

# PROJECT REPORT: IBM TECH ETHICS GRANT - THE COMPLETE PICTURE PROJECT

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## The Original Idea

In early January 2022, the Complete Picture Project was awarded a grant from the IBM Tech Ethics Foundation to work on a more detailed roadmap and develop a prototype for a test dataset for the CPP project. The idea for the Complete Picture Project was developed in 2020 as a response to the challenge to find solutions to counter algorithmic gender biases through data. A group of Oversight International Associates came together to develop the concept around balanced test datasets to be applied to models to test for a specific bias hypothesis. The idea is that if the data input and the algorithmic output are perfectly known, the model can be understood even if it is a “black box” system. The idea was presented and eventually selected as the winner of the AI for Good Breakthrough Track 2020.

Since the award, the project has been working through Oversight International’s links into the humanitarian sector to experiment and test the basic feasibility of the idea and to develop a clearer understanding of potential ways to implement such a tool.

The proposed roadmap is outlined as follows:

Description	Activity
Strategic Partnerships	Confirm 1-3 strategic partners who are problem owners.
	Flesh out the <b>roadmap</b> based on new partners and learnings from prototype dataset creation.
	Outreach and fundraising
Identify priority use cases	Exploration phase of the problem, define requirements for test datasets
Identify data sources	Conduct research for potential data sources and how to access them.
Construct test dataset	Construct a <b>prototype test dataset</b> to be trialled with an AI/ML developer
	Develop documentation for the test dataset

The ideal CPP partner organisation for this pilot is a third-sector organisation concerned with providing essential services to an underserved population. These organisations would be the

entry point to a workable context, use case and potential bias problem that could be addressed in a pilot implementation of a dataset. In addition, the setting should be grounded in a real physical place and community where AI is going to be implemented to guide decision-making or provide efficiency gains. The final requirement is that the projects need to be committed to addressing biases through a lens of broadening their understanding of beneficiaries and users impacted by the use of AI. This requires technical and human resources from the partner organisation.

## A More Complex System of Value

However over the course of the implementation and while engaging with AI projects the team was confronted with a set of more complex challenges than what was originally anticipated. The projects as well as approaches to tackle these are outlined further down in the report.

### Bias within a Simple Linear Process

The conventional view of AI uses has embedded AI in a linear process. For example, an AI evaluates a candidate for a loan and then either approves or rejects them and perhaps sets an interest rate. This kind of linear process fits well with many commercial applications, where services and functions are framed as decision points or value settings. Bias in this linear flow would show up as unfair decisions or calculations that either affects a person's ability to move through the process or provide an incorrect/unfair result. This might be an unfair loan interest rate or an incorrect diagnosis of a disease.

This was the view that the CPP project initially approached the challenge of bias in data. In the aid sector, we identified a particular risk of groups being systematically excluded from data sets generated in chaotic crisis environments and those who had limited access to digital technologies. This is a particular risk for women, the elderly, people with disabilities, and marginalized groups. Our hypothesis was that more complete and balanced data sets for these communities would provide a better starting point for the linear decision-making processes with embedded AI.

### Unbiased Decisions vs. Access to Good Outcomes

Our work with practical applications in the aid sector exposed a challenge with the underlying assumption that linear processes are at the heart of AI work. In Aid environments, both humanitarian (which focuses on crisis situations) and development (which focuses on building longer-term community systems), the ultimate goal is to produce good outcomes for members of a community. The humanitarian sector in particular is built on pillars of humanitarian principles<sup>1</sup>:

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<sup>1</sup> [https://civil-protection-humanitarian-aid.ec.europa.eu/who/humanitarian-principles\\_en](https://civil-protection-humanitarian-aid.ec.europa.eu/who/humanitarian-principles_en)

Humanity: means that human suffering must be addressed wherever it is found, with particular attention to the most vulnerable;

Neutrality: means that humanitarian aid must not favour any side in an armed conflict or other dispute;

Impartiality: means that humanitarian aid must be provided solely on the basis of need, without discrimination;

Independence: means the autonomy of humanitarian objectives from political, economic, military or other objectives.

As a general model, it is not considered a good outcome to simply be 'fair', if that results in individuals or groups facing bad conditions. The shift in thinking, using our example from above, moves from 'who should get a loan' (with no particular concern for those who fail to qualify) to 'how do we create financial opportunity for all community members that are in need of them'. This shift in thinking challenges the usefulness of AI in linear applications.

As an example, if a young woman is missing from a data set and that results in an AI rejecting her from a job opportunity because of an incomplete understanding of her skills, that would be a bias that could be corrected simply by modifying the data sets. However, if a complete picture of her data actually reinforces the choice to reject her, then there is a broader system design problem that must be addressed to produce good results for her and others in the process.

## Broadening the View of Bias in Aid Contexts

Shifting the view of success from, unbiased decisions to broad access to good outcomes substantially changes the nature of the challenge. Balanced data is still critically important, but it must be embedded in a system that supports more options and paths forward.

As part of this grant, Oversight teamed up with Umuzi, an organisation that matches youth across several countries in Africa to skill-building opportunities that then lead to employability. Umuzi consistently receives orders of magnitude more applications than training opportunities on offer. In this case, most are young African youth who are growing up in challenging economic conditions that do not typically provide them with a path that leads to fulfilling job opportunities. Merely matching 5% of the best applications and letting go of the remaining youth looking to learn is not an acceptable solution. The idea emerged that the application data should be and can be used to redirect youth to other suitable opportunities within the Umuzi / Yoma / UNICEF ecosystem.

