TIDAL N+
Transformative Innovation in the Design of Assisted Living products and services

Mapping of the Mobility AT Ecosystem in Malawi: The Case of Malawi Against Physical Disabilities (MAP)

Evaluating local innovations and services for Mobility APs

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Cover photo: Taken at the workshop managed by the Malawi Against Physical Disabilities (MAP) in Blantyre, Malawi.

Foreword

This report is written by George Kayanga, PhD candidate, Loughborough University, with additional material by Daniel Hajas, Innovation Manager, GDI Hub, UCL.

It presents the findings of a mapping exercise carried out by George Kayanga, aimed at understanding Malawi's assistive technology (AT) environment. It focused on mobility assistive products (APs) and took the form of a case study of Malawi Against Physical Disabilities (MAP) owing to its significance to the local AT scene, particularly regarding the development and provision of mobility aids.

George Kayanga makes several recommendations to address the issues raised. These emphasise the potential for collaborative efforts to enhance Malawi's AT sector, and proposes strategic approaches that involve capacity building, policy reform, and stakeholder engagement to expand access to efficient and effective AT services throughout the country, identifying roles for the Malawi government, the UK government, and other partners.

In response to the findings and recommendations, Daniel Hajas, an innovation expert asks, 'What is the role of the UK engineering and AT research community in helping to solve the challenges of global AT provision, as exemplified by the Malawi case study?' He provides additional material identifying lessons of value to the UK and opportunities arising from the case study to inform future funding strategies, and research and innovation collaborations between Low and Middle-Income Countries (LMICs) and the UK.

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TIDAL N+ Investigator Team
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Glossary

AP: Assistive Product

APL: Assistive Products List

AT: Assistive Technology

CSR: Centre for Social Research

CSR: Corporate Social Responsibility

FCDO: Foreign, Commonwealth & Development Office

GATE: Global Cooperation on Assistive Technology

GDI Hub: Global Disability Innovation Hub

HICs: High-Income Countries

IDS: Strategy for International Development

LMIC: Low and Middle-Income Countries

MAP: Malawi Against Physical Disabilities

MSD: Musculoskeletal Disorders

MSI: Musculoskeletal Injuries

OPDs: Organisations of Persons with Disabilities

OTT: Occupational Therapy Technicians

RDM: Research Data Management

RT: Rehabilitation Technician

SWOT: Strengths, Weaknesses, Opportunities, Threats

TIDAL N+: Transformative Innovation in the Delivery of Assisted Living products and services Network Plus

UCD: User-Centred Design

UCL: University College London

USAID: United States Agency for International Development

WHA: World Health Assembly

WHO: World Health Organisation

1.0 Executive Summary

This research report presents the findings of a mapping exercise aimed at understanding Malawi's assistive technology (AT) environment and identifying lessons of value to the UK AT research and innovation sector that could inform future research collaboration between Low and Middle-Income Countries (LMICs) and the UK. The mapping exercise in Malawi spanned two and a half months, from November 2023 to mid-January 2024.

The study found that local non-profits and government institutions provide most of Malawi's AT sector's funding; private companies involved in AT manufacturing are conspicuously absent. Due to the sector's dispersed network and absence of a centralised coordination framework, it is not easy to monitor and promote AT provision.

Since it was impossible to focus on every type of AT within the time limits of this mapping exercise, this work focused on mobility assistive products (APs). The mapping process designated Malawi Against Physical Disabilities (MAP) as the primary case study phenomenon and highlighted its significance to the local AT scene, particularly regarding the development and provision of mobility aids.

This mapping assignment had the following main objectives:

a) To understand the role played by MAP and the challenges to its sustainability; to assess the roles, technological and innovation capacity within MAP for developing and implementing next-generation AT.
b) To identify significant service providers with a specific emphasis on mobility APs collaborating with MAP and their areas of specialisation.
c) To identify learning lessons of value to the UK that will inform future research collaboration between Low and Middle-Income Countries (LMICs) and the UK.

Key findings are as follows:

- A diffused network of service providers and unclear AT provisioning processes.
- The lack of a government ministry or central organisation essential to AT coordination.
- MAP's noteworthy contribution in offering mobility aids and medical rehabilitation treatments despite financial and technical challenges.
- A pressing requirement for a unified AT policy and heightened stakeholder cooperation to improve the AT ecosystem.

