AT2030
Case Study

AT2030 – Final Report 3D PETRA Project

Prepared by
Humanity & Inclusion

Cluster 2
Innovation
Spark Innovation

Country
Uganda

Date
May 2021

Funded by

UKaid
from the British people

Led by

Global Disability Innovation Hub

In partnership with

humanity &inclusion

AT2030

Impact Stories

About AT2030

AT2030 tests 'what works' to improve access to life-changing Assistive Technology (AT) for all; investing £20m over 5 years to support solutions to scale. Led by Global Disability Innovation Hub and funded by UK aid, AT2030 will reach 9 million directly and 6 million more indirectly, driving a lifetime of potential. AT2030 is operational in 31 countries globally.

About Humanity & Inclusion

Humanity & Inclusion (HI) is an independent charity working in situations of poverty and exclusion, conflict and disaster. We work tirelessly alongside people with disabilities and vulnerable people to help meet their basic needs, improve their living conditions and promote respect for their dignity and fundamental rights.

In Uganda, HI operates in 13 districts and 8 refugee settlements. HI in Uganda is implementing a range of projects including functional rehabilitation, mental health and psycho-social support, inclusive health, inclusive education and livelihoods targeting refugee populations and Uganda communities. HI works in the Omugo refugee settlement in Arua District to deliver orthosis to refugees with disability with the 3D Printing through Emergency Tele Rehabilitation Access (3D PETRA) project.

HI was awarded a European Innovation Council Horizon Prize of one million euros in September 2020 for our ground-breaking work using technology and telemedicine for physical rehabilitation.

The AT2030 - 3D PETRA Project

Over one billion people with disabilities are currently in need of Assistive Technology (AT) according to the World Health Organization (WHO); a number predicted to rise to two billion by 2050 (fact sheet on Assistive Technology 18th May,2018). Yet, only about one-tenth of the people who need AT – to learn, work, or fully participate in their families and communities – have access to it (WHO, 2017) which renders the SDGs' achievement highly unlikely if not impossible.

The 3D Petra project sought to develop effective solutions combining tele-rehabilitation, Computer Aided Design (CAD) Computer Aided Manufacturing (CAM), and 3D printing to increase access to orthotic devices (a sub-set of AT) for use in emergencies and remote settings. Regarding the technology in use, only the shells of the orthoses were printed. The rest of the devices were assembled using conventional materials and components. Fitting also followed a conventional process.

The project was implemented in the West Nile part of Uganda, specifically Arua District, within the refugee settlements of Omugo and Imvepi, including the catchment of host communities.

The 3D project has built HI's experience through a well-designed production process using 3D printing Technology. HI has realised significant savings in materials

consumed and the amount of waste product generated. Production is closer to the beneficiaries and there is high possibility of reaching more vulnerable populations since service provision is localized and closer to them. Therefore, transportation costs for beneficiaries to service points, for packaging and shipping materials from Kampala to Arua have more than ever before been reduced significantly. It has improved our presence and visibility in the refugee settlements by providing orthoses to persons with disabilities from the refugee settlement and host communities. This has gotten even better courtesy of the complementary Comprehensive Refugee Health Response (CRHR) that offers physiotherapy treatment, provision of assistive and mobility devices, psychosocial support, caregiver support and training and Support to health facilities currently ongoing in Arua District.

3D Project Beneficiaries

Direct Beneficiaries:

Individuals who were benefitting from orthoses, from refugee settlements and host communities.

Based on the beneficiary selection and eligibility criteria, eighty-two (82) persons in need of orthosis were identified. More people were identified knowing that after scrutiny by the consultant some may not meet the selection criteria leaving HI with a substantial number to still pick from. Indeed, even though 82 were identified, some beneficiaries were not selected by the consultant because they were below the

recommended age. According to the design guidelines and recommendations from the consultant, children below five years of age would not have the capacity to use the orthosis. Besides, they have the potential to easily outgrow disabilities at the time which would not necessitate the device in the long run. Others needed additional services like surgery before they could benefit from the project, which was outside the scope of this project.