## Immature Systems - Readiness for More Complex Solutions

Responding to challenges with more complex non-linear, multi-actor solutions is a difficult task. It requires building out more than an AI decision-making process. Instead, there is a need to create an entire ecosystem of resources, tools, and actors that can support a range of actions that meet varying needs. AI can be a key enabler of these complex systems, but there are lots of other moving parts.

Our work found that there was limited maturity in the AI applications we explored. While projects had built out individual components of their solution, we did not find examples of broad system readiness for more complex systems that would leverage AI.

## Looking for Opportunities to Reduce the Impact of “Bias” in Aid Contexts

We see three paths forward from these learnings.

- 1) Develop an approach for examining AI system readiness using an Aid Sector lens
- 2) Research the readiness of AI system applications using this approach
- 3) and draw up specific actions to globally strengthen the approach and implementation of AI systems in the humanitarian sector
- 4) Select applications with sufficient maturity for broad-based bias work

## Challenges and Opportunities

To start tackling these broader challenges we propose two holistic approaches and roadmaps tailored to two specific examples: 1) Shifting algorithms from a funnel-system youth matching algorithm to a holistic matching process. 2) proposing a framework to understand map data holistically that is inclusive of affected stakeholders and viewpoints.

At the outset of this work, our project team underestimated the early stage of the applications in humanitarian and third-sector contexts. Subsequent mapping of AI projects in humanitarian settings identified several dozen projects at various stages so advancement. We are now in a process of mapping the maturity of these.

The project identified together with our partner Umuzi a potentially suitable dataset to pilot the test dataset methodology. The data is based in South Africa and comprises about 30,000 individuals who have applied for training opportunities offered by Umuzi. The dataset includes sensitive and personally identifiable data such as gender, age, email addresses, nationality, amplitude tests, analytical skillsets, and refugee status, among other elements. We have begun looking at partnerships to help anonymise this data. However, in the meantime and due to the sensitive nature of the data, this dataset could not be published. Instead, we offer a more generalized framework on how to approach datasets as one element of the overall ecosystem to help similar projects reach impact faster.

## Proposed Roadmaps for two Case Studies

### UMUZI/YOMA

<https://www.umuzi.org/africanyouthlearncoding>

<https://www.yoma.foundation/about>

### Background

Yoma supports an ecosystem of partners to deliver individualised learning-to-earning pathways that put African youth at the centre, aligning opportunities with their aspirations, potential, and the market demand. As young people engage on the platform, their achievements and personal growth are verified using blockchain and added to a digital CV, which they can share with peers and employers. This allows youth to build a digital identity and alternative trust profile, which enhances employability and allows for more informed matching with the labour market.

Additionally, youth are incentivised to engage in the marketplace through digital tokens, which can be redeemed in the real local marketplace (e.g. for transport, data bundles and airtime) and in the digital space to access other opportunities (e.g. mentorship and more advanced or tutored programmes with limited intake).

This platform not only supports the training and educational needs of youth, it provides key staffing for businesses and organisations that are struggling to identify talent in a tight labour market for IT and programming skill sets. Commercial organisations see the value in engaging with this programme as it meets a tangible business need while leveraging CSR programs. This creates a sustainable collaboration where both employers and youth benefit from active participation.

### Taking the platform to the next level: Two challenges

Delivering effective and equitable matching with opportunities is a challenge when operating on such a large geographic and cultural level (across the entire African context). Candidates from different countries, with different backgrounds and levels of education, compete for the same training or earning opportunities.

Not all Yoma opportunities can be available to every young person, and in many cases spots for learning or earning opportunities are limited. The current program can be envisioned as a 'funnel' where candidates are evaluated against a set of defined criteria that are specific to the job or training opportunity. Candidates that don't align with these criteria fall out of the funnel and are effectively lost to the initiative. This is a significant issue since many youth seeking opportunities fail to pass through the entire process.

## Recruitment Funnel



**Figure 1: The Recruitment Funnel<sup>2</sup>**

Umuzi — a training organisation and partner of the Yoma project — has been collecting data on aptitude tests as a means of selection for software development and other digital skills training programs. For the ~30,000 candidates who have applied, approximately 20% pass the tests and only 5% of applicants are taken on to their programs.

There are two major challenges associated with this program outcome. **The first challenge** is tied to the nature of a funnel process. A large population of youth fail to receive benefits because they fall out of the funnel. This issue also impacts potential employers since the pool of candidates is reduced. Each candidate that is not matched with training and given access to job opportunities can be seen as a lost chance to deliver impact.

**The second challenge** is the risk of bias in the filtering process. Candidates who fall outside of the expected selection criteria for factors such as educational attainment, language skills, time availability and internet access may be removed through the funnel filtering process. Even though this is a data driven approach to identifying the best candidate, there are underlying risks of bias in the selection process. For example:

- **Educational attainment achieved as a proxy for gender:** in many contexts, women are less likely to reach the highest levels of schooling.
- **Time availability as a proxy for gender:** women with children will have to spend their time on childcare. As such, women might be less likely to be able to commit to the requisite amount of time for training programs.
- **Language as a proxy for ability:** if the selection process for training programs includes language assessments, this can filter out candidates who have a strong ability — for

<sup>2</sup> <https://www.slideteam.net/recruitment-funnel-presentation-powerpoint-example.html>

example in STEM subjects — but who do not get through the application process because they misinterpret test questions.

- **Internet access as a proxy for economic status:** if a candidate only has limited access to the internet, they may be rejected from a training program, but this might well be as a result of their socio-economic background.