In conclusion, this report proposes several recommendations to address the issues raised. Among them, they include:

1. Reassess and revise MAP's resource strategy to maximise current resources and broaden its revenue streams, with the government of Malawi facilitating resource mobilisation mechanisms while the UK Government facilitating linkages with the UK-based institutions that can assist with capacitating MAP.
2. The UK government and other international partners should offer financial and technical support for creating, implementing, and harmonising policies to encourage domestic production of AT and deter needless importation.

3. To lessen dependency on imported goods, UK-based development partners and the private sector should be encouraged to invest in expanding local AT manufacturing capability.
4. For academics and researchers, to advance the study of regionally produced AT solutions through strategic cooperation between research institutions in Malawi and the UK.

It is worth noting that this report emphasises the potential for collaborative efforts to enhance Malawi's AT sector. It also proposes strategic approaches that involve capacity building, policy reform, and stakeholder engagement to expand access to efficient and effective AT services, including mobility APs, throughout the country.

2.0 Contextual Background

This chapter explores global and local perspectives on the AT situation, highlighting the initiatives and obstacles reshaping the field. It opens with a summary of the global background, underlining the discrepancies in access, particularly in LMICs, and AT's critical role in several development domains. The chapter then transitions to Malawi's unique situation, analysing the complex challenges related to the access levels of AT in the country.

2.1 Global context

The notion that facilitating access to AT is crucial for individuals with disabilities and others who require AT to function appropriately and to be included in various development domains – including education, daily life, employment, and healthcare – is widely recognised by various other players, including the World Health Organisations (WHO) (Desmond et al., 2018) with the potential to facilitate their active, participatory, and productive involvement in development, thereby contributing to the achievement of Sustainable Development Goals (SDGs) (Tebbutt et al., 2016). However, despite the overwhelming benefits of AT, as of 2017, only about 10 to 15 per cent of people with disabilities and others who needed AT in LMICs had access to them(Matter et al., 2017).

Furthermore, the challenge of limited access to AT globally has been compounded by limited access to rehabilitation services for people with disabilities in most LMICs (Smith et al., 2023). For instance, in South Africa, the availability of rehabilitation services, particularly in rural areas, is limited by a lack of service capability (Bright et al., 2018), resulting in their inability to receive specialised assistance. The shortage of rehabilitation in most LMICs, therefore, underlines the urgent need for increased investment in rehabilitation services and AT.

In this context, WHO launched the Global Cooperation on Assistive Technology (GATE), an international endeavour to guarantee that everyone who needs AT for participation can access it to bridge the gap between the need for and availability of AT (Khasnabis et al., 2015). Since then, the GATE Initiative has created the Assistive Products List (APL), a list of priority assistive devices that lists the fifty assistive products that every country should facilitate through universal health care (World Health Organization, 2016). Several discussions with AT users, suppliers, organisations that support people with disabilities (OPDs), and other interested parties resulted in the development of this list.

In response to the APL's introduction, the World Health Assembly (WHA) subsequently adopted Resolution 71.8 (WHA71.8) on Improving Access to Assistive Technology, whose ratification in 2018 is reported to have signalled the convergence, reaffirmation, and bolstering of endeavours to bridge

AT disparities and enhance accessibility to AT (Tangcharoensathien et al., 2018). Beyond the GATE initiative and the adoption of Resolution WHA71.8, we have also witnessed a proliferation of various global initiatives that support and complement the work of WHO in the AT sector; key among them include the Global Disability Innovation Hub (GDI Hub), TIDAL N+ Transformative Innovation in the Delivery of Assisted Living products and services, the Global Partnership for Assistive Technology (ATscale), the AT2030 programme, and the newly launched Unlock the Everyday. The central theme for all these initiatives is increasing access to appropriate AT through various strategic approaches such as research, advocacy, AT innovation hubs, financing at both international and national levels and seed funding local AT solutions such as start-ups.

