not have to come only through creating new products. There are many opportunities for this field to grow through utilizing existing digital technologies and tools (such as chatbots, radio content, or satellite imagery) in new and innovative ways.
4. **Strengthen the ecosystem through principles and frameworks.** Development and utilization of any technology for peacebuilding and prevention should also be conflict-sensitive and respect the "do no harm" principle. Technology has to be ethically built but also be safeguarded from malicious use and unintended consequences.
5. **Strengthen the ecosystem through community and partnership.** New AI/tech hubs and open collaboration platforms, that gather data scientists and ML experts and are oriented towards social impact, can play an important role in building the ecosystem. Over time, the international community should consider creating a **Hub for Peacebuilding and Prevention Data**, providing access to data, generating research, building capacities, and connecting actors in the data for peacebuilding and prevention field.

Implementing these recommendations will help to further develop the capacities of existing actors, attract new ones, and develop the ecosystem as a whole. Indeed, it is our hope this paper will be used by peace and prevention activists, data, ML, and AI experts, and any organizations and individuals working at the intersection of peace and technology. The information compiled here is aimed at all who are eager to capture the benefits and reduce harms of advanced data science methods deployed around the globe to build peaceful and just societies.

Terminology

Data, big data, data-driven approaches, data science, and exponential technologies

Data is any information in digital form that can be transmitted and processed. **Big data** is high volume, variety, and velocity of data from any type of digital resources—so big that traditional data processing software cannot be used to manage it. **Datasets** are large collections of digital information, which are often used to train AI.[1] **Data-driven approaches** refer to any methodologies that allow utilization and enable a better understanding of massive amounts of qualitative and quantitative data to provide practitioners with informed decision-making and enhanced response. Data-driven means that the activity is completed by data, rather than by intuition or personal experience. **Data science** is considered as a blend of various tools, mathematical models, algorithms, machine learning, and artificial intelligence techniques that aim to discover patterns, correlations, and relationships from data. To refer to this complex blend of different approaches we use the term **"advanced data science methods."** To reflect the richness and diversity of terminology, we use another term, **"exponential technologies,"** to refer to the set of technologies rapidly accelerating and shaping industries and our lives. These include artificial intelligence, augmented and virtual reality, data science, nanotechnology, robotics, etc.

Peace, peacebuilding, and prevention of violence

Our initial approach was to formulate this research as "Data for Peace and Security." Learning from and alongside many interviewees and experts in this field, however, we decided to reformulate our research as **"Data for Peacebuilding and Prevention,"** in order to bring greater clarity to specific objectives we wish to support and the fields in which we are engaged. Our research builds on the work of **PeaceTech**—as technology that contributes to peacebuilding—and **digital peacebuilding**—as a broader nexus between the field of peacebuilding and digital technologies[2]—while exploring and contributing to the new emerging sphere of big data and data science for peacebuilding and prevention. **Peace** is not just the absence of violent conflict, but also a society in which everyone can thrive.[3] Thus, we turn to defining **"peacebuilding"** as a strategic activity to solidify peace and avoid violent conflict; to provide the tools for building something more than just the absence of war; to strengthen capacities for conflict management; and to lay the foundations for sustainable peace and development.[4] Focusing on **"prevention of violence,"** we acknowledge that technologies and data have a role in not only protecting the national and global security, but also in addressing the root causes of violence and building social resilience to violence, which is a preventive approach.

Introduction: Objectives And Methodology

Our research and this report are part of the new multi-year initiative on data for peacebuilding and prevention, hosted by the NYU Center on International Cooperation (CIC), in New York. In March 2019, CIC co-hosted the first Data for Peace and Security Practitioners Workshop,[5] in conjunction with the Netherlands Ministry of Foreign Affairs and the UN Peacebuilding Support Office. More than 70 people assembled to present and discuss advances in data-driven approaches to peace and security. One year later, the second conference was organized in The Hague[6] by the Netherlands Ministry of Foreign Affairs, with more than 150 participants to providing even greater opportunities for exchange about emerging peacebuilding applications. (These events also built upon other recent and ongoing events such as Build Peace, PeaceTech Summit, and the Paris Peace Forum.) The number of applicants, participants, and enthusiasm around presented projects was a sign that this is an active field with the potential to increase future impact. Insights and ideas generated through both of these events and their associated projects and initiatives inspired this report.

To enable stakeholders to grow and use the benefits of new data-driven technologies for advancing the peacebuilding field, we should first understand the broader environment in which they work. Our wish is to understand the ecosystem's state of play, its needs, and its greatest potential for growth and positive impact. We conducted this mapping research following the ecosystem research framework in order to help create long-lasting positive change.[7]

It is our hope this paper will be used by peacebuilding and prevention practitioners, as well as organizations working at the intersection of peace and technology, who are eager to capture the benefits and reduce harms of advanced data-driven methods deployed around the globe. We envision that this paper will encourage dialogue on current and future utilization of advanced data science methods and data-driven approaches to peacebuilding, and also promote future research and enable the field to take better advantage of new opportunities presented by cutting-edge technologies.

Objectives

The general objective of our research is **to analyze the current state of the existing global ecosystem** of data-driven approaches to peacebuilding and prevention. The specific objective is to map and share information on existing **organizations, projects, and their cutting-edge approaches to the use of data in peacebuilding**, particularly the use of advanced data science methods, quantitative methods, predictive analytics, ML, and other techniques to address ground-level problems in the field.

Our goal is to help build a shared understanding of the ecosystem, recognize some of the gaps and missing elements, help shape future interventions, and enable the field to grow its impact. We wish to encourage an inclusive dialogue on important and pressing issues, such

as existing gaps (research, operational, capacity, technology access or data availability) to effectively using data for decision-making and achieving positive change on the ground. We wish to emphasize the importance of continuous, inclusive debate on issues such as data bias, privacy, accountability, security, and safety, potential misuse of artificial intelligence and machine learning, and the potential for harm and even physical threats against sources of data and information. And finally, we wish to highlight success stories and practical examples of technology advancing peace and security, in the hope of motivating more impactful future applications.

Methodology

We used a multiple-step methodology. First, we reviewed existing documents and reports concerning data-driven approaches or utilization of technology in relation to peacebuilding and conflict prevention. The desk review was complemented by a set of stakeholder interviews with peacebuilders, peace and conflict experts, data scientists, ML engineers, ethicists, and peace advocates.

Interviews included governmental and intergovernmental, private, civil society, academy, and research representatives throughout the world, with the aim of reflecting as much as possible the interdisciplinary and global nature of the field. As the majority of participants in the previous two workshops came predominantly from countries defined as the Global North, our intention was to extend our reach to those based in the Global South to make this mapping more geographically representative, while at the same time reflecting the objective representation of the existing work in the field. The mapping was conducted in a form of a table overview, with general classification according to the type of the organization, covered issues, tools, data resources, objective, project, and headquarters location. An online, publicly accessible mapping platform will be developed using this data in the second stage of the project.

We wish to highlight that this document does not provide a final or complete overview of all applications or organizations, since there are many actors in this field that were unable to be mapped due to time, language, or other constraints. Thus, the list is not exhaustive and should continue to evolve along with increased applications of existing data techniques and the development of new technologies. Our intention is to start this open-ended process of an online mapping platform in order to facilitate greater transparency and coordination of work in this field, along with its future advancement. Also, the goal is not to map each and every actor, but rather to define the current state of play and, through identifying gaps and tackling challenges, contribute to the field's growth.

Mapping the Ecosystem

To map innovative data-driven approaches to peacebuilding and prevention, we use the metaphor of an ecosystem to refer to complex, dynamic environments in which innovative approaches are implemented and characterized by various elements, actors, relationships, conditions, trends, and forces that either enable or obstruct innovation.[8]

Creating and sustaining positive change and building a community of effective practice to advance the field requires us to first understand the broad environment in which this community works. This environment includes all organizations mapped in our research, but also other "friends, foes, competitors and even innocent bystanders, as well as the larger environment—the laws, policies, social norms, and cultural institutions—within which the actors play."[9] Understanding these forces in the system will allow us to design the most effective ways to intervene while rapidly evolving technological changes take place alongside constantly changing local, regional, and global developments in peace and conflict.

In this section, we first survey the overall context in which the ecosystem is developing, and then turn to different types of actors engaging in it.