Whilst it is logical that training and career development programs look to identify candidates with a suitable CV for their programmes, it is also important to account for such biases during the selection process. For a platform like Yoma — which aims to improve opportunities for African youth on a large scale — knowing where the innate biases are and putting in place systems to improve the equity of opportunity is essential.

## A next level solution I: Moving from funnels to matching

Our vision for a next level solution seeks to address both of these challenges; high rates of fall out from the 'funnel', and the risk of bias in the narrow selection process. The first part of the solution vision is a strategic shift from Funnel based selection to Matching of candidates and best opportunities for training and employment.

In this model there are multiple types of opportunities, which would be suited to different candidates. Candidates that enter the process would not simply be evaluated for matching a narrow set of criteria focused on a specific role or type of training. Instead, a portfolio of work and training offerings would be considered with the candidate being matched with those that best align with their skills and circumstances. (This can be best visualised using a Sankey flow diagram, where candidates enter on the left, and are matched to opportunities on the right).

Ideally, if 100 Yoma youth candidates start the process, 100 (or a large portion) would be matched by the end of the process to suitable activities.

This approach is structurally designed to support a much wider range of candidates, who have a diverse range of backgrounds and talents. Instead of falling out of the funnel, candidates are shifted to opportunities where they are likely to have success. It also becomes possible to search for niche roles that require an unusual combination of skills or interests, identifying the few unique candidates that match the needs. This helps avoid routing youth into a few standardised job types.

## A next-level solution II: Proactively address bias with a data-driven approach

The move from a Funnel to a Matching approach provides an opportunity to better identify and mitigate the impact of bias in underlying data and data-driven algorithms. Since more paths are available, a richer view of candidates can be leveraged in a matching model. More dimensions of a candidate and their context can be considered, providing a more complete and robust picture of their world and abilities.

Developing a more complete picture of the youth candidates is a significant challenge, but one that is required for accurate matching algorithms. The continent-spanning range of communities served

by the program will vary widely and will have many different individuals with unique situations and skills.

Despite this relatively low applicant success rate, the data provided in these aptitude tests could provide a valuable dataset to better understand the variables and structural biases that determine whether an applicant possesses the relevant skills to pass the test. The tests collect data on age, gender, education, location, internet access, education, refugee status, and many other determinants that could be linked to the results at various stages of the application process.

Such a rich data set is a starting foundation for the in-depth data analysis this project seeks to carry out and for findings to be extrapolated to help candidates throughout the Yoma ecosystem. Utilising regression techniques, Outsight and Umuzi intend to identify biases and missing skill sets and overlay these with demographic data in order to identify structural shortfalls of the current application system.

CSIC — another partner of Yoma — is currently working to implement a career path algorithm, based on an academic project that identifies the right module to take during a degree to reach a certain career path. The data analysis and systems approach we are proposing for this work offers an excellent opportunity to help CSIC and Yoma develop algorithms of increased complexity and usefulness as it can feed in information on lacking skill sets and how these can be filled. The details for this are outlined below.

## Implementing our approach

Clearly, this approach adds a much higher level of complexity than the traditional funnel process, but it also offers a suitable learning to earning pathway tailored to the needs of each candidate.

Working with the existing dataset, Outsight has identified a four-step process to improve the equity and impact of Umuzi and Yoma's selection processes. This is as follows:

1. **Data Completeness/Bias Analysis:** Through analysis of their existing dataset, Outsight will help Umuzi improve the equity of its recruitment process — especially from a gender perspective — in the short term. This will be done by identifying biases and overlaying the existing data with other open datasets available. The team will use these data insights to explicitly eliminate gender biases by proactively adjusting current approaches used for outreach, fostering of talent, providing training resources etc. This will be used as a pilot of the methodology for other components of the Yoma platform.

Using the Umuzi data as a test case, we will then aim to apply the findings as a foundation for more equitable systems for Yoma in the following ways:

2. **Apply to a Matching Process:** Use the data to better match potential Umuzi candidate profiles to learning and earning pathways elsewhere in the Yoma ecosystem i.e. redirecting candidates who performed well in X to Y, or directing candidates who might otherwise have

succeeded but for a single competency section to training channels. In doing so, we will also be able to identify training and support structures that might be lacking in the existing Yoma planning.

CSIC's work helping Yoma in the development of a career planning algorithm is based on a university career service that matches academic modules to careers i.e. in order to reach the skill set required for these careers, you should take modules X, Y and Z. The approach lends itself well to the approach. 'Modules' can easily be used as a proxy for 'skill sets' (that can be tagged within the meta-data of learning pathways), and the careers can be the opportunities provided by Yoma's partners i.e. in order to apply for this opportunity in IT management, we suggest you have training or previous experience in project management, IT coding skills etc. Our proposed approach, therefore, allows CSIC and Yoma to look ahead to a more advanced iteration of the matching platform, and strategise accordingly.

3. **Selection Process Advances:** Help Yoma and its partners strategise to develop more equitable selection processes — aptitude tests, interview techniques, and outreach activities — by already identifying the pitfalls and best practices from the Umuzi example. These learnings and best practices will be reiterated and improved over time, becoming an integrated, critical component of the Yoma platform which supports matching youth to opportunity at scale.