Since the advent of the introduction of GATE, there has been significant positive strides in galvanising various strategic stakeholders towards, for instance, applying market shaping approaches that are geared to increase access to AT in LMICs as evidenced by the work of the ATscale (End Fineberg et al., 2019; Savage et al., 2021, 2019). However, despite these ongoing concerted efforts, many people still face numerous barriers when accessing AT. There seems a lack of evidence regarding the impact of these interventions so far on individuals with disabilities and others who require AT in LMICs. Therefore, it can be deduced that the efforts to improve AT's situation since the launch of GATE are still a work in progress.

2.2 Malawi country profile

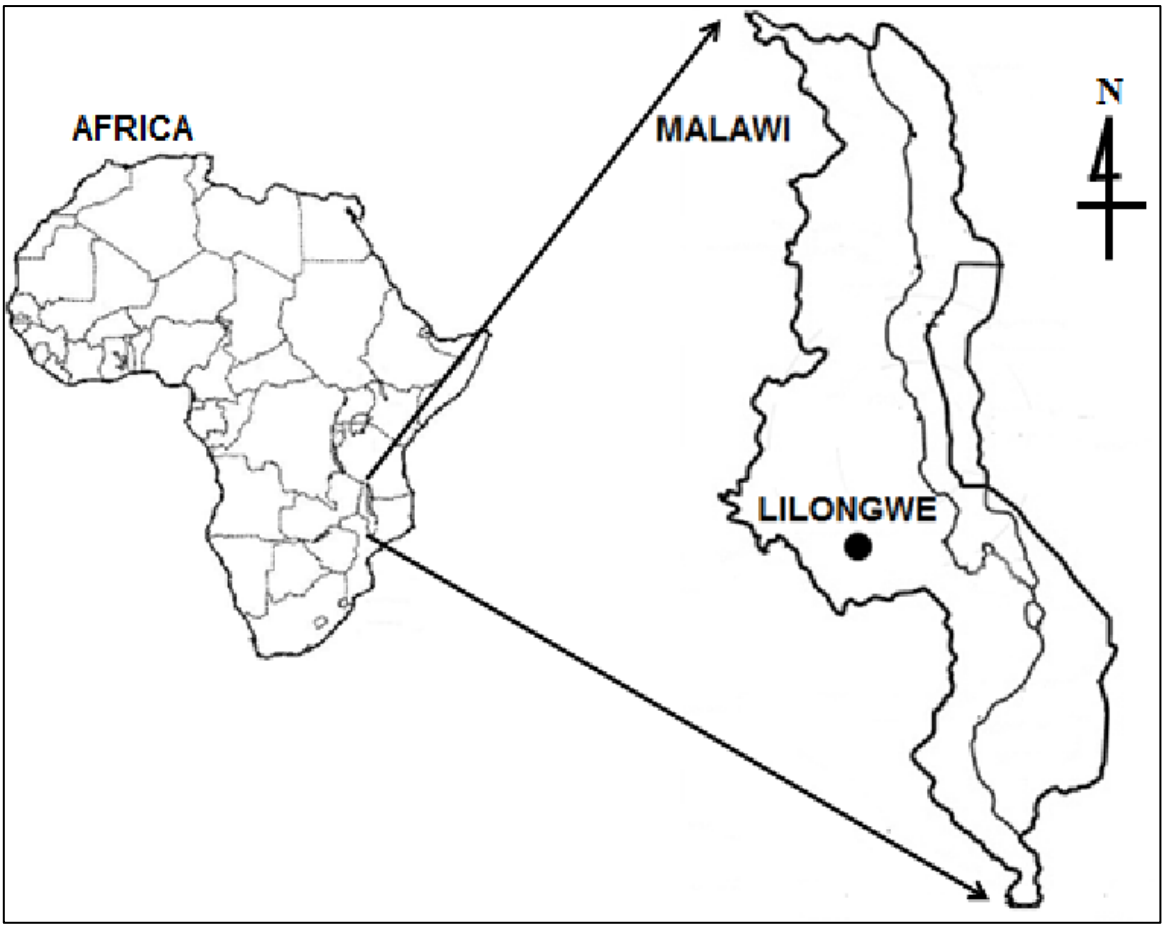

Figure 1: A map of Africa with two black arrows pointing to the map of Malawi. Source: Chikumbusko et al. 2015

Malawi, located in southern Africa, is regarded as one of the least developed nations globally due to its limited infrastructure and high population density. The country is landlocked, and it is predominantly rural, with most of its population in such areas. The country's economy relies heavily on agriculture, constituting 80% of the total population of approximately 17.5 million (*FAO in Malawi: A country office profile*, 2022).