Context

There are two major trends shaping the development of the ecosystem: 1) **deterioration of peace, security, and human rights,** and 2) advancements in data science methods followed by the **development of exponential technologies.** Also relevant to the overall context are the **policies, standards, and partnerships** currently being forged. While other technological, social, cultural, political, legal, and economic factors are important to the ecosystem's development, especially at local and national levels, we highlight these as the most important.

Deterioration of Peace

The 2020 Global Peace Index reveals that the average level of global peacefulness deteriorated for the ninth time in twelve years.[10] Conflicts and crises that emerged in the past decade have begun to decrease, only to be replaced with new tensions and uncertainties as a result of the COVID-19 pandemic. While some countries still face prolonged armed conflict, other regions have enjoyed increased levels of peace and security. Many regions in Latin America, sub-Saharan Africa, and Asia face an increased risk of homicides.[11] The average total number of homicides per year is around three times the number killed in armed conflict and terrorism combined.[12] Although there is significant progress being made in some fragile states, there is still widespread fragility and vulnerability, poverty and inequality, conflict, violence, instability, and repression in many parts of the world, according to the 2020 Fragile States Index.[13] And COVID-19 had not yet appeared when the data for this year's Fragile

States Index was compiled. The exposure to risk (and insufficient coping mechanisms to absorb and mitigate risk) leaves communities unprotected in situations of violence, conflict, displacement, humanitarian crises, and other emergencies.

The number of people forcibly displaced because of persecution, conflict, violence, or human rights violations is at a record high, with an estimated 79.5 million forcibly displaced people in 2019.[14] This number grew substantially from 43.3 million in 2009.[15] Freedom House found that 2019 was the fourteenth consecutive year of decline in global freedom, with more than half of the countries that were rated "free" or "not free" in 2009 suffering a decline in the past decade.[16]

Development of Exponential Technologies

Mobile phones, software development, and sensors have all created an abundance of data that can be collected, mined, and analyzed to gain new insights about the world and then used to transform almost every sector. Data is publicly available at an unprecedented scale and in real time. AI itself is shaping up to be "the single biggest technology revolution the world has ever seen."[17] Some are emphasizing AI as "the ultimate breakthrough technology," while others think that AI will "not only be a game-changer, but it will disrupt the entire playing field."[18] A series of fast technology trends has been driving this revolution, such as processing power, storage ability, lowered cost of cloud access (combined with large availability of data), and lowered barriers to entry for advanced data-driven approaches. A whole spectrum of so-called exponential technologies is rapidly accelerating and shaping all aspects of our lives. These include AI, augmented and virtual reality, data science, robotics, and autonomous systems, to name just a few. These trends are also shaping the current environment across a wide range of industries and fields, including the humanitarian-development-peace nexus.

Countries are increasingly looking at not only how exponential technologies can unlock economic benefits, but also how they can enhance the public good. Many surveys and forecasts of exponential technologies show investment increasing every year, and more sectors are introducing these technologies.[19] Governments and companies across the world are looking at how to leverage the large economic potential of AI, e.g. the estimated $13 trillion in additional economic activity in the European Union (EU) by 2030.[20] The majority of the world's biggest economies have already announced their own AI and big data initiatives. Academic institutions are also looking into big data and how to maximize the benefits of new technologies. There has been a 300-percent-plus increase in the number of scientific peer-reviewed AI papers in the last ten years,[21] as well as an upsurge in patent applications.[22]

Contrary to the positive hype and a trend toward quick adoption of AI in many industries, there is nevertheless considerable distrust among the general population, creating an obstacle for favorable cultural and social conditions necessary for any ecosystem to flourish.[23] This distrust comes from concerns about technologies being used for mass surveillance, creating massive unemployment, being used for autonomous weapons, or enabling cyberattacks. For this ecosystem to grow and create positive impact, building trust is crucial.

Initiatives such as **Tech for Good**, **Data for Good**, and **AI for Good** are positive examples in the direction of trust-building and fostering conditions for the ecosystem to develop and grow. These initiatives are emerging from both private and public sectors, using the latest

technological advancements to address some of the biggest societal problems and the world's greatest challenges. Microsoft's **AI for Good** program provides technology, resources, and expertise to empower those working to solve humanitarian issues and create a more sustainable and accessible world.[24] IBM started **Science for Social Good**, applying AI, cloud, and deep science to scale social impact.[25] Apart from creating its **AI for Social Good** program, Google also created **Jigsaw**, its forecasting unit, to confront emerging threats such as disinformation, censorship, online harassment, and violent extremism and identify how technology can make people safer.[26]

Policies, Standards, and Partnerships

The development of this global ecosystem is shaped by many international and intergovernmental standards. At the international level, in May 2019, Organisation for Economic Co-operation and Development (OECD) members and partners (and soon after, the G20) adopted the **AI Principles**, which provided the beginning of the global ethical benchmarks to follow (OECD, 2019). Following this example, many governments and international organizations have adopted similar principles and strategies, cultivating policy and regulatory frameworks that are influencing the ecosystem. They incorporate codes of conduct, data and privacy protection policies, accountability rules, protecting people and society rules, guides to data innovation, and creation of global alliances.[27] All these global and local, national, and international strategies and policies are shaping the utilization of data-driven approaches to peacebuilding.

Another important element in building the ecosystem are partnerships inside and across different sectors. Partnership on AI is an example of a global platform recognizing this by bringing together researchers, academics, businesses, and policymakers to cooperate in using AI to tackle some of humanity's most challenging problems. Another platform facilitating and advancing the idea and importance of partnerships is the United Nations platform **AI for Good Global Summit**, connecting AI innovators with organizations and people working to solve global challenges.[28]

Box 1: Peacebuilding Innovation in the Face of COVID-19

As we write this report, the world is facing one of the most serious crises in recent history. The COVID-19 pandemic has been the most disruptive infectious outbreak of the past century. The pandemic threatens to undo considerable improvements in socio-economic, security, and peace developments for many countries. Many negative impacts are already visible, with economic crisis leading to political instability, increased government repression, and the use of lockdowns to pass laws restricting freedoms and violating human rights.[29] Macroeconomic problems created by the pandemic have direct implications for social policies necessary for sustaining peace.[30] While there has been a decline in some types of crime mostly due to lockdowns, other types of violence are increasing.[31] Every news story on a cease-fire is followed by a story of a deteriorating situation.[32] At the same time, the pandemic creates opportunities for the development of many technologies. It can also open the door for many applications with potential positive impacts not only on health, but on peacebuilding and conflict prevention, including advocating for secure data collection, the use of drones in humanitarian settings, and training predictive algorithms on new data. Rapid technology development for countering the epidemic could motivate innovation, potentially catalyzing novel applications for peacebuilding.

Facing the COVID-19 pandemic, peacebuilders began expressing a need for technological tools, knowledge, and resources to adapt their work to changed global circumstances. In response, **Shift Power to Peace** started offering digital support to local peacebuilders to enable their efforts to prevent conflict and sustain peace—and build resilience beyond the pandemic. Together with **Peace Direct,** the **Platform4Dialogue** convened more than 450 peacebuilders from around the world to discuss how the current crisis impacts their work and explore how to support technology uptake. Other organizations started analyzing both historical and new publicly available data, using AI techniques to monitor conflict and violence during pandemic and enabling more informed, data-driven policies. **ACLED data**, for example, showed an increase in inter-state gang violence across Central America. As governments started introducing lockdowns and the pandemic disrupted markets and trafficking routes, the struggle for control over territory intensified. **UN Women** analysis and data discovered another alarming trend: increasing violence against women and girls. Advanced data methods are increasingly enabling faster analysis and providing insights for better policymaking.

Types of Actors

Various actors are experimenting with data-driven methods of tackling problems in peacebuilding, identifying and analyzing the data, providing actionable insights, and communicating to policymakers. Their work covers issues such as conflict prevention, protection of civilians in conflict zones, registering evidence of large-scale human rights abuses, enabling effective mediation, early warning/early response, and risk analysis. While some of them are facilitating data collection and visualizations or directly creating data platforms, others are processing this data with **tools** such as AI, ML, or NLP. Our research showed that all actors use a diversity of **data sources**: crowdsourced data, citizen reporting, drone or satellite imagery, photos, videos, radio, TV, social media, qualitative and quantitative data, SMS, etc.