Health staff trained on digital technology.

Two (2) Physiotherapists (PTs) of the CRHR project were seconded to the Project and trained on the scanning software since the 3D project did not have Physiotherapists assigned to it. However, the CRHR project had been implemented for some time and its PTs were already experienced so they would easily be of support. The PTs participated in the different stages of the project – identification, scanning, fitting of the devices, and gait training. They thus collaborated with the project Consultant to finalize the devices before printing.

On-the-job training happened in remote meetings with the Consultant, particularly in the assembly and fitting of the devices on the beneficiaries. The exchanges improved the technical staff's skills in 3D technology, tele-rehabilitation and orthotics.

Indirect Beneficiaries

Household members of the individuals benefitting from the orthoses

Forty-eight (48) family members of the 35 persons who got fitted with orthoses received counselling on the benefits of the orthoses and acceptance of the devices

and physiotherapy gait training and exercises for the beneficiaries. The training also supported them to be able to support their family members who benefitted to be able to continue physio exercises to improve their functionality, to maintain the donated devices and report any issues they may face with the devices so they can be addressed.

Project Tasks, Objectives & Accomplishments

Sub-Programme 3: Spark Innovation

P3.4 AT Innovation for Humanitarian Response

Component 1: Use of digital innovative technology for provision of orthopaedic devices for acute trauma injury

1.1: Persons in need of orthosis are identified according to specific criteria in their community.

Both the Prosthetic and Orthotic (P&O) Technical advisor and External Consultant who supported the project were recruited by the Rehabilitation Specialist from HI Headquarters. They worked with him to finalize the project design, beneficiaries' identification and selection criteria for the 3D PETRA project. (See annex 1)

Both the Consultant and HI Rehabilitation Specialist were in Uganda for a month and provided:

a) Orientation to HI West Nile team on the pilot 3D PETRA project, which led to a kick-off meeting identifying potential challenges, risks and success factors for the pilot project.
b) Technical support to HI and Arua Regional Referral Hospital (ARRH) partners and hands-on training to CRHR physiotherapists on scanning.
c) Support in identifying beneficiaries in the refugee settlement and host communities in the West Nile.

A total of 82 potential beneficiaries were identified by trained community-based volunteers and had their measurements taken. Of these, only 35 beneficiaries qualified and were prescribed and fitted with 43 orthoses out of the 63 devices produced during the project timeline. They were selected after proper evaluation by the consultant through Tele-rehabilitation sessions and others through face-to- face sessions by the external consultant. Different prescriptions were made to provide orthotic devices depending on individual orthotic needs. Beneficiaries who qualified were then measured, scanned and their files digitally modified. The difference of the 20 devices that were never fitted were as a result of the following reasons:

- 5 beneficiaries who were to be fitted with 6 devices relocated to South Sudan.
- 3 beneficiaries who were to be fitted with 4 devices outgrew them and theirs had to be re-produced, hence 4 additional devices.

- 3 other beneficiaries who were to be fitted with 4 devices recovered due to physiotherapy services offered to them
- 2 beneficiaries to be fitted with 2 devices opted out.

The table below puts the above information into perspective:

Number of beneficiaries fitted	Orthoses Fitted	Orthoses Produced	Orthoses produced but not fitted
35	43	63	20

1.2: Persons in need of orthoses follow a comprehensive rehabilitation process

Since the Project was inextricably linked to an ongoing CRHR project, orthotic treatment protocols were adapted to the existing comprehensive rehabilitation and Mental Health and Psychosocial Support (MHPSS) treatment protocols. This was in such a way that the clinical assessment was done by a combined team of a Physiotherapist and Psychosocial Workers and when beneficiaries qualified to receive devices, they were then offered psychosocial support to address any psychosocial issues they could be facing. This included helping them to come to terms with their new devices but also be ready to re-integrated into family and community afterwards feeling confident. (See annex 2 below)

Home follow-up of beneficiaries was done by the Community Based Volunteers (CBV) trained to continue counselling and treatment with technical support from the PT and Psychosocial (PSS) workers of the CRHR project.