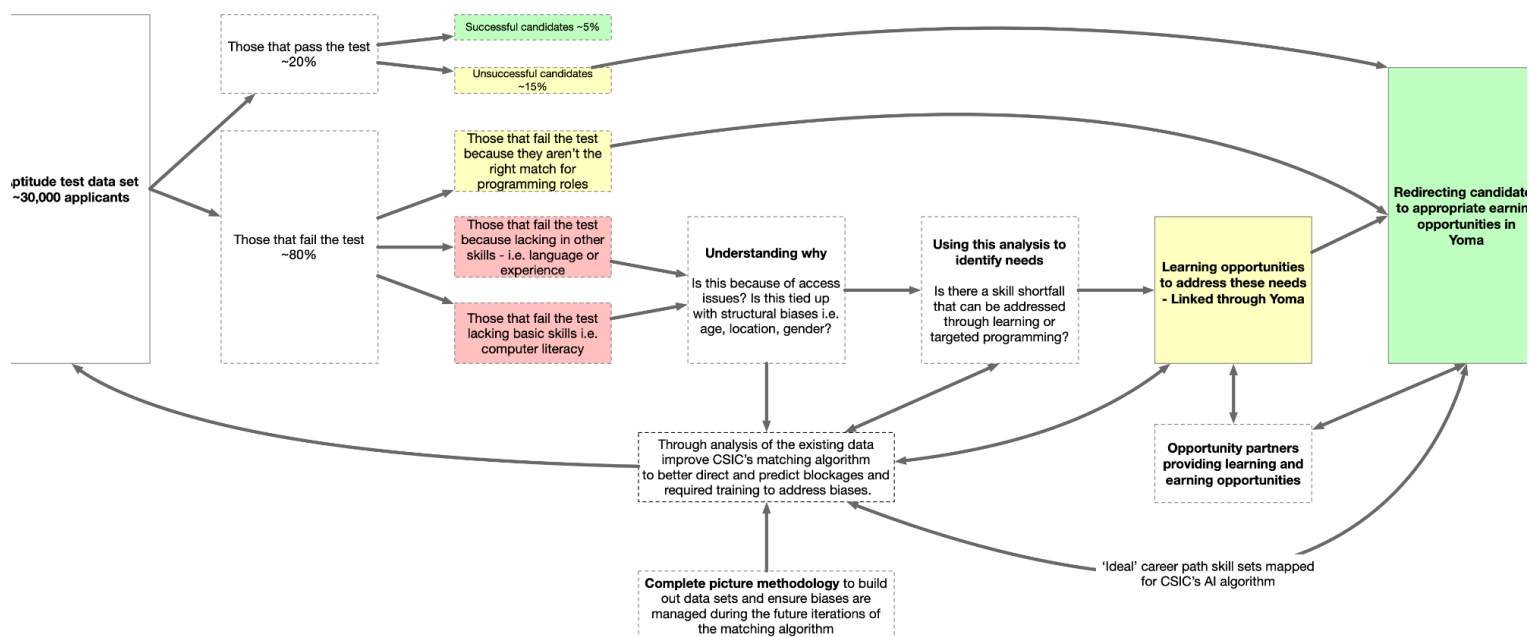
Linked again to the work that is being done by CSIC, this stage of the process will enable Yoma's candidates to be better informed about the learning and earning opportunities on the platform. This also helps consolidate the format of hiring techniques by partner organisations that can then feed into the matching algorithm being implemented by CSIC. A possible outcome of this broader approach could be to have a percentage matching score for candidates to each opportunity — allowing candidates to quickly identify the right opportunities for them — and saving the partners time filtering candidates who may not be particularly suited to a position. For example, this could mean that candidates who have already completed certain aptitude tests or learning courses would know that they are an 80% match for opportunity X. It would also tell them that, in order to be a better match, they could complete a specific course, which would then push them up to 90%.

4. **Sustainable Complete Datasets:** Develop complete data collection methodologies that will continue to hone Yoma's approach to providing data-driven, high-quality services to youth. This also serves to help with Oversight's CPP project as a demonstration of what a 'complete' dataset looks like that could then potentially be taken forward to be used as a training set for AI developers.

The existing algorithm is proposed by CSIC is based on tags for particular career paths. Linking Oversight's CPP approach into this methodology should allow for biases in selection to be picked up early and account for them. For example, if a particular subset of

candidates tended to be lacking in a particular skill, the matching algorithm could nudge them towards completing a course that would fill this gap, thus proactively tackling systemic issues.

This implementation process can be visualised in the following diagram which aims to show the different components and how they interact around the Umuzi aptitude example. As Yoma evolves, so too with the complexity of this diagram (much like Figure 2).



**Figure 3: The implementation process**

Not only does this project offer an exciting opportunity to critically assess and understand the biases surrounding equity of opportunity for youth in the African professional community, it also allows Yoma to get ahead of potential bias issues early on in their development process: especially those that might come from utilising AI or ML methodologies. This research — and its implementation — can provide practical examples and best practices, but also quantitative measures of impact for those looking to utilise the platform.

## Four models of value

We believe that this project provides four clear value propositions for the partners involved:

1. **Better outreach and targeting of the best candidates** — Umuzi, by opening up their dataset (with appropriate anonymisation) will receive insights and selection approaches that will help them improve the equity of their offering.
2. **Improved learning and earning pathways** — this analysis will support UNICEF and Yoma's goal of youth engagement in the African region and help inform strategic

approaches: crucially, through data-driven methods. Richer digital identities of Yoma's users will help guide them to the most appropriate opportunities.