The following section provides some examples of actors and their partnerships, as well as summaries of a variety of peacebuilding initiatives utilizing advanced data-driven methods. Different actors occupy different complementary and sometimes competing spaces in the ecosystem. Some actors are providers of financial, human, technological, or knowledge resources, while users have different levels of access to these resources. Competition often comes not only for financial resources but also for human capital, with workers often attracted by the advantages of jobs in the private sector.

Academia

Academic actors are mostly concentrated on data collection and analysis, including advanced statistical or ML calculations for conflict and violence predictions, as well as satellite imagery analysis. There is already a burgeoning field of scholars. Two examples are Harvard Hegre at Uppsala University, who uses advanced predictive models to analyze specific determinants of different types of conflict, including civil and interstate war;[33] and Weisi Guo at Cranfield University and the Alan Turing Institute, who also focuses on using data science techniques to predict conflict and reduce conflict likelihood.[34] Additionally, dedicated research centers are exploring data-driven approaches to peacebuilding and prevention. An important initiative that seeks to understand the determinants of peace rather than the determinants of conflict is the **Sustaining Peace Project**[35] at **The Earth Institute at Columbia University**. Academic actors are also contributing to data-driven approaches on thematic or country-specific issues. As just two examples, the **University of Nottingham**[36] utilizes satellite imagery from Google Earth and expertise in remote sensing to help end modern slavery, while the **Data4Peace**[37] center at the University of Texas at Austin has used data-driven strategies to help carry out the 2016 peace accords in Colombia.

Civil Society

Some of the major international civil society organizations were among the first to focus on new technologies. One of the leaders in this field is **Amnesty International** with its efforts to use new technologies in verifying images of airstrikes and images of destroyed buildings in conflict areas. One crowdsourcing project, **Strike Tracker**,[38] involves thousands of digital activists[39] around the world, using satellite imagery to analyze how the US-led military coalition's bombing destroyed the city of Raqqa in Syria. Data and advanced computer processing opened new avenues of utilizing AI to help researchers sift through pictures and videos. As digital documentation proliferates, so does the time necessary to investigate this information. ML is one of the technologies quickly solving this problem, assisting human rights organizations in processing this data quickly. As these technologies become cheaper

and more widely available, even some smaller civil society organizations will be able to find ways to engage with them.

Although there is a prevailing perception that this field is dominated by actors in the Global North, our research mapped some interesting and promising initiatives developed in the Global South. **Missing Voices**[40] is a Kenyan nonprofit with a mission to end enforced disappearances and extrajudicial killings in Kenya. This platform complements the work of the Police Reform Working Group Kenya and facilitates citizens' reporting on all issues of extra-judicial executions and enforced disappearances, and also serves as accountability and advocacy tool. The **Igarapé Institute**[41] is a "think and do" tank with a mission to address complex social challenges relating to security, justice, and development in Brazil and countries in the Global South, using innovative solutions and approaches including data and new technologies. In partnership with institutions from private and public sector, Igarapé has designed, developed, and tested high-impact data visualization platforms, mobile phone apps, and advanced predictive software using machine learning.

Additional examples that show the diversity of civil-society-led approaches include **ELVA**,[42] a platform that combines a range of possible data collection tools like SMS, smartphone and web reports with versatile data analytics, visualizations, and accessible interface. The ELVA-powered **Social Peace Index**[43] has been capturing results of an ongoing survey of social peace in Libya since September 2014, aiming at monitoring and managing conflict tensions during the political transition. The **Sentinel Project**[44] uses tech with the aim of preventing mass atrocities, including genocide. It enables effective early warning through gathering information from social media, mobile technology, or directly crowdsourcing information through mobile phones. An increasing number of actors use social media monitoring to detect events as well as hate speech. **C4ADS**[45] is an example of visualizing complex conflict environments through machine vision and open flight tracking.

Box 2: AI Collaborative Platforms Throughout the World

Our mapping discovered a whole subgroup of actors emerging as AI collaborative platforms gathering hundreds of data scientists, ML, and AI experts who are putting their skills into building innovative AI solutions to real-world problems. Here are a few examples working on different continents: **Omdena** is sourcing high-performing teams of AI engineers, data scientists, and domain experts around the world to build high-impact solutions through the power of collaboration; **DataKind** is another global initiative harnessing the power of data science in the service of humanity, giving social change organizations the opportunity to boost their impact; **Code for Africa** is the continent's largest network of civic tech labs, data journalism newsrooms with member labs across eight African countries; **Zindi** is connecting organizations within the African data science community to solve the world's most pressing challenges using machine learning and AI. Our ecosystem mapping suggests these emerging actors still play a bystander role, as they are mostly not engaged in the peacebuilding sector. However, we do recognize them as an important element with a potential to enter and advance the field.

Governments

Many governments throughout the world are innovating their data-driven approaches to peace and prevention through advanced methods, reflected in many examples of different strategies adopted in previous years. As just one example, **PREVIEW** is the data analysis platform for crisis early warning, developed by the **German Federal Foreign Office** (FFO), the Division for Crisis Early Warning. It is the data-driven component of the FFO's political decision making on conflict prevention, post-conflict stabilization, and humanitarian aid. The system facilitates access to underused or previously unused publicly available data, provides transparent and comprehensible visualizations, and based on these, makes analysis and predictions. Other governments also experiment with their conflict early warning and early action systems utilizing predictive analytics and advanced data science. Governments currently developing early warning tools include **France, the Netherlands, and the United States**, among others. Many mapped projects in this ecosystem are cross-sectoral collaborations including government as a partner. However, detailed mapping of governmental actors as a group outpaced the scope of this research, and more detailed analysis is needed.

Box 3: Early Warning Systems

Traditionally, early warning systems are important components of governmental, intergovernmental, and non-governmental work on conflict prevention, as they focus on identifying rising risks and early response. Advances in data science have enhanced the relevance of early warning systems, which have struggled with false alarms, the need for better analysis of root causes of conflict, and a gap between early warning and early response. The **EU Conflict Early Warning System** is a tool for EU decision-makers to manage risk factors and prioritize resources accordingly. The tool enables EU member states to identify and communicate where they see long-term risks for violent conflict and deterioration in a country or region, and to stimulate early preventive actions to address those risks. The **Economic Community of West African States (ECOWAS)** established its own early warning system more than a decade ago which is responsible for observing and monitoring sub-regional peace and security indicators, and providing timely reports with recommendations to the Office of the President. The system monitors peace and security in the region, providing real-time information and data for short-, mid-, and long-term analysis. The African Union, as well as several other African sub-regional organizations such as **IGAD, ECCAS,** and **SADC**, have pursued early warning and prevention activities including **CEWARN and CEWS.**[46] Within **South Asia**, early warning mechanisms that have been operationalized include the **SAARC** database on monitoring violence, and other national mechanisms which monitor local groups and localized ethnic issues.[47]

International Organizations

Various UN agencies are leading the way in utilizing advanced data science methods to support just, peaceful, and inclusive societies. With the appointment of the High-level Panel on Digital Cooperation, the secretary-general stressed that the "UN must strengthen its internal capacities and deepen exposure to new technologies while increasing understanding, advocacy and dialogue around technology."[48] In 2009, the UN created **UN Global Pulse** to bring the power of data-based prediction to policy making, instead of relying only on surveys and statistical analysis. It currently leads projects on utilizing data from social media and public radio broadcasts to extract insights that feed early warning systems, with a focus on sustainable development, humanitarian action, and peace. In 2014, UN Global Pulse established a **Data Privacy Advisory Group** to address the challenges posed by the use and non-use of data. In 2019, the group expanded to incorporate greater expertise in AI ethics and human rights, given the rapid development and use of emerging technologies.[49]

The UN Middle East Division of the **Departments of Political and Peacebuilding Affairs and Peace Operations (DPPA/DPO)** has been utilizing ML to canvass public opinion concerning ongoing political developments in the region. This division is also a part of a consortium of universities based in the Middle East, using NLP to create a customized sentiment analysis and opinion mining tool focusing on Arabic dialects.[50] UNESCO is another agency on a mission to elaborate the first global standard-setting instrument on ethics of artificial intelligence through an inclusive and multidisciplinary approach.[51] **UNOSAT**[52] is another intergovernmental initiative that functions as a technology-intensive program of the United Nations Institute for Training and Research. It provides satellite imagery analysis during humanitarian emergencies—both natural disasters and conflict situations—and delivers capacity development to the UN system, member states, and partners. A number of intergovernmental organizations are also creating serious initiatives around early warning and early response (see Box 3).