Economic development issues and healthcare provision for citizens, including those with disabilities, are some of the challenges facing the country. Malawi has limited infrastructure and a high fertility rate at 4.2 children per woman, a literacy rate for people aged 5 years and over pegged at 68.6%, a high maternal mortality ratio of 439 deaths per 100,000 live birth, an infant mortality rate of 30.9 deaths per 1000 live births, and a low life expectancy which has been compounded by 9.6% of Malawian adults living with HIV and AIDS, which is one of the highest HIV prevalence rates on the continent and beyond (Chiumia et al., 2022).

There is currently a lack of accessible data on disabilities in Malawi. However, it is known that Malawi, like many other developing nations, faces challenges in addressing the needs of people with disabilities, including access to life-changing AT, particularly mobility APs (Alswang et al., 2022). Besides limited access to these APs, people with disabilities in Malawi face challenges accessing healthcare, rehabilitation, education, and employment opportunities. While there is a consensus among various stakeholders that a dedicated policy would go a long way in addressing the gap in access to AT, a lack of a stand-alone AT policy continues to be a major concern (Ebuenyi et al., 2020).

However, as illustrated by some previous studies, the country's AT stakeholder network is highly distributed rather than centralised (Smith et al., 2022), making coordination difficult, especially when developing and distributing contextually based APL. In this context, WHO encourages State Parties to consider community needs and other local contexts when developing APLs and rehabilitation policies that promote the provision of APs and services. (Smith et al., 2023) Hence, there is a need for more coordination and networking amongst stakeholders such as service providers, suppliers, and end users.

In addition, there have been concerns about the limiting research evidence when developing the APL amidst increasing demand for APs that are not readily available in the country (Munthali et al., 2023). Moreover, a thorough grasp of the current ecosystem, its major players, and areas of growth potential is lacking. Therefore, the mapping exercise in Malawi sought to bridge this knowledge gap by focusing on emerging local AT innovations and services in Malawi.

3.0 Methodology

Data Collection Method: A qualitative approach was used for this mapping exercise, which involved conducting one-on-one interviews as the primary data collection method. This methodology effectively gained an in-depth understanding of specific aspects of AT and AP provision, especially the roles and perspectives of key stakeholders such as officials from the line ministries in government, such as Disability Affairs and Health at the policy level and personnel from MAP, with additional interviews with various stakeholders at community level such as NGOs, rehabilitation officers, social workers, community leaders, and persons with disabilities themselves. Qualitative

research methods are precious when exploring complex and context-specific issues where quantitative data may not provide sufficient insights.

Interview Setting: Interviews were conducted in a comfortable setting for the participants, vis-à-vis their offices, to encourage openness and honesty.

Recording and Duration: Most interviews lasted between 45 minutes and one hour and were recorded with participants' consent to ensure accurate data capture.

Nature of Data: This qualitative approach emphasises collecting non-numerical data, such as opinions, experiences, and insights, to provide depth and context to the research subject.

Sample Size: 6 interviews were conducted at the policy level, targeting officials from the Government ministries of Disability Affairs, health, and MAP. In addition, 28 additional interviews were made around AT and disability overall, which also fed content and context into this study, bringing the total to 34.

Purposive Sampling: The selection process for participation in the mapping was based on purposive sampling. Participants were chosen based on specific criteria relevant to the mapping objectives. For instance, individuals who are policyholders in government offices are in a good position to answer research questions related to policy issues and coordination. On the other hand, individuals from MAP were selected based on the nationwide community structures that the organisation established to deliver its mobility assistance programmes. Community stakeholders, such as NGOs, rehabilitation officers, social workers, community leaders, and persons with disabilities, were well placed to share their experiences and perspectives regarding their roles as important agents within the MAP community structures.

4.0 Limitations

Sample Size: A tight schedule of two and a half months was allocated for this mapping exercise. However, part of this time was spent booking and arranging interviews with suitable informants. Consequently, only a limited number of interviews were conducted, which may not have represented the full range of perspectives in the field thus potentially compromising the validity of the conclusions drawn from the investigation (Oppong, 2013).