3. **Improved data collection, standardisation and use methods** — Outsight and Yoma, will be able to use this data to help improve their data-collection methodologies to identify factors that should be taken into account when hiring within the African region. This understanding will help standardise the data collection across Yoma's offerings and will allow for CSIC's AI/ML methodologies to be built on sound foundations and more nuanced data.
4. **Improved and more efficient hiring practices** — Not only does this project offer value to Umuzi, Outsight and Yoma, but it can offer a broader value to the corporate world looking to hire within the African region. Hiring processes are expensive and time-consuming. Identifying suitable candidates can be difficult without knowing the required skill sets and outreach approaches. By implementing this project, Yoma can become a more attractive proposition for corporate partners for job postings and save them time during the hiring process by offering aptitude tests that could be completed by Yoma users in advance. As such, skill 'pools' can be formed for particular disciplines and candidates redirected to appropriate opportunities. As such we believe there is the possibility to ask for corporate partners to help fund this work.

## Outputs/results

The proposed approach is ideally combined with and implemented concurrently with specific projects and initiatives to help incrementally build a data foundation for programming equity by design for the wider yoma ecosystem.

For the first phase of this approach, the outputs would be the following and provide a foundation for further activities:

- Actionable results from the data analysis on how to reduce biases;
- improved outreach and testing methodologies for Umuzi and Yoma;
- the forming of a strategic plan to help Yoma and CSIC better assess and redirect candidates to other learning and earning pathways;
- a data collection and standardisation strategy to help Yoma have the required data moving forward;
- and the initial exploration of the types of corporate partner hiring practices that could be incorporated into the Yoma platform; increasing the number of opportunities and attracting additional corporate sponsors and partners moving forward.

Given the wide-ranging positive impact of this proposal, we hope it would be of interest to a number of foundations and funds focused on improving career opportunities in the African region.

# HOTOSM

## Background

Our mapping of humanitarian projects has shown that several of the more mature AI algorithms that may find use in humanitarian contexts are used in the context of geospatial information and map data. However, in spite of the potential to quickly accelerate essential work to create maps for the unmapped, there is much suspicion what regards the use of AI. It is not clear that popular algorithms are fit for purpose for the context of mapping vulnerable people in diverse places and contexts. The following is a proposal to address a shift in thinking about what it means to create a map and how AI can be applied to support the process.

Map and data play an integral role in sustainable development and the achievement of the Sustainable Development Goals (SDGs). It is essential for clarifying land rights, especially for underrepresented minorities and women. Map data supports building more resilient communities, planning for essential services in rapidly growing urban environments, reducing vulnerability to disaster risk, and enabling community action and preparedness<sup>3</sup>.

Without maps, entire communities are left out of decisions and provision of services that will save or improve their lives. This is an injustice with severe consequences: communities and the organizations trying to serve them are disconnected. This problem manifests in two critical contexts:

- **Crisis response:** when disasters and crises occur, humanitarians must quickly answer a set of basic questions to action an effective response, including what aid is needed (e.g. water, shelter) and where to deliver it. They cannot do this without basic information. This was particularly evident in the 2014–15 West Africa Ebola outbreak, when a lack of maps caused responders to lose time locating, notifying and educating those who had come into contact with an infected person, leading to significant loss of life.
- **Providing essential services:** accurate, up-to-date data is a basic foundation for any development program. Without this, programs lack the information to deliver essential services to the most vulnerable populations. Whether vaccinating children, providing clean water, or investing in infrastructure, programs intended to help vulnerable communities miss them when data is not available. Map data is also needed to understand how programs are succeeding – 26% of the 232 Sustainable Development Goal (SDG) indicators require geospatial data for accurate measurement.<sup>4</sup>

The ability to generate and use rich digital pictures of the world where people live is a transformational tool for improving people's lives. As with all powerful tools, many different elements must come together if the technology is to work well for everyone.

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<sup>3</sup> <https://opendri.org/about/>

<sup>4</sup> Firth, Rebecca, "OpenStreetMap and the Sustainable Development Goals," The Institution of Environmental Sciences, 2017. [https://www.the-ies.org/sites/default/files/journals/es\\_science\\_without\\_borders\\_sept\\_17.pdf](https://www.the-ies.org/sites/default/files/journals/es_science_without_borders_sept_17.pdf). Pages 9-13, figure derived from review of SDG indicators and analysis on which of them require geospatial data for measurement.

## Context and problem

The global data landscape disproportionately represents already empowered individuals and demographics. The reasons for this are varied, but it means that AI and machine learning (ML) models are also biased when trained on incomplete data sets or out of context, which in turn amplifies any biases that may already exist. This can have severe impacts on the lives of millions of people who are already subjected to under-representation and discrimination.

According to Forbes, the global AI-driven machine learning market will reach \$20.83B in 2024. Low- and middle-income countries have already seen a rapid expansion in applications using this technology. The humanitarian and development sectors increasingly make use of machine learning models to reach beneficiaries faster, understand needs better, and make key decisions about the form and execution of life-saving programs. How can the community leverage Artificial Intelligence (AI) algorithms to serve all the members of a community equitably and fairly?

The lack of maps covering vulnerable populations is a result of a market failure. To date, neither commercial nor humanitarian organizations have been both willing and able to map the world's most vulnerable places. Humanitarian organizations and governments need maps, but traditional mapping is expensive, and no single actor can pay for a global base map. The result is many small incomplete efforts. Commercial maps like Google are driven primarily by revenue from advertising and data sales, meaning few maps extend to vulnerable places. In these places, people suffer simply due to a lack of a business case.