Private Sector

In recent years, many big companies launched or expanded their **AI for Good** initiatives and adopted standards addressing ethical principles in research, design, development, deployment, and application. However, few of them include projects in the domain of peace and security. The **GDELT Project**,[53] supported by Google Jigsaw, is one example of big companies utilizing NLP to monitor the world's broadcast, print, and web news in more than 100 languages. It identifies people, locations, organizations, themes, quotes, images, and more, then uses NLP algorithms and AI neural network analysis to produce insights about upcoming conflict risks. GDELT includes around 300 categories of physical activities around the world, from riots and protests to peace appeals and diplomatic exchanges.

Startups are increasingly joining this group of private stakeholders, in many cases filling the gaps of big companies, intervening where big companies are failing. **Moonshot CVE**,[54] based in the UK, is one startup example using technology to halt violence by understanding vulnerable individuals online and planning interventions to safeguard these audiences. The company uses data-proven techniques to enable its clients to respond to violent extremism all over the world. Another private sector actor protecting civilians in conflict is **Sentry**,[55] a threat prediction system designed by **Hala Systems** to be used by civilians. The project uses remote sensing to generate credible, real-time, situational awareness of threats, and

harnesses AI to validate information from multiple sources, allowing stakeholders to detect, identify, and predict threats. **PublicSonar**[56] is an example of a social media monitoring tool for emergency and crisis management. It uses algorithms to filter social media content, detect incidents, and quickly create a situational overview of that incident.

Cross-Sectoral Cooperation

A recent and relevant prevention success story comes from the cross-sectoral cooperation of government, academia, non-profits, and think tanks. The Water, Peace, and Security (WPS) partnership[57] develops tools and services that help identify water-related security risks and allow stakeholders to take action at an early stage. WPS supports efforts of local and global actors to prevent, mitigate, or adapt to water-related security risks, and to increase cooperation and peacebuilding efforts. The team utilizes ML-based methodology to forecast conflict up to a year in advance. A web-based tool that houses the model allows users to explore forecasts and individual predictor indicators spatially and through time, providing additional information on underlying vulnerabilities as a first step toward enabling timely, effective, water-related interventions to mitigate conflict and build peace.

Cutting-Edge Technologies on the Horizon and Potential For Future Impact

Despite the common perception that peacebuilding and prevention practitioners are lagging behind their colleagues in other fields in applying advanced data approaches, this research showed multiple examples of often "invisible" projects and initiatives being implemented throughout the world and contributing to more peaceful societies. We believe that these examples of creative use of big data, data visualization, AI, ML, image recognition, social media listening, and other tools utilized in peacebuilding can help us understand what these technologies can do for peacebuilding—and serve as an inspiration for others.

This section provides a sampling from the interviews and desk research of applications with unique promise for positive future impact in the peacebuilding field. Although we categorize them under the heading of a single technology, most are in fact a combination of technologies and tools, from ML and web scraping to data analytics and computer vision. The selection is intended to be emblematic and suggestive rather than comprehensive, and some initiatives may be in the early stages, but they all represent the potential of exponential technologies and advanced data approaches to enable the creation of a more peaceful, just, and free society. Although we recognize their positive potential, we also emphasize that all these technologies carry a risk of misuse or unintended negative consequences. Therefore, they should always be researched with caution, applying necessary ethical standards and frameworks to safeguard privacy, security, and protect human rights.

NLP and ML for Online Hate Speech Monitoring

Online hate speech takes place on social media, or generally on the Internet, with the purpose of attacking a person or a group on the basis of their race, religion, ethnicity, sexual orientation, disability, or gender.[58] Hate speech itself is not a new phenomenon, but what is new is the speed and scale with which it spreads because of increased access to technology, massive use of social media, and other means of online communication. Facebook alone removed more than seven million instances of hate speech in the third quarter of 2019, which is an increase of 59 percent against the previous quarter.[59] Failure to detect and remove hate speech can sometimes have even fatal consequences, as shown in several recent hate-related terror attacks where the perpetrators had an extensive social media history of hate-related posts.[60] Another example relevant to the peacebuilding community is Facebook's role in spreading hate speech in Myanmar, where the company failed to prevent its platform from being used to incite violence against the Rohingya community.[61]

However, manually filtering hate speech through so-called human checkers—individuals employed to check online content—is often not enough to detect all instances and remove them in a timely way. With increased online interactions and the high speed of sharing, the

need for scalable, automated methods of hate speech detection has grown substantially. These challenges have been attracting ML and NLP communities in the last few years and have led to efforts to automate hate speech detection.

Combating online hate speech usually starts with the highly complex tasks of defining hate speech and identifying language constructs considered derogatory in a particular context. Automated tools are then used to curate, organize, filter, and remove specific content. Currently, a wide range of NLP tools can be purchased off the shelf for a variety of use cases including hate speech detection and filtering.[62] However, automated approaches still face considerable challenges such as the difficulty of detecting moderation, nuances, and fluidity of human speech, as well as the limited availability and lack of diversity of datasets to train detection algorithms.[63] Keeping the "human in the loop" is still a necessary approach for these tools to render accurate results across different languages, communities, contexts, and cultures. Peacebuilders knowledgeable about local context and familiar with language and dialects can engage either in direct detection of hate speech, or by addressing and tackling the extremist content online.

Box 4: Project Example: Monitoring and Analyzing Conflict and Hate Speech Trends in South Africa During 2019 Elections

PeaceTech partnered with **Media Monitoring Africa** to develop a lexicon of hate speech used to conduct semi-automated online and offline media monitoring. The process examined offensive and inflammatory language directed toward individuals and groups based on ethnicity, religion, race, gender, national identity, or political affiliation and with the potential to lead to violence. This initiative also produced biweekly reports with predictions of violence on the ground and compared these predictions with monitoring of hate speech. A predictive model was developed using publicly available historical data sets to develop predictions for the week ahead. The project is not showing causal relationships, but it is observing trends and correlations between speech and violence.

ML for Early Warning and Conflict Prevention

Preventing conflict has the potential to save lives and avoid immense losses in human and economic capital that accompany violent conflict—and also safeguard considerable development gains.[64] Many governments, researchers, and others have developed models on conflict using predictive analytics, although a key challenge has been accessing enough meaningful real-time data. Recognizing the opportunities of big data, including easy access to large amounts of information about what people say and do online, combined with advanced computational capacity, many actors in the field are experimenting with analytical models for conflict prediction. Even back in the beginning stages of testing ML on conflict prediction, early models offered better predictive power than simply using a prior outbreak of violence as a leading indicator of current violence. They provided a clear indication that ML algorithms could offer a significant addition to the early warning toolkit.[65]

Box 5: Project Example: ViEWS Prediction of Violence in Ethiopia

Soon after Abiy Ahmed was sworn in as a prime minister of **Ethiopia in 2018**, promising to end years of ethnic unrest and launch a new era of unity and reform, a fresh wave of ethnic violence forced almost two million people from their homes. Throughout the violence, **Uppsala University's ViEWS** conflict prediction model has been making predictions of what will happen in Ethiopia using statistical and ML approaches. The model was correct in identifying the region of Somali as having a very high risk of conflict, which was then proven by a series of violent clashes. The model proved wrong, however, on predicting low-level of violence in the capital Addis Ababa, where it assessed a lower risk of conflict due to good infrastructure, policing, and economic growth. In this case, the system did not factor in those who returned to Addis after the conflict in Eritrea, which raised sectarian tensions leading to violence.[66]

Computer Vision Tools for Human Rights Protection

Human rights researchers and activists often rely on photos and videos shared through virtual networks to document war crimes, atrocities, and human rights violations. For example, Amnesty International has one terabyte of footage documenting possible human rights violations and crimes in Myanmar.[67] In the era of social media, mobile phones, and widespread Internet availability, citizens are becoming "digital witnesses," providing important content for conflict monitoring and documenting war crimes, government repression, and human rights abuses.[68] Manually reviewing these contents is often expensive and extremely time consuming. Processing by humans can present additional challenges for activists, potentially generating trauma due to explicit violent and disturbing contents. New computer vision tools are being developed to address these and similar challenges. Our research mapped various examples of utilization of ML tools developed and applied to support humans in data analysis.