Subjectivity: Qualitative research methods, including purposive sampling, often yield subjective findings that may lack generalisability to the larger population. However, they are commonly accepted assumptions (Handa, 2023), hence researchers must interpret their results cautiously ensuring that the interpretations are “grounded in interviewees or respondents' contributions...(Anderson, 2010, p.5)”

5.0 Ethical Considerations

Informed Consent: The objectives of the mapping exercise and the entitlements of all participants were communicated clearly, and they were informed of their right to withdraw their participation at any time. Detailed information about the purpose, procedures, and potential risks was also provided

to the informants, allowing them to make informed decisions about their involvement. This ensured the integrity of the mapping exercise.

Confidentiality: Reasonable measures were taken to protect the confidentiality of participants' information and responses. However, while all informants' names were kept confidential, participants allowed their organizations to be identified.

6.0 Why MAP?

As mentioned in the limitations section, due to the short duration of the mapping exercise, it was not feasible to cover multiple types of APs within the given time constraints. For this reason, only one type of APs – mobility APs – was chosen as a unit of analysis to facilitate a more in-depth analysis of the subject matter and gain insights into various issues affecting local innovations and the provision of mobility APs in the country.

The Malawi Against Physical Disabilities (MAP) is the leading player in the mobility aid industry in the country, with the log history of producing various types of mobility APs which it continues up to date. The list of these mobility APs is outlined under the institutional overview below.

Therefore, MAP was selected as the focal point for this mapping, collaborating with its strategic partners, including government line ministries and NGOs.

6.1 Institutional overview

Formerly known as Malawi Against Polio (MAP), the organisation's primary goal was to combat the disease after a polio outbreak left many physically disabled. However, Malawi Against Physical Disabilities (MAP), the oldest charity organisation traditionally funded by the Malawian government, later focused on providing medical rehabilitation services to Malawians with physical disabilities.

MAP aids those who have been rendered physically disabled due to a variety of conditions, including clubfoot, TB of the spine, meningitis, cerebral palsy in children, amputations, strokes, accidents involving cars and workplaces, domestic and gender-based violence, and many more conditions that are currently under MAP care. Besides physiotherapy and occupational therapy, MAP develops and distributes a wide range of mobility aids, including wheelchairs, tricycles, callipers, gloves, crutches, clubfoot sandals, and adaptive chairs for children.

In this context, the scope of this mapping exercise encompasses a diverse range of mobility devices and solutions outlined above but is not limited to the full list that MAP provides. Rather, the scope may also include motorised wheelchairs, mobility scooters, prosthetics, orthotics, vehicle modifications, ramps, adaptive sports equipment, pressure relief tools, and exoskeletons, should evidence of such devices exists withing the ecosystem. However, while evaluating stakeholder collaboration, the scope does not extend to non-mobility-related AT or healthcare equipment outside the specified scope, ensuring a more focused evaluation of the mobility assistance landscape in Malawi.

7.0 Key Findings

The following are the critical case study findings for mobility APs that are mainly focused on the government-sponsored institutions and nonprofit organisations that were the primary sources of local AT innovations and services:

7.1 Stakeholder mapping

Part of the key objectives of this assignment was to map critical stakeholders with the country's AT sector. It was found that MAP collaborates with diverse stakeholders to provide medical rehabilitation services and mobility APs to Malawians with physical disabilities. During the mapping exercise, a list of stakeholders, along with their roles, were identified, as shown in the below table.

Table 1: Categories of stakeholders and description of their roles or contributions.

Category	**Stakeholders**	**Role/Contribution**
Governmental bodies	Department of Disability Affairs	Policy making, regulatory guidance, funding
Governmental bodies	Ministry of Health	Health services, policy implementation
Governmental bodies	Malawi Ministry of Education	Education, awareness, policy support
Governmental bodies	Malawi Human Rights Commission	Advocacy, rights protection
International organisations	World Vision International	Funding, program support, expertise
International organisations	Motivation Africa	Technical assistance, expertise
International organisations	Islamic Relief	Funding, humanitarian support
International organisations	International Development Partners (USAID, etc)	Funding, project management, expertise
International organisations	Church of Jesus Christ of Latter-day Saints	Community services, funding
Local non-profits	Local NGOs	Grassroots support, local expertise
Local non-profits	Local OPDs	Grassroots support, local expertise
Educational institutions	Tertiary academic institutions and colleges	Training, research, awareness
Educational institutions	Centre for Social Research (CSR), University of Malawi	Research and development, innovation