Traditional motivations for mapping exacerbate the divide. In higher-income places, digital map data can be sold, and maps can be monetized by advertising, but this is not the reality in vulnerable places. Government mapping is often coordinated by the military and is usually considered military intelligence which is almost always kept private. If a low- or middle-income country government does have a mapping department, it usually has just a handful of staff members covering the entire country. The development community, which spends millions of dollars each year on data collection and mapping, is limited in two regards. First, siloed data; each organization collects its own data and stores it offline in non-machine-readable formats. Second, funding cycles: NGO projects and their associated activities are often time-bound. This means the data that is collected through NGO efforts is not maintained when a project finishes and rapidly becomes out of date.

Maps are a Key Tool for Defining Place: Maps provide information about what a place 'is', defining the types of connections and physical resources that are available within an area. Maps can be correct & without gaps ... but still not complete: Much of the focus of mapping organizations is on generating correct maps, maps with no data in error and no data omitted. However, this requirement can be met, without the map being complete across dimensions that are not part of the original specification for what the map includes. For example, the same physical road may offer different options for users based on the rules for using the road (e.g. no foot traffic or bicycles) or a building of a given type may offer different levels of access (e.g. a hospital just for children).

There is an urgent need for a free, open, and comprehensive map of the world. And there is incredible momentum around three trends that make now the perfect time to dream big:

- **Critical mass of volunteers:** as smartphone availability has grown, mobilized and equipped volunteers around the world have the motivation and capacity to map using offline tools.
- **Surge in demand for data:** NGOs, governments, and other actors recognize how critical high-quality local data is to improve their work and are seeking more.
- **Availability of technology and tools:** high-quality satellite imagery is openly and freely available, and technological advances like artificial intelligence (AI) and machine learning (ML) are speeding up the mapping process.

## Opportunity: Make maps work for everybody

Through collaborative action, bringing together the OSM (wider audience), NetHope AI working Group (specifically on map themes), and AI/ML of HOT OSM-specific expertise on map data and broad collaboration to correct and avoid leveraged bias data, ensure that people can equitably benefit from available data and AI/ML tools.

CPP Data Set Use Can Inform OSM Map Creation: This provides an opportunity to think about how the use of data sets that include map data could inform the creation of source mapping information. Conversely, understanding the map creation process can inform how to best use data sets in downstream AI applications without inadvertently driving bias.

## Recognizing the Layers of Complexity

Big data and the associated sophisticated technology solutions that use it are complicated subjects that require specialized expertise to master. This technical difficulty can obscure challenges that require a broader "systems" view to addressing. Systems have become something of a buzzword, so it will be important to provide a concrete view of what these challenges are and how they interconnect with each other.

**System 1 - The Map Itself:** Like most complex data sets, maps create a picture of a system in the real world. This picture shows how different roads connect and where specific things might be found within this network. What is on the map is the product of many different choices about what is included and how the pieces are tied together. These choices empower, distort, or limit how the data may later be used, and so shaping this view of what's on the map provides a crucial foundation for all other work.

**System 2 - Creating the Map:** Data sets are created through a system of technical and human efforts. Who is included in this process affects the choices made about what finally are represented in the data. The addition of powerful AI tools to the system for creating data sets further complicates the challenge of avoiding bias.

**System 3 - Application of the Map:** Maps sit at the heart of a growing number of applications, ranging from familiar route-finding tools to much more sophisticated tools for understanding and interacting with communities. These complex applications create systems that transform data into action. While they offer the promise of powerful new capabilities that can improve lives, with this power comes the risk of explicit bias (discrimination in the award of loans by geography), and

unintended harm (routing applications that fail to bring traffic through a local community business center).

**System 4 - Users Receiving Value:** The people and organizations using a data-based application are different from each other. They fit the tools and the underlying data into the unique challenges of their lives. Their personal systems have specific needs, constraints, and possibilities. This system is ultimately where value is created, which depends on the ability to customize and tailor the product of the prior three systems to shift real-world needs.

### **Bringing these Systems Together**

It is common for these four systems to evolve and operate separately from one another. One collection of actors works to create a map, while a different set of groups develop tools, which is often done at a distance from the incredibly diverse set of communities that they serve.

The quality and effectiveness of the different systems can vary. Some may be robust, while others are immature. Bringing the systems together so that they build on and support each other is an even more significant challenge. There is often no one with a big-picture view of the whole ecosystem, and so efforts proceed in silos that are poorly positioned to see broader challenges or opportunities.

The Alliance seeks to provide a unified view and connection across the four systems. It looks at how each of the component systems needs to work together to connect complex data with real-world value.

## **Objectives**

To create an alliance to support broadly accepted tools and guidance and an ecosystem of practitioners that engage in responsible mapping activities throughout the entire lifecycle of map data. This work should set the foundation to create a global base map that is inclusive and representative of everyone. It has the objectives of

- Strengthen the community of practice around responsible, inclusive map data,
- Creating practical tools that lead to an increasingly responsible, inclusive, and aware, responsible practice around map data,
- Aligning and getting stronger acceptance for AI/ML within OSM and mappers,
- Bringing increased awareness and understanding around AI and ethics to practitioners in the ecosystem.

## **Proposed Activities and Outcomes**

Highlighting why data does and does not work for some stakeholders needs to be explored and problem statements defined. The project will use the following steps:

### **Inception and Framing**

#### Workshop

A half-day workshop (4 hours) that brings together stakeholders from different parts of the system, including map creators, application builders, users (NGOs, aid organisations, local governments using maps and applications to make decisions, etc.) and other actors who are affecting and being

affected by the creation and use of maps. Some of these stakeholders might end up being part of the Mapping Data Alliance and be more involved throughout the project, while others form the extended community that can be called upon at specific points.