Box 6: Project Example: AI Helping Human Rights Activists to Prove War Crimes in Court

The ongoing project led by researchers at **Swansea University**, in partnership with **Global Legal Action Network**, **VFRAME**, **Syrian Archive**, and **Yemeni Archive**, observes war crimes in Yemen and creates better accountability around them. In 2017, Yemeni Archive started gathering videos and photos from thousands of sources including journalists, civilians, and open-source videos from social media platforms, all preserved on a blockchain to prevent tampering. This team utilizes an ML system to detect all situations of banned cluster munitions being used in the attacks. One challenge facing the team is the fact that this weapon is unlawful, so photos of it are uncommon, resulting in little material with which to train the algorithm. To tackle this problem, the team used a few prior examples to create 3D-printed and painted models of the munitions, then videotaped and photographed them to validate the detection system. This system will be combined with billions of video frames of footage collected by Yemeni Archive. It is estimated that it would take an individual 2,750 days to search through this information, while the ML system would require only 30 days.

AI for Fighting Transnational Criminal Networks

Given the strong links between transnational crime and fragility and conflict, tools to deal with different types of criminal networks are useful from a peacebuilding and prevention lens. As one example, human trafficking and modern slavery are thought to be among the most widespread crimes in the world, affecting people each day.[69] Victims are forced into agriculture, domestic, and industrial labor, prostitution, and other forms of exploitation from which there is rarely any chance of escape. An increasingly common feature of contemporary armed conflict, human trafficking should be an important agenda for peacebuilders, and understanding trafficking can help to mitigate and prevent future conflicts.[70] Hence, anti-trafficking efforts should be integrated in conflict prevention strategies, conflict analysis, and peacebuilding support.[71]

Advanced data science methods have already found application in assisting anti-trafficking efforts in peace (as shown in the box below). Similar approaches have the potential to advance anti-trafficking in conflict and post-conflict societies, identifying and allocating trafficking patterns, trends, traffickers, and victims.

Box 7: Project Example: Using AI to battle sex trafficking

Marinus Analytics is a startup that utilizes AI and ML to comb through publicly available data to help identify patterns of human trafficking. It assists law enforcement with analyzing data such as phone numbers, locations, texts, and images on sex trade online postings to help identify victims. Computer vision can identify the same patterns in different photos and help identify multiple victims in the same location. This technology can save days and weeks of time sifting through data manually. Marinus Analytics is using AI such as Amazon Rekognition to assist law enforcement agencies in identifying and locating victims more quickly. Detectives can upload a photo of a victim to the system and see if it matches anything in the database.

Facial recognition technology used to disrupt criminal activity is extremely powerful—but controversial. At the writing of this report, Amazon announced that will suspend police use of its controversial facial recognition technology for one year, after studies showed and advocates pointed out that Rekognition is biased against Black people and people with darker skin.[72] MIT Media Lab researcher Joy Buolamwini led a study in 2019 showing that Rekognition had difficulty identifying gender in faces with darker skin.[73] This research was confirmed in real life with the first reported case of a man being wrongfully arrested because of identification by an algorithm.[74] Amazon still plans to allow organizations like Marinus Analytics to use the tool to help rescue human trafficking victims, and it advocates for governments to add stronger regulations governing how facial recognition technology can be used. Another study of a Chinese company, Megvii, and its facial recognition system known as Face++, demonstrated similar biased results and showed that this challenge is present across the globe. Bias, combined with the potential of mass surveillance of the public, are chief among the reasons why many civil liberties groups are working to stop police from using facial recognition technology. Achieving a balance between community and individual safety and privacy is a crucial factor in future utilization of this technology in peacebuilding and prevention contexts.

NLP for Public Sentiment Analysis

Effective peacebuilding work and prevention relies on monitoring and understanding trends in public opinion. Traditional qualitative and quantitative methods, such as surveys and interviews, are crucial for increasing transparency and inclusiveness of peacebuilding processes.[75] However, many of our interviews confirmed that these are not always enough, and moreover are very costly to undertake, placing them out of reach of many in the peacebuilding field. To understand local context, it is important to understand the local language or local dialects, which often presents a challenge for peacebuilders. The spread of social media, availability of big data, and the development of advanced data science methods of analysis offer potential solutions to some of these challenges. ML-based systems can be used for detecting and analyzing public opinions in local languages, in written, audio, and video forms. This approach can be applied in conducting large-scale digital focus groups in local languages or dialects, and in real time. This can provide faster insights into public sentiment and enable more effective decision-making for those in the peacebuilding and prevention fields.

Box 8: Project Example: UN DPPA Arabic Sentiment Project and Digital Focus Groups

Since 2018, **DPPA's Middle East Division (MED)** has been working with a consortium of universities and computational linguistics experts on building an ML-based system for detecting and analyzing public opinion in the Arab world. The project focuses **on opinion mining** and **sentiment analysis** based on various social media sources. It expands situational awareness and allows for early warning in peace mediation processes. Building on this Arabic Sentiment Project, the MED is also working on the creation of a tool to conduct digital focus groups. The tool uses ML to probe questions on a peace process with a larger constituency in Arabic dialects. If a UN mediation team wishes to evaluate the public's receptivity to an aspect of a peace agreement, this tool would allow thousands of members of a concerned constituency in a country and its diaspora (e.g., refugees) to be consulted in real time. The UN could eventually conduct instant tests on behalf of the conflict parties, assessing different aspects of the prospective agreement under negotiation and expanding the inclusivity of peace negotiations.[79]

AI to Support Mediation and Peacemaking

Mediation is a key tool to prevent, manage, and resolve conflicts. Even though mediation and peacemaking are essentially about people and human-to-human relations, AI can nevertheless be leveraged to enhance mediation processes in a variety of ways. Mediators are increasingly using digital technologies and social media to get information, to reach the target audience or general public, and to mobilize support. They also use mapping and geographic information systems (GIS) for monitoring ceasefires or the disengagement of forces.[76] AI can help to capture and analyze agreements and compare patterns and conflict solutions. It can also be used for gathering and analyzing data to inform mediation during the preparatory, process, follow-up, and implementation phases.[77] AI can **help mediators see patterns and draw connections** that would be invisible to human eye. Sentiment analysis using AI tools, as mentioned in the previous section, can also be valuable for helping mediators to **understand local and wider attitudes toward the conflict**.

While new AI tools are emerging to support mediation processes, it is important to raise awareness and tackle the problem of bias in data and algorithms. Since mediation relies on vast amounts of conflict-related sensitive data, the issues of data privacy and security need to be addressed and the highest standards of protection need to be applied.[78]

Box 9: Project Example: IBM Project Debater

Project Debater is an IBM AI project designed to participate in a live debate on complex topics with expert human debaters. Its goal is to help people build persuasive arguments and make well-informed decisions. It relies on three capabilities: data-driven speech writing and delivery, listening comprehension, and the modeling of human dilemmas and form arguments.[80] Debater is trained on millions of news articles and other content, and uses a technique called "argument mining" to comb through huge data sets to help humans make decisions. It uses software to analyze written documents and extract key sentences that provide evidence for or against a given claim. Debater was already tested with many top-class human debaters, demonstrating its capacity to augment human potential. In one application, IBM collected 3,500 opinions from citizens in Lugano, Switzerland, about whether the city should invest in autonomous vehicles, and used the AI to extract and assess arguments for and against the proposal. It presents the interesting potential of adapting AI to the process of mediation.[81]

Crisis Mapping for Violence Prevention, Civilian Protection, and Accountability

Crisis mapping is another useful tool indicating where emergencies are occurring and enabling a visual understanding of incidents and threats. A crisis map is an online tool, like a Google Map, indicating the type of incident, its precise location, and (often) the kind of help that is needed.[82] From crowdsourced mapping of earthquakes in Haiti (2010) and Nepal (2015), and of the Ebola outbreak in West Africa (2014), crisis mapping has become an integral part of protecting civilians in humanitarian settings.

Geographic information systems (GIS) are a key technology for crisis mapping. GIS stores, analyzes, and maps information such as the location of buildings, water access, elevation, distance, and travel time between places. This technology is especially useful in humanitarian settings where humanitarian agencies often lack physical access to conflict zones. Crisis mapping can also be useful for civilians on the ground, informing them in real time about the incidents happening in their vicinity and about the places where they can find safety. Maps visually communicate often complex information and as such are also a useful platform for in-depth analysis and evidence-based discussions in peacebuilding efforts.