1.3: A follow-up process is implemented for the persons fitted with an orthosis.

Within a week after delivery of devices, beneficiaries were visited at home and device body parts inspected. All families of 35 patients that were fitted with orthotic devices were followed up with twice a week up to the end of project. The follow up process consisted of a return visit two weeks after provision of orthopaedic device and discharge of beneficiaries who were fitted, trained on orthosis use and adapted well. This was to ensure devices provided did not cause harm to them and if they needed modifications, that these were done. During home visits the team realized that patients were comfortably using their devices and had achieved great improvement in their mobility. The process ensured that beneficiaries were comfortably adapting and using devices with satisfaction. And in case a beneficiary presented a concern(s) about a device, the device was picked, taken back to the orthopaedic workshop for further modification and in turn delivered back to the beneficiary

All the patients that were fitted with 43 orthotic devices were continuously monitored until the end of project. They were on average monitored 3 times. Community Based Rehabilitation (CBR) Workers also monitored and followed up beneficiaries and fed information weekly into the data base. During follow ups, beneficiaries were able to use their devices in their activities of daily living an indication that their functional abilities had improved. Others have since purchased additional shoes on their own to compliment the pair of shoes that were provided to them by HI for use. Children who had not been able to walk have learnt to walk and play around homes, move within

neighbourhoods while some adults for the first time could access markets, churches and other social gatherings with ease.

It's anticipated that in the next few months that some children may have outgrown their devices which will require replacement or adjustment. These could be managed with the HI bridge funding that has ensured the continuation of this action.

Component 2: Design of a process of fitting using digital technologies

2.1: Adaptation of the facilities

The two 3D Printers arrived in Uganda by 22nd November 2019. In anticipation of their arrival, HI West Nile moved to a bigger office and refurbished one of the rooms to house the two printers and related accessories. Electrical fittings from the city, battery inverters and generator were adapted to allow for uninterrupted electricity supply to ensure seamless use of the printer. An Uninterrupted Power Supply (UPS) system was installed to guard against unstable electricity power supply with batteries and an inverter linked to the power supply grid. Additionally, a cooling system was installed with a fully functional air conditioning system to maintain normal room temperature at all times but also free from dust was fitted to ensure the printer does not overheat while being used.

A 3D PETRA Technician who had a Diploma in Telecommunication, Certificate in Printing Technology and had worked with Uganda's Defence Unit and two of the

leading daily newspapers the Daily Monitor and The New Vision was recruited and provided technical support in printing devices.

Meanwhile the HI P&O TA attended a five days training from Wasp, the manufacturer of the Two 3D printers from Italy. Both the P&O TA and 3D PETRA Technician were to participate; however, the 3D printing Technician could not make it to Italy for the training since the Italian embassy could not issue him visa on time. Meanwhile the P&O Technical Advisor who attended the training resigned soon afterwards before he could fully impart his knowledge and skills to the 3D Printing Technician. He however was able to partly share the knowledge and skills learnt in setting up machines. So, the 3D Technician largely had to make do with online training and figure out his way going forward.

2.2: Design of protocols of treatment for each device and pathology and validation by all stakeholders

The HI project Team and ARRH staff were trained on the use of assessment tools and protocols, and the P&O TA ensured that staff were conversant with developed tools. These were adapted to the ongoing rehabilitation project alongside the 3D PETRA Project to ensure the continuation of support to beneficiaries. The Consultant and the rehabilitation specialist also made a lot of effort to ensure that other stakeholders like Ortho-prosthetic Technicians from ARRH were taken through various tools used during the assembling of devices. This greatly minimized the time

spent during the assembling of devices and also reduced the number of devices breaking during the assembling process. Supervision and mentorship by the Consultant through tele-rehabilitation and tele-medicine built the capacity of Staff and improved skills of the Ortho- prosthetic Technicians at ARRH.