Workshop objectives:

- Bridge building: Share experiences, challenges and needs across different systems (4 systems mentioned above), identify overlapping and conflicting priorities
- Problem definition: Define clear and prioritised problem statements that have buy in from all four systems
- Solution definition: Build on these problem statements to define a clear vision and mission for the Mapping Data Alliance, including the desired tangible outcomes of the project.
- Alignment and next steps: Once alignment on the mission and outcomes has been achieved, we define the project methodology and roadmap for how to achieve this mission, defining clear tasks and responsibilities for the Alliance. We also define an ongoing engagement model for all stakeholders in the workshop to ensure that those who want to be involved can continue supporting the project.

### **Founding the Alliance**

The Alliance should be composed of key stakeholders who can support finding broad support and alignment on actionable collective decisions to support the further development of AI-assisted mapping tools. The alliance should further enable existing stakeholders in the space to make it radically easy for anyone, anywhere, to make low-effort “micro” map contributions and to use the information they map. This means increasing contributions through mobile apps, adapting tools to even lower-resource environments, and improving the speed with AI. This is a work in progress, with key activities including

- *Leveraging Machine Learning (ML) and AI to create faster and higher-quality data:* With ML and AI, volunteers can map quicker and can shift from mapping on laptops/desktops to smartphone apps such as MapSwipe.
- *Improving the accuracy of ML and AI for mapping vulnerable communities:* ML and AI are often insufficient or inaccurate in mapping remote and rural places. Many maps created through AI alone have extremely low accuracy in places where roads are unpaved and buildings are made of natural materials. This is why HOT focuses on pairing ML/AI with volunteers to verify accuracy. HOT has developed the “Machine Learning Enabler” so any technology company can easily share outputs from their algorithms to OpenStreetMap.<sup>5</sup>
- *Creating new types of contributions:* As we work to create a truly open and equitable map, AI/ML offers the opportunity to amplify the voices and contributions of groups who are historically underrepresented or marginalised. By using AI/ML to generate data predictions (features such as roads and building) and combining them with validation by local users (e.g. An app that prompts ‘Can you confirm this building is a hospital and what are it’s

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<sup>5</sup> To learn more about Microsoft’s use of the Machine Learning Enabler service, see: <https://blogs.bing.com/maps/2019-09/microsoft-releases-18M-building-footprints-in-uganda-and-tanzania-to-enable-ai-assisted-mapping>.

opening hours?), context can be added to the data to make it both rich and valuable to all users of the map.

- The alliance itself needs to maintain a composition of stakeholders and facilitation that provides a neutral discussion space that allows for input from a variety of stakeholders emphasizing inclusivity and equity.

## **Developing the playbook**

The Playbook lays the foundation for understanding what data is required to fully represent communities affected by AI/ML technology when used in a mapping context. It addresses the types of data needed, the current data availability, bias risks, safeguards and the actions required to move forward with a bias mitigation program.

*Develop Problem Space Model* - Creating a structured view of the domain where the AI will be applied, understanding who the key actors are and the activities that they perform. This is a highly collaborative process where multiple subject matter experts may contribute from varied domains.

*Landscape Analysis* - A qualitative and quantitative review of what data sets exist and their quality. This also includes an assessment of potential data gaps.

*Context analysis* - This analysis is tactical and linked to physical on-the-ground examples in Tanzania and India.

*Bias Hypothesis* - Development of potential Bias Hypotheses that may arise from the use of AI within the problem space and from the nature of the available data sets.

*Remediation Strategy* - An actionable plan for building a complete picture project data set for use by AI teams.

## **Piloting, testing and validating the playbook on the ground**

The playbook will be based on experiences that have been collected in the field including in Tanzania and India and will also be applied, tested and refined on the ground in multiple settings. This activity will test out the playbook on the ground and validate and reiterate the product. We propose this also to be part of the follow-up phases.

## **Expertise**

### **Outsight International and the Complete Picture Project (CPP) Team**

([outsight.international/cpp](https://outsight.international/cpp))

Outsight will serve as a facilitator and bring design and strategic expertise to the implementation. The Complete Picture Project (CPP) team of Outsight International works to address hidden and pervasive AI and Machine learning algorithmic biases by constructing complete test datasets that better represent the true diversity of human societies and communities.

Outsight International is an organization specializing in providing services to the humanitarian and development sector. Outsight is agile and efficient and builds on the range of expertise offered by a

network of Associates in order to deliver quality results adapted to the specific tasks at hand. Organisations our team has worked with include MSF, UNICEF, World Bank, WFP, ICRC, Gates, Yale University, EPFL, GAHI, Antenna Foundation, and WHO.

### **Humanitarian OpenStreetMap Team** (hotosm.org)

HOT is an international team dedicated to humanitarian action and community development through open mapping. We work together to provide map data which revolutionises disaster management, reduces risks, and contributes to the achievement of Sustainable Development Goals.

Over the past three years, HOT has been increasing its exploration and implementation of ML/AI-assisted mapping workflows. HOT has achieved this by working closely with leading technology organisations around the world including Microsoft, Facebook and others and bridging the space to the community and local collectives that can benefit greatly from the integration of ethical and responsible ML/AI for humanitarian mapping goals.

### **Building on existing expertise**

HOT has experimented with AI/ML-assisted mapping in its early iterations in a few countries including Indonesia, the Philippines, Uganda and DRC.