Although crowdsourcing information and crisis mapping technology can both be leveraged for peacebuilding and prevention, they also come with the potential to harm the very people they are trying to protect.[83] Hence, all safeguards should be applied to protect from risks related to access and use of potentially sensitive information.

Box 10: Project Example: Syria Tracker Crisis Map

Ushahidi, an organization created as a response to the post-election violence in Kenya in 2008, is a pioneer in the use of crisis mapping technology to gather real-time data and inform citizens to protect their safety. It was developed as a platform that gathers data from SMS, emails, and social media to map hot spots, provide data visualization, and data management. **Syria Tracker Crisis Map**, a project of **Humanitarian Tracker**, uses the Ushahidi platform, and it has been one of the major applications of crisis mapping in conflict.[84] It was created by eight US-based Syrians with an idea to monitor the conflict in Syria in 2011 using firsthand citizens' reports submitted through social media, videos, photos, emails, and voicemails, combined with data mining from social media, online news, and blogs. It displayed a list of killings, arrests, and missing-person reports, providing potential evidence of crimes to help hold the perpetrators accountable.

Harnessing Satellite Imagery for Human Rights Protection

In the past few years, satellite images have been used to confirm the existence of forced labor camps in North Korea, mass graves in Burundi, Boko Haram activities in Nigeria, human rights abuses in Darfur, and forced relocation in the Democratic Republic of the Congo and Zimbabwe.[85] Furthermore, the ICC indictment of former Sudanese President Omar al-Bashir relied on satellite imagery of human rights abuses in Darfur.

Not that long ago, there was just one viable source for Earth imaging data: **Landsat**, a joint program of NASA and the US Geological Survey. Today, not only governments, international organizations, the military, and intelligence apparatus, but also civil society and individuals have an abundance of observation data available to use, and more is on the way. Access to data has been democratized, as much of it is publicly available for free. **DE Africa**[86] is one recent example of a platform using free and open images captured by the European Space Agency. This is the first ever continuously-updated satellite data at the continental scale for Africa. The availability and accessibility of the data has been optimized by translating the data into a format that makes it suitable and easy to use for anyone.

Satellite imagery has already been explored and utilized in the development and humanitarian fields. It offers huge potential for peacebuilding organizations, which often lack direct access to conflict or fragile areas, or have their access directly denied by local governments. Satellite imagery can be used as a useful tool for analyzing conflicts, in conflict resolution, and in post-conflict reconstruction.[87] Satellite imagery does not require strong ground presence for data collection. As such, it provides a potential solution for the constraints posed by conflict and fragility settings. There is also enormous potential in combining high-quality satellite imagery, deep learning, and other recent advances in computer science that have transformed how we extract information from images.[88] However, the immense power of this technology also reveals immense perils. As it collects sensitive data—often on already vulnerable populations—and positions this data as an open source, these populations can be put in even greater danger.

Box 11: Project Example: Satellite imagery for tracking Uyghur human rights violations

Satellite imagery captured over a remote region of Xinjiang in western China uncovered the size and spread of internment camps used to indoctrinate vast numbers of the Uyghur Muslim population. A **research** study conducted by the **Australian Strategic Policy Institute** (ASPI) and ABC News identified and documented the expansion of 28 detention camps as part of a massive program of subjugation in the region of Xinjiang. The autonomous province of Xinjiang is home to about 14 million Chinese citizens belonging mainly to Muslim ethnic groups, the largest of these being the Turkic-speaking Uyghur people. China views this region as separatist and an incubator of terrorism, and has begun introducing strict policing measures, expanding police stations and security check points, and creating strict surveillance systems. Since the Chinese government denied the existence of detention camps and created restrictions on accessing the area to prevent investigations, there was little evidence of gross human rights violations. The utilization of satellite imagery provided important proof of the existence and nature of these facilities. A growing number of victims' testimonies, combined with this high-resolution satellite imagery of "educational camps" surrounded by watchtowers and razor wire fences, generated enough evidence for the international community and the public to demand accountability and an end to human rights abuses.

Data Sets and Visualizations for Showing Trends and Incidents

A key conclusion reinforced in multiple interviews is the importance of data visualization for communicating results clearly and advocating for action. Translating a complicated data set into a visual format that tells a story and can drive decision-making is often the best use of these new tools and technologies. The results bring clarity to complex situations and can enable quick communication of relevant information, which is frequently crucial in fragile and conflict-affected contexts. While mapping the ecosystem, we identified multiple data sets, dashboards, mappings, and indices already making a difference in this field. Following is just a sample.

The Armed Conflict Location and Event Data Project (ACLED)

ACLED is a crisis mapping and conflict analysis project that collects dates, actors, types of violence, locations, and fatalities of reported political violence and protests across Africa, East Asia, South Asia, Southeast Asia, the Middle East, Central Asia and the Caucasus, Latin America and the Caribbean, Southeastern and Eastern Europe, and the Balkans.[89] ACLED provides data and dashboards and generates reports and infographics. It is also widely used by people working on early warning/early response, as well as conflict modeling and prediction. Some have expressed concerns around the "selection bias," referring to selective reporting of a certain type of event depending on location, actors, and motivation. This brings a risk of underreporting events, limiting the validity and utility of data to study conflict dynamics.[90]

Global Peace Index (GPI)

Produced by the Institute for Economics and Peace, the GPI[91] ranks states and territories according to their level of peacefulness. The Index is developed in consultation with an international panel of peace experts from peace institutes and think tanks with data collected from the Economist Intelligence Unit, the Uppsala Conflict Data Program, the UN Survey of Criminal Trends and Operations of Criminal Justice Systems, the International Center for Prison Studies, and the International Institute for Strategic Studies, among others. It measures peace according to 23 qualitative and quantitative indicators using three thematic parameters: the level of societal safety and security, the extent of ongoing domestic and international conflict, and the degree of militarization. While the Index has received endorsements from many respective international figures, presidents, politicians, and diplomats, it has also been criticized for focusing exclusively on measuring what is considered negative peace, or on assessing the absence of violence or the fear of violence. Recognizing this, the Institute introduced a **Positive Peace Index (PPI)** to measure attitudes, institutions, and structures that, when strengthened, can improve a country's potential for positive peacefulness.[92] (Institute for Economics and Peace, 2020).

Uppsala Conflict Data Program (UCDP)

UCDP[93] is a data collection program on organized violence housed at the Department of Peace and Conflict Research of Uppsala University. It is the oldest ongoing data collection project for civil war, recording ongoing violent conflict history since 1970s. The data is available through an interactive website and published annually in the Journal of Peace Research. It uses both printed and electronic public sources, including newspapers, books, case studies, journals, research reports, and publications by NGOs such as Amnesty International and Human Rights Watch. UCDP is part of several collaborations, including the Peace Research Institute-Oslo (PRIO), Violence Early-Warning System (ViEWS) project at Uppsala University, and the Quality of Government Institute, among others. UCDP is widely used by the UN as a main data source in reports published by different UN agencies. It is integral part of the World Bank's World Development Indicators and the Global Burden of Disease program.

Fragile States Index (FSI)

FSI[94] is an annual report published by the Fund for Peace, a non-profit dedicated to preventing violent conflict and promoting sustainable security. The list aims to assess states' vulnerability to conflict or collapse, ranking all UN member states with enough available data for analysis. FSI's rankings are based on twelve indicators of state vulnerability, grouped by category: cohesion, economic, political, and social. The process includes content analysis of millions of documents; quantitative data from sources such as the UN, WHO, World Factbook, Transparency International, World Bank, and Freedom House; and qualitative reviews of each indicator for each country. In past, some critics have identified weaknesses with the FSI's measurement criteria and criticized the lack of transparency in its base data analysis.[95]

Challenges and Constraints

This section presents crosscutting technical challenges that affect all actors in the ecosystem and derive from the nature either of exponential technologies or of peacebuilding work. Operational and capacity constraints are different for each actor and are presented here as a general effort to highlight the problems in peace and conflict fields.