Category	Stakeholders	Role/Contribution
Private sector	Private Sector Companies	Funding and purchase of mobility APs for their workers and Corporate Social Responsibility (CSR) activities.
Private sector	Local Business Communities	Purchase of mobility APs for their CSR activities
Private sector	Pharmacies	Distributors of mobility MAP APs are mainly in the urban centres.
Media and community	Media Outlets	Awareness raising and advocacy
Media and community	Local Community Leaders	Community engagement, grassroots support
Healthcare and professional	Community health clinics	Direct healthcare services, local outreach
Healthcare and professional	Professional Medical Associations	Training, certification, policy advocacy
Sports and Recreation	Sports and Recreation Organisations	Inclusive activities, rehabilitation through sports

7.2 Primary sources of local innovations and services

78% of the respondents indicated that the local nonprofit organisations were the primary sources of local innovations and services for mobility AT, while the other 22% were unsure.

In addition, 92% of the respondents felt the private sector companies served only as commercial suppliers or distributors rather than AT innovators or manufacturers, while 8% did not have an opinion.

7.3 Mechanisms for providing AT.

Most respondents (96%) did not think there were precise mechanisms for providing AT in Malawi. The key themes of discussion regarding the mechanisms for providing AT were the existence of any policy frameworks governing the supply chain systems of AT, financing mechanisms for AT, including the APL list, integration mechanisms of AT into healthcare systems, and the AT regulatory environment, such as the mechanisms for developing and enforcing the AT regulatory environment.

7.4 Stakeholder network

22% of the total respondents indicated they believed some form of a multi-stakeholder network around issues about AT existed in the country, of whom 85% observed that the existing network was

not exclusively for AT; rather, it existed to serve the broader disability agenda of which mobility APs were part. Meanwhile, 15 % did not have an opinion regarding the nature of the network.

Additionally, 83% felt the multistakeholder network was highly distributed rather than a centralised network.

7.4 MAP's leading role

All respondents (100%) viewed MAP as the leading player that galvanised a network of different stakeholders within the AT sub-sector for mobility APs.

Furthermore, 88% recognised MAP as the only organisation that was actively and consistently involved in the designing and manufacturing processes of various mobility APs in the country. In comparison, the remaining 12% did not have an opinion. However, it is also important to point out that one respondent indicated the existence of a new workshop for mobility aids at the biggest referral hospital in the country. However, it was still being trialled and yet to be fully operationalised at the time of this mapping exercise.

It must also be pointed out that most respondents mentioned that there were instances in the rural communities in which individuals would be involved in making or improvising specific mobility APs such as crutches or walking sticks. However, there was no proper documentation of these *ad hoc* efforts, and this mapping found no evidence of the same in the few locations where the mapping was conducted.

8.0 Discussion

After presenting the key findings, this chapter provides a detailed interpretation of each. These are discussed as follows:

8.1 Stakeholder mapping

On the one hand, MAP manufactures its mobility APs and distributes them to communities for free. To do this, MAP partners with various organisations listed in Table 1 in districts where they are more present than MAP, to assist with the distribution of its mobility APs. As the table highlights, these partners belong to various sectors, including government, international organisations, local non-profits, educational institutions, the private sector, media and community, healthcare and professional, and sports and recreation. On the other hand, some of these partners import their APs and use MAP's structure to distribute them to communities where these partners are less present than MAP. This win-win partnership approach is beneficial for both MAP and its partners.

Nevertheless, as highlighted in the findings chapter above, there is consensus among the respondents that were involved in this mapping that MAP still has the most extensive outreach structure in the country regarding the distribution of mobility aids despite the phasing out of the nationwide community outreach programme. For instance, MAP has a rehabilitation centre in Rumph District that serves as a delivery conduit for its mobility APs and other services to all the other districts in the country's Northern region. It also has a similar centre in the Lilongwe District that makes delivery easier to the other districts in the Central Region. At the same time, its headquarters at the Kachere Rehabilitation Centre in Blantyre District helps it serve every district in

the Southern Region. The Kachere Rehabilitation Centre operates a workshop in Kanjedza Township within the same district dedicated to designing, producing, and assembling various mobility APs.