Assessment tools (see annex 5) for CRHR such as the general assessment, physiotherapy assessment, psychosocial assessment and action plan were shared with the Monitoring, Evaluation, Accountability & Learning (MEAL) Officer who supported with their adaptation and developed specific tools related to the 3D PETRA Project; like the 3D assessment clinical evaluation, 3D follow up, 3D process evaluation and user satisfaction assessment. The MEAL Officer ensured the existing database was adapted and linked to include information from the 3D project. This eased extraction of information, tracking of data and information sharing with staff and stakeholders (See annex 5).

2.3. Rehabilitation Operational Procedure

The rehabilitation staff were oriented on the rehabilitation operational procedures right at the onset of the project. This was done because it was to be used throughout the lifetime of the project. Therefore, during assessment of patients, Staff ensured agreed tools and protocol were observed and applied accordingly. In essence, patients were identified, evaluated and had their prescription, measurement and scanning done. This was followed by digital rectification, printing of orthosis and assembling from Arua Hospital. Thereafter, fitting and adjustment, exercise and

delivery processes followed to ensure complete rehabilitation. (See annex 2 for detailed information).

2.4. Evaluation of the digital process

The digital process was a bit challenging since everything in the digital world requires fast internet which was not the case in the settlement where implementation took place. For example, after scanning the team was meant to send scans immediately to the consultant to evaluate, something that was not possible sometimes due to poor internet connectivity.

Printing time was yet another challenge due to the fact that the smallest orthotic device would take a minimum of 13 hours; meanwhile a big device would take up to 72 hours which calls for a lot of patience.

Initially the technology was hard to understand in the Ugandan context as it was the first of its kind. Orientation of Staff and other processes took long which affected timely project implementation and production process, coupled with delays caused by the COVID-19 pandemic.

Every step within the protocol of treatment and its sub-stages was assessed and measured in regard to time and cost. The Consultant and 3D printing technician oversaw the whole digital printing process, although the tools designed for monitoring could not sufficiently capture all the relevant information necessary to better understand the progress of recovery. For example, tools on follow up could not capture information on how and if beneficiaries were improving as a result of device

usage, which made it difficult to have information entered in to Survey CTO automated data base system used by HI, for easy data analysis. The survey CTO is a mobile data collection system used on tablets where Information is instantly generated and automated making it a lot much more efficient and environmentally friendly as it rules out the use of paper and saves time.

But despite the challenges explained above, the 3D technology created fast designs and production, minimizes waste and is cost effective compared to traditional methods. In a nutshell the digital process is more effective and efficient way of producing the assistive devices.

`

3.1: On the job training for the PT, OT, and P&O concerning the pathologies targeted by the project.

A three-day training was conducted from 21st – 23rd August 2019 at HI's Omugo Sub-Base Office targeting five (5) HI field Staff and three (3) Community Base Rehabilitation Workers from Omugo. The training provided by the P&O TA focused on the anatomy of human body, relevant pathology, orthopaedic principles and practical training in taking measurement, and scanning following pre-determined devices for the project. These included: Ankle-foot orthosis, knee-ankle-foot orthosis, upper limb orthosis, Spinal corsets and Adapted seating systems.

Photo showing 3D Technician Disan practicing digital scanning while a team of Physiotherapist and one volunteer look on during the training in Omugo HI office. As well as HI Staff Paul practically scanning James' feet during digital scanning technology training exercise while P&O TA giving instruction on beneficiaries sitting position during scanning exercise on 29th/8/2019

3.2. Training on the use of digital technologies

The Ortho-prosthetic Technicians at the regional referral hospital were trained on good digital scanning casting using Ortenshape software. As a result, they were in

position to practice and scan few beneficiaries identified from the hospital, that were then fitted with orthoses.