For example, in Uganda, the HOT team supported the Uganda Bureau of Statistics (UBOS) to estimate and determine the number of households in a particular village area, to determine the total number of enumeration areas. The HOT Uganda team combined a recent Microsoft Machine Learning (ML) generated building footprint data set with the OpenStreetMap available imagery to enable the UBOS staff to more accurately plan and distribute resources (surveyors, technical equipment) needed to carry out national census activities at scale.

## **George Washington University**

### **Background**

The CPP project has teamed up with George Washington University School of Engineering and Applied Sciences to better understand the state of play for the use of AI in the humanitarian sector more broadly and to be able to distil more concrete activities and roadmaps for investment towards realized impact in the humanitarian space. The humanitarian sector already has a good grasp of the potential benefits and risks of AI deployment in humanitarian space and various articles and papers have been published on this topic. What's less explored and of practical value is an investigation of *what is needed* to better leverage AI technology, within the data-to-action ecosystem of the sector.

As such the joint research initiative seeks to answer:

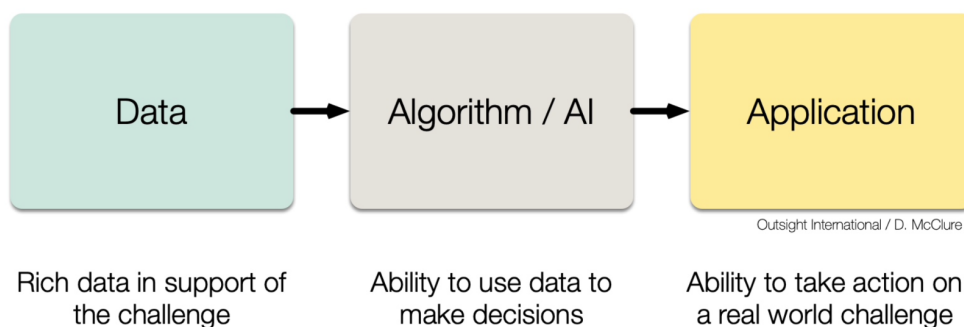
- Where is AI already useful in the humanitarian sector?
- What research or practice advances are needed in order to make AI useful in more areas?

## Catalogue of Humanitarian AI Projects

Outsight and GWU researchers have compiled a catalogue of ongoing and past AI projects in the humanitarian sector. Projects were identified using one of the following AI types: i. Predictive analysis ii. Computer vision iii. Conversational AI iii. Chatbots and virtual assistance iv. Natural language processing v. natural language understanding and vi. Text analytics. Each of the projects was further classified into one of two purposes: 'improving efficiency' or 'generating insight'. The findings will be published in a paper on the same topic including a model that helps understand the maturity of AI projects.

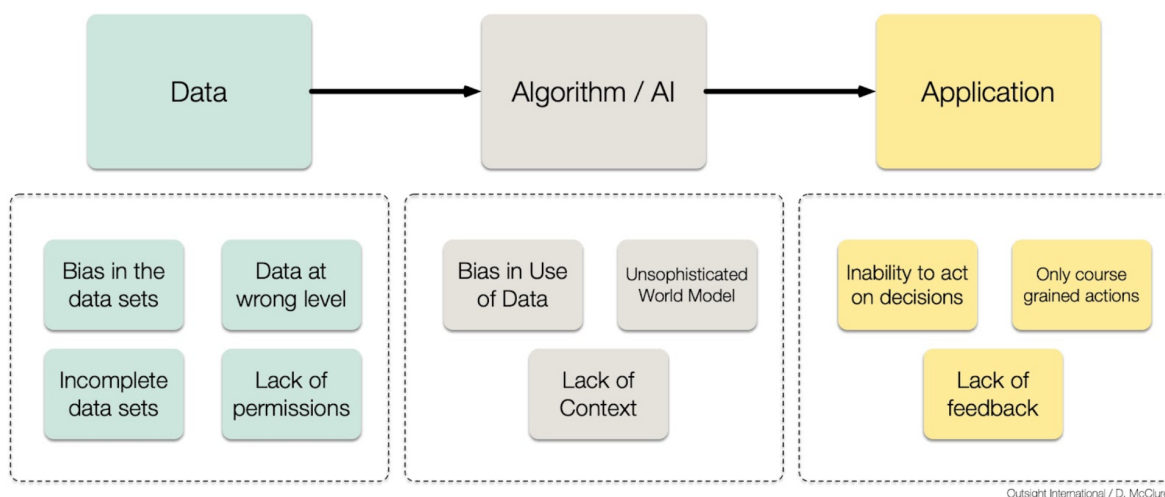
## Maturity Assessment Model Under Development

Level 1 - Maturity of the AI Ecosystem  
Are all the parts needed to turn knowledge into action present?



## Level 2 - Quality of the AI Ecosystem

What weakness exist within a complete ecosystem?



Samples of weaknesses in each part of the ecosystem

The result will be a paper that points to the concrete investment needs to leverage AI in humanitarian settings. This work is currently continuing.

## Other considerations

We are continuing to work on unpacking the ecosystem around AI and the data needs in humanitarian settings. The sensitive nature of the Umuzi dataset has barred us from being able to work with the data as much as we would have liked. We have initiated discussions with groups that specialize in data-preserving analytics such as Inpher<sup>6</sup>.

*This report was compiled with contributions from Dan McClure (Outsight International), Devangana Khokar (Outsight International), Erica Gralla (George Washington University), Louis Potter (Outsight International), Bo Percival (HOT OSM), Warwick Vlantis (UNICEF).*

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<sup>6</sup> <https://inpher.io/xor-trial/>