Lack of Data or of High-Quality Data

Limited access to technologies, including access to mobile phones, computers, and Internet, often leads to lack of data. This situation creates an obstacle to utilizing many advanced techniques, especially social media or traditional media listening and sentiment analysis. Predictive models may rely on structured data sourced from national statistics offices, databases, and international agencies—sources that can often be problematic due to variable quality and availability.[96] Insufficient or manipulated data may lead to invalid conclusions and discrimination. Lack of data in conflict, post-conflict, or violence settings often comes as a result of **lack of access due to security reasons.** Thus, what we can collect in the first place has to be realistic, and will affect the choice of technologies and methods that can work with limited data.

Data Sovereignty

Increased data gathering and utilization has opened a discussion about a new phenomenon of "**data colonialism,**" introducing the exploitation of human beings through data, "Just as historic colonialism appropriated territory and resources and rules subjects for profit."[97] The term is also used to explain the extractive and exploitative nature of the relationship between technology companies and people.[98] For this field to advance, not only do technical obstacles need to be solved, but also digital data needs to be "de-colonized" in line with ethical and human rights frameworks. This topic is especially active within indigenous communities. As a response, a number of movements for sovereignty and self-determination over data and data-analysis have emerged, claiming the right of a nation to govern the collection, ownership, and application of its own data.[99]

Paradox of Data Protection and Privacy

As data becomes more and more available, the more concerns are raised around protecting privacy. Risks related to data protection are inherent to data collection and storage. This is a particular concern in conflict- and violence-affected contexts where the collected data might contain information related to conflict activities, issues politically sensitive to the government, or sensitive information about victims that could lead to personal identification. On the other side, privacy regulations can also obstruct applications and innovation, especially in training algorithms, which require the use of large amounts of data. This puts practitioners in a position to balance **the risk of misuse of big data against the risk of**

missed use, which is even higher for fragile populations.[100] While recognizing the problem of missed use, it is also important to acknowledge various risks of misusing the data in the peace and prevention field, such as **data weaponization**—i.e., using sensitive data in conflict areas to intentionally target facilities or members of a specific vulnerable group. A prime example would be in contexts like Myanmar.[101]

Other Challenges

Traditional peacebuilding actors have been using data-driven approaches for many years through surveys, interviews, and focus groups for collecting data to plan their programing and inform next iterations. They often face the hard question of **how to collect the right things**—that is, what exactly is the right data? This question still presents a challenge even with the use of advanced data analytics and new approaches like ML and NLP. Another big challenge concerns **capacity constraints**, since many organizations, especially those working in the field, simply do not have enough people to allocate for data collection or people to train for utilization of advanced data analytics. This fact directly influences the previously mentioned problem of lack of data or lack of good quality data, which can only partially be resolved by the proliferation of information and communication technologies.

With every new wave in the development of new technologies, practitioners and experts in peacebuilding, conflict and violence prevention, and human rights protection have seized opportunities to experiment and introduce new tools—from ICTs and information-gathering to data analytics and ML. However, more advanced technologies came with more limitations in utilizing them in traditional peacebuilding. One of these constraints has been the **financial limitation** of those organizations either to develop capacities internally or to engage external experts in their programs. Even if external help comes as a pro bono effort, it still brings time constraints and a burden on already-stretched capacities of smaller organizations.[102]

Another important operational constraint specific on the peacebuilding field is physical insecurity itself. **Conflicts and violence** do not only lead to destruction, deprivation, and displacement, but also often result in **impediments to accessibility in the most insecure locations** for security and logistical reasons. These interruptions prevent the continuous collection of data.[103] This issue has recently been tackled with more systematic use of information and communication technologies, geo-enabling, satellite imagery, and other methods and tools that enhance interventions in regions with limited physical access. Many of these tools are unfortunately still very expensive and still too complex to allow broader adoption, especially in areas with no radio or mobile phones.

A further identified challenge is **a lack of user-centric approaches**, leaving users out of the design and testing process, which in turn results in solutions that are not relevant to local needs and thus do not get adopted. One often-shared observation in our interviews was that the tech field tends to be Western-dominated, while people in the conflict (mainly non-Western) are those who may have solutions. **Integrating input from local beneficiaries, from the concept and design phase onward,** is a recommended practice. Engaging deeply with local peacebuilding knowledge as part of tech initiatives is a valuable strategy in a peacebuilding objective.[104] One of the expressed concerns in our research is the practical difficulty of integrating local knowledge in relation to advanced data science methods. What would it mean in practice for an NLP or ML project to integrate continuous local input?

The latest advancements in technologies and big data bring transformational changes to societies, peace, justice, and human rights, and at the same time bring **an array of complex ethical questions**. This section highlights some of the general ethical considerations created by exponential technological change and specific challenges for the field of data-driven peacebuilding. We emphasize that this is not a complete effort, but rather an attempt to start a discussion and advocate for more in-depth research on the ethical challenges of data-driven approaches in the peacebuilding field.

Greater availability of data, increased adoption of big data practices, and utilization of ML and deep learning have all brought more attention to ethical challenges, especially around **collection, use and processing of big data, data ownership** and **sovereignty**, **rights and consent** of those whose data is being processed, **trustworthiness** of AI systems, dangers of codifying and reinforcing existing **gender, racial, and other biases**, or disregarding **human rights and privacy**,[105] **accountability and responsibility**, **security, accessibility and transparency**, **safety and trust**, **social harm and social justice**, and **existential risks**.[106] Numerous ethical guidelines have been adopted to help us move towards ethical design, development, and applications.[107] Without a doubt, ethical frameworks need to become part of every new technology application and govern how it is being built and used—and this is particularly true in relation to peacebuilding work. Immense effort has gone into advocating for ethical principles, leading to many local and international organizations, companies, and even countries declaring and committing to ethical and responsible AI principles. All of them are considering not just how technology and data will be used to solve problems, but also how applications can be misused, and how to ensure appropriate safeguards. They all agree that AI should be **researched, developed, deployed, monitored, and used** in an ethical manner. There is, however, an uneven articulation of specific principles, laws, and rights across the world, which can lead to some populations being more or less protected—and some corporations taking advantage of these gaps.

This work to advance the field of ethical technologies, and lately ethical AI, has paved the way for practice and principles in the peacebuilding and prevention fields as well. For example, over the last 10 years, numerous humanitarian agencies have published their own data protection manuals. That said, the ethical challenges of exponential technologies go beyond data protection and security measures and should include additional focus on issues specific to peacebuilding.

There are some core priority values for peacebuilding to guide the development and application of data-driven approaches: setting standards for a technology to be **inclusive**; to respect **human rights** and fairness; be **transparent**, explainable, and secure; and for the actors to be **accountable**. Recently published frameworks for data ethics in the

humanitarian field[108] have brought this issue closer to peacebuilding, especially as most of its applications are happening in crisis situations and conflict-affected countries, often **affecting already vulnerable populations**. The uniquely sensitive nature of peacebuilding brings heightened ethical considerations and challenges.

Utilizing new data-driven technologies can expose populations that provide information or are impacted by solutions to certain **security and safety risks**.[109] Lack of protection of personal information and location of end-users, data providers, or collaborators, can lead not only to violation of their digital rights but to direct attack on their physical security and safety. Therefore, protecting individuals' personal data is an integral part of protecting their life, integrity, and dignity.[110] Safety can be jeopardized in both direct and indirect ways. Every hate speech detection tool or conflict prevention method we mapped in the ecosystem can be misused by malicious actors wishing to incite more violence toward specific groups and create more disinformation. If used by an authoritarian government or violent group, a specific technology can bring greater risk and damage to the same population it aimed to help.

Box 12: Ethics and Drones

Drones are widely discussed in defense, but also in the humanitarian-development-peace nexus. While some experts are raising their voices against the proliferation of armed drones and calling for more robust oversight and accountability measures,[111] others are emphasizing the good humanitarians can do in alleviating disasters and saving lives. The case of drones raises challenging questions of use and misuse, and also ethical dilemmas of missed use of the technology in peacebuilding. Drones can play undeniably positive roles in early warning and early response, fact-finding missions, investigations providing real-time information to affected communities, and enabling quick and appropriate response.[112] However, the risk of potential mass surveillance and data privacy violations should not be discounted because of efficiency needs.[113]

Recommendations

While there are many emerging applications for data-driven approaches in peacebuilding and prevention, we are only at the beginning of exploring the potential of these transformative methods and technologies. The following recommendations aim to support this emerging ecosystem through building trust and capacities, fostering innovation, responding to ethical challenges, and building a community of practice. Parallel work also needs to be done to reinforce and coalesce these recommendations.