In addition, the P&O TA and 3D PETRA Technician participated in a three-day training on plaster Cast 2 transtibial, Legs for KAFO (Knee Ankle Foot Orthosis), drop-foot & varus & parese, Plaster Cast trans femoral, Transtibial as well as repairing KAFO cast with alignment and Soft socket transtibial (monolimb => SwissLimbs). Organized by AVSI Foundation in collaboration with Gulu Hospital and whereas it was not technological in nature, the training equipped them with more in-depth understanding what other organization do in the field. It also provided an opportunity for HI to demonstrate their new technology, the tele- rehabilitation process, but above all, foster new partnerships and technical exchanges with other partners.

Furthermore, a one-day stakeholders' meeting was organized to review project implementation, progress, achievements, challenges and way forward. The review process was a big boost in fostering better understanding on 3D PETRA project and its activities but also getting buy in from local authorities. It also provided an opportunity for District leaders (the Resident District Commissioner- RDC) to emphasise the need to locally raise resources for follow up of beneficiaries, since it lies within the government mandate. More importantly the local authorities also expressed willingness to support sustainability of innovative technology. In his own words he had this to say; "… continuity and sustainability of projects falls within

Government departmental programs and Government allocates budgets for that by sector. The departmental heads have to budget and submit budget allocation."

Photo showing HI representative updating Stakeholders on 3D PETRA Project (left) and RDC Arua (right) making closing remarks as well on 26th/11/2020.

3.3: Training of the Community/Social worker for the identification/ referral/ follow up of the beneficiaries

Three (3) Community Based Rehabilitation Workers participated in training sessions on identification, referral and follow up of beneficiaries (as detailed in Section 3,1). The CBR Workers were integrated in the identification, assessment and follow-up after delivery of devices. This was because the 3D PETRA project had no provision for recruitment of PTs, PSS Workers and CBR Workers yet they were essential for the success of the project. These were thus easily mobilised for support since they were already covered by the CRHR Project.

They equally participated in follow up of beneficiaries with HI Staff. During follow up, the project team used an integrated monitoring and evaluation approach, where both

CRHR and 3D PETRA beneficiaries were followed up at the same time. This therefore exhibited HI's ability to efficiently utilize readily available resources.

3.4: Strengthening of the Health referral system

A community awareness raising and sensitisation was conducted by HI project Staff and CBR workers, during a training for Organisations of Persons with Disabilities (OPDs) in Rhino-Ofua and Omugo where staff utilised the opportunity to create awareness on the 3D Petra project's innovative approach and the targeted beneficiaries that could benefit from project. A total of 78 (52 males, 26 females) attended. There was also information dissemination during the awareness session which targeted direct CRHR beneficiaries, caregivers/parents, Omugo Village 2 Health Centre III Staff, previously run by Medical Teams International (MTI) and now International Rescue Committee (IRC) and other partners within the settlement on rehabilitation and CBR approach. This helped to reduce heightened expectations from partner organisations and at community level with regard to what kind of patients could be referred for treatment. Initially partners and community members thought that the project would provide prostheses and other livelihood support. But these sensitisations clarified what HI could and could not provide.

Furthermore, HI under this project developed a training package (see attachment below) for the Arua Referral Hospital orthopaedic staff, which suited the kind of engagement they were involved in. The Staff managed and transferred knowledge,

skills learned and were able to successfully sensitize the community on innovative approach and targeted beneficiaries who came to the hospital and had qualified to benefit from project. This training gave Ortho-prosthetic Technicians basic knowledge about the 3D technology which in turn helped them select the right beneficiaries who qualified for project. It also equipped them with the skills on how to handle the devices during assembly.

Impact against deliverables:

How many people were you able to reach so far with your innovations? Please provide a brief paragraph with more details.

One of the objectives of the project was to provide at least 50 orthotic devices to beneficiaries who met the selection criteria. Sixty-three (63)-126% devices, 13 more than the initially targeted, were produced. Thirty-five (35 out of the 82 initially identified) beneficiaries were fitted with 43 devices which contributed to 86% of the total project target goal achievement. The project could not achieve its target 100% due to the COVID-19 pandemic with restricted access to hospital where devices were assembled.

Have any new businesses or start-ups building on the innovations been created? If yes, please provide a brief paragraph with more details.

A Memorandum of Understanding (MoU) with Arua Regional Referral Hospital (ARRH) was developed and signed on 9th January 2020. HI project staff worked closely with the Orthopaedic Workshop Staff at the regional referral hospital. The partnership enabled successful assembly, adaptation and fitting of devices produced. The hospital Staff capacity on innovative technology has been enhanced through various trainings.

Another partnership with CoRSU hospital was also established. In this partnership, CoRSU was sub-granted to conduct direct implementation and as a result provided five (5) prosthesis to five 3D Petra project beneficiaries using digital innovation through 3D printing. This partnership helped compliment HI's efforts but also provided a platform for sharing knowledge since CoRSU is a respected service provider in Uganda

Did you secure any additional funding and/or investment to support your project? If yes, please provide a brief paragraph with more details.

Due to the absence of funding after this phase, HI was able to ensure a minimum running of the project until June given its importance and impact in the community. Additional funding was therefore received via HI's bridge funding for a period of six (6) months from January through to June 2021.However, its start was delayed due to the delays of the current action that were occasioned not only due to the challenges

encountered to identify the right technical persons to run the 3D machine and consultant to offer technical support, but also COVID-19.

Have you developed any new methodologies for market-shaping? If yes, please provide a brief paragraph with more details.

HI in collaboration with CoRSU hospital and Skymac developed 50 face-shield masks which were donated to remote Health Centres through Ministry of Health (MoH) in the fight against COVID-19 pandemic. These Health Centres lacked PPE equipment to protect frontline health workers during the COVID-19 pandemic.

HI reached out to the Rotary Club of Muyenga in Uganda to partner and produce face shields but due to the cost of production especially the raw materials, the collaboration didn't pan out as had been envisaged. Rotary Club of Muyenga, opted for a cheaper version of face shield made of cheaper plastic and available locally.

Have you developed any disruptive technologies with potential for life-changing impact technologies? If yes, please provide a brief paragraph with more details.

Not yet

Have you created any innovative service delivery models? If yes, please provide a brief paragraph with more details.

This project provided HI a platform to provide the first ever such digitally oriented assistive device production model in Uganda that remains a marvel but also an innovation at the heart of which is its ability to address pressing functional needs of persons with disability. As indicated in the report above, it not only cut down on time involved or even lost in long procurement process that sometimes-rendered assistive devices useless when delivered belatedly. It also brought services closer to communities thus eliminating barriers such as transportation costs that beneficiaries endured to get similar services from far and wide.

In March 2020, the Ugandan National Task Force on COVID-19 reported a significant shortage of Personal Protective Equipment (PPE) for its frontline and health worker staff. They requested donations from industry and organizations capable of producing locally made PPEs. The shortage of face shields for medical responders testing and treating COVID-19 patients in hospital was putting medical staff at risk and under great strain. HI through coordination with local partners, CORSU and Skymac, designed a digital template for the 3D printers and a manufacturing process. The headband was the part of face shield suited to 3D printing. The plastic filament used created a lightweight, flexible and resistant object ready for assembly in just four and a half hours. The first batch of 50 printed face shield were donated to the Ministry of Health National Task Force on COVID-19 in August 2020. Continued

production of PPE alongside orthoses is planned should significant opportunities for funding arise.

Photo showing the 3D PETRA Technician (left) and Regional Program Director (Right) during donation of PPE face-shield to the COVID-19 National Task Force in Kampala at Ministry of Heath (MoH)