Strengthen the Ecosystem Through Building Trust and Human-Centered Approaches

Trust in advanced technologies is essential for harnessing their value and enabling the ecosystem's positive development. Advanced data science methods and approaches must be introduced in ways that build trust and respect human rights. To build and keep that trust, some level of supervision is needed to protect safety, security, and human rights.[114]

Since successful applications of data-driven methods require more than big data and advanced math, another recommendation is an early and more intentional use of **human-centered design** in developing and applying new approaches to peace and prevention. Any new technology, no matter how sophisticated it might be, needs to reflect **conceptions of user needs** and human psychology.[115] One related idea suggested by researchers that meshes with similar calls in the expert community is **"keeping humans in the loop,"** while at the same time asking important questions of "**which loop" and "which human**," making sure we do not reinforce inequities and injustices in the systems we build.[116] This would allow a human to identify misbehavior in autonomous systems and take corrective action. It would also provide **accountability**, giving assurances that there is a human behind the system taking responsibility for decisions and mistakes.

To build trust, we also need to intervene and influence trends and forces that shape the ecosystem. Discussions around "killer robots" and autonomous weapons systems are important, and the peacebuilding community can play an important role in ensuring safeguards. However, **we need to shape the discourse with positive examples** as well. Citing cases of new technologies that protect human rights, safety, and security while respecting privacy is an important tool for building trust and opening pathways for more organizations, ideas, and people to enter the ecosystem.

Finally, there is an element of trust that relates to competency and relevance of new applications, which are often promoted by actors in the Global North. In this sense, ensuring that data-driven approaches are **driven by local needs and decisions**—and that they **focus early on end-user design relevant to the context**—is critical.

Strengthen the Ecosystem Through Capacity Building

As data-driven approaches are still novel for many in the peacebuilding and prevention fields, capacity building must start with **raising awareness**. Many practitioners are still not aware of what different technologies can do, and how freely available or affordable they are.[117] Additionally, successful implementation of exponential technologies requires **specific knowledge and resources**. While researching challenges and risks, we saw that many organizations in the ecosystem—especially civil society organizations—do not have a budget or staff to take full advantage of the data revolution. And although it is not possible for every peacebuilder to become a data scientist or programmer, there is also no need to do so. We recommend developing capacities through building knowledge on the potential of new technologies, while opening pathways for partnerships with data scientists possessing valuable skills and the motivation to utilize those skills in mission-driven organizations and projects dealing with peace and security problems.

Building capacities and learning is more sustainable in a community. **Creating the platform** for a community to emerge, learn, and share—as well as careful moderation and facilitation of this space—are essential for the ecosystem to grow. This should be a space for synthesizing scientific knowledge and expertise and discussing challenges and opportunities for using data and exponential technologies to solve practical challenges in peacebuilding and prevention.

Strengthen the Ecosystem Through Innovation

Our research classified several ways to strengthen the ecosystem through innovation: **using old tools** in a new and innovative way; **building a new tool or platforms** allowing problems to be solved differently; **using new advanced technologies** to collect and share the data but using traditional human or computer processing to analyze the data; using traditional data gathering, like surveys or polls, but **using advanced data processing techniques**; and using new sources, such as **social media scraping**, and new methods and tools, such as **AI and ML, for processing or predictive modeling**. Despite the considerable technical, operational, and capacity constraints facing ecosystem actors, there is still huge potential for growth through innovation.

There are several ways peacebuilding practitioners can innovate their work. Usually, the most intimidating method is to create a new product. This is what causes many actors to give up early in the process, since the capacity to create something new doesn't exist.[118] However, **innovation** can come through using existing digital technologies that generate and process information: e.g., chat bots, websites, radio, apps, satellite imagery, and others.[119] In short, peacebuilders should be encouraged and supported to innovate, and to learn from innovators already working in the field.

Strengthen the Ecosystem Through Principles and Frameworks

"Do no harm" approach and conflict sensitivity: development and utilization of any technology for peacebuilding and prevention should also be conflict-sensitive, to safeguard from deepening social fractures or worsening the conflict drivers that may lead to violence. Any new technology used for peaceful outcomes can also be leveraged to incite violence, promote conflict, and perpetrate crimes. "Human input, political awareness, and conflict sensitivity remain vital from the conception of an initiative until long after its completion."[120]

There is still no clear understanding how this principle is impacted by the speed and nature of algorithms being deployed, and if "do no harm" for AI applications is enough to respond to the sensitivities of the peacebuilding field.

"Ethics by design" as a "core part of exponential technologies rather than an afterthought": intended and unintended consequences are often discussed in academic and expert circles after they happen, but what needs more urgent attention is anticipating problems before they happen. Safety should be built into AI systems from the design phase, following a set of guidelines and questions to ask even before the technology is deployed in the field. Ethics needs to become a "part of how AI is made and used, rather than an add-on or afterthoughts."[121] Technology developed with good intentions can be repurposed by governments (and others) to target the very people that technology was supposed to help. This emphasizes the need for the **technology to be not only ethically built but also to be safeguarded from malicious use and unintended consequences**. As most data-driven applications in crisis situations and conflict-affected countries are affecting already vulnerable populations, we must ensure that affected communities are not being used as "test beds" for new technologies (Hickok, 2020). Technologies that would not be used in Western settings because of protective legislation should not be tested on vulnerable populations either.

In addition to all above mentioned approaches, we support the Build Up's ethical framework of **six best practices,** developed to manage ethical challenges in using innovations in peacebuilding. These are: designing with all users in mind, and being sensitive to local needs and specific contexts; considering the risks of new exclusions potentially created through technology, due to location, literacy, and socio-economic constraints; watching for unintended consequences (political mobilization, polarization, misinformation, inciting violence); managing how innovations challenge power; minimizing risk and seeking consent; and aiming for sustainability (Build Up, 2020).

Strengthen the Ecosystem Through Community and Partnership—the Role of New AI Hubs and Networks

The peacebuilding field has a long tradition of practitioner community building, with many organizations facilitating communication and cooperation among peacebuilders throughout the world. These include Alliance for Peacebuilding, DME for Peace, and Peace Direct, among others. The PeaceTech community has a more recent history of community building, with **Build Up**[122] as one of the leaders in creating a space within the broader peacebuilding community for collective conversations and contributions to learning how to build peace in the digital age and integrate technology in everyday work. The **Alliance for Peacebuilding** is another example of facilitating this work through its **Technology & Social Media**[123] Working Group, which aims to embrace innovation and harness technology to address the issues of rising geopolitics and new forms of warfare, leveraging opportunities and managing disruptive impacts of new technologies.[124]

What our research suggests is that these networks work in traditional peacebuilder circles, while experimenting inside their own capacities with innovative approaches to new technologies in order to create a more peaceful world. Although this model is inclusive

globally and especially toward local grassroots peacebuilders, it often shows gaps in cross-sectoral cooperation with data science. There is also an opportunity to learn from and create networks with other ecosystems that are already generating cross-sectoral cooperation with data science: e.g., humanitarian, development, or climate change arenas.

Our research revealed that there is an important group of stakeholders—**currently bystanders**—still located outside of the ecosystem, a group that can potentially play a crucial role in advancing the field through advanced data science methods. This group consists of new **AI hubs and open collaboration platforms**, gathering data scientists and machine learning experts and oriented toward social impact. We recognize them as ecosystem actors that can fill the capacity gap of other actors, propelling the entire field toward more advanced technologies utilized for sustaining peace.

Box 13: Creating a Hub for Peacebuilding and Prevention Data

A good model for a data-driven hub comes from the humanitarian sector: **The Centre for Humanitarian Data** in The Hague, managed by the **United Nations Office for Coordination of Humanitarian Affairs (OCHA)**. The Centre generates leading-edge research, provides access to key data sets, connects a wide variety of actors (from UN and governments to grassroots), and acts as a repository for different kinds of expertise. The Centre manages the **Humanitarian Data Exchange (HDX)** as an open platform for sharing data across crises and organizations, available in over two hundred countries and territories. It also includes predictive analytics as a core aspect of its work, and offers a catalogue of predictive models in the humanitarian sector. Over time, the international community should consider creating an analogous hub for peacebuilding and prevention data.

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