MAP also has a training school called Kachere Medical Rehabilitation College, which trains hub and OT technicians. Two academic courses, the Diploma in Medical Rehabilitation Technicians (RT) and the Diploma in Occupational Therapy Technicians (OTT), are offered at its campus within the Kachere Rehabilitation Centre in Blantyre. According to the latest information on its official website, both courses run for three years (MAP, 2023) but do not state the course intake number.

8.2 Primary sources of local innovations and services

During the mapping exercise, it was discovered that no private commercial entities were solely engaged in manufacturing or innovating mobility APs. No companies focused exclusively on creating new AT devices or improving existing ones.

In contrast, most private commercial entities served only as suppliers of specific mobility aids but were confined to urban areas. These entities were predominantly pharmacies. They offered limited mobility APs such as wheelchairs, crutches, walking frames, and clubfoot braces. They did not engage in any significant innovation or manufacturing of these mobility aids but functioned as distributors of those pre-existing products.

8.3 Mechanisms for providing AT

The interviews conducted with stakeholders during the mapping exercise confirmed what other researchers have found; for instance, there are no clear-cut mechanisms for providing AT in Malawi (Ngomwa, 2019). As highlighted in the findings chapter above, the discussion regarding the mechanisms for providing AT was focused on the following key themes: policy frameworks governing the supply chain systems of AT, financing mechanisms for AT, including the APL list, the integration mechanisms if AT into healthcare systems; and the AT regulatory environment, such the mechanisms for developing and enforcing the AT regulatory environment.

Clear policies outlining the provision, distribution, and maintenance of AT can have a significant impact on the quality of the AT that is accessed by end-users. Putting in place some form of regulatory framework can improve the quality and safety of mobility APs. Efforts to include or integrate mobility APs that have been certified through the regulatory framework referred to earlier within national health and disability policies can be a game changer in ensuring the quality, reliability and durability of the various APs.

It was clear that the absence of comprehensible mechanisms for providing AT hinders the access levels and availability of these APs to people with disabilities and others who need them for several reasons. The lack of access to AT can have a significant impact on the quality of life and independence of people with disabilities, which highlights the need for urgent measures to address this issue.

8.4Stakeholder network

The mapping validated earlier research findings that found a highly distributed, rather than a centralised network, with “no single organisation or government ministry playing a central role (Smith et al., 2022. P4).” The absence of explicit systems for providing AT in Malawi, along with a more distributed than centralised network, makes it challenging to monitor correctly and document

who is doing what in the AT sector and how the Government and other relevant duty-bearers could support manufacturing of various AT types.

It is in this context that both Ngomwa 2019 and Smith et al. 2022 agree on the urgent need for all inter-sectoral stakeholders – inclusive of local organisations, service providers, and government ministries, among others – to collaborate on putting in place an effective AT policy as a starting point for ensuring a cohesive AT system that benefits from a collective leadership. Similarly, in this mapping exercise, the lack of an enabling policy framework was the most common theme among most of the informants, which highlights the importance of a policy framework.

For instance, the absence of clear policy frameworks poses a challenge when confronting issues related to AT quality control, AT tax incentives, and regulation of imports, among other things. Furthermore, evidence shows that policy frameworks tend to sit at the centre of any strong systems-thinking perspective of AT ecosystems as they enable more equitable, resilient, and sustainable APs at all levels of ecosystems (MacLachlan and Scherer, 2018).

8.5 MAP's leading role

During the interviews with MAP personnel, they stated that the organisation was the sole organisation actively involved in the design and manufacture processes of various forms of mobility APs related to physical limitations. Furthermore, they claimed to possess a unique and efficient community-level structure that enables the effective distribution of its proprietary AT and some imported or donated AT, compared with other stakeholders.

MAP's structure is designed to effectively deliver ATs to people in need at the grassroots level. While other stakeholders, primarily local NGOs in partnership with development organisations, have developed similar delivery models, MAP's structure is said to stand out for its efficiency and reliability. The high-level delivery structure of AT, along with the position of MAP, is illustrated in Figure 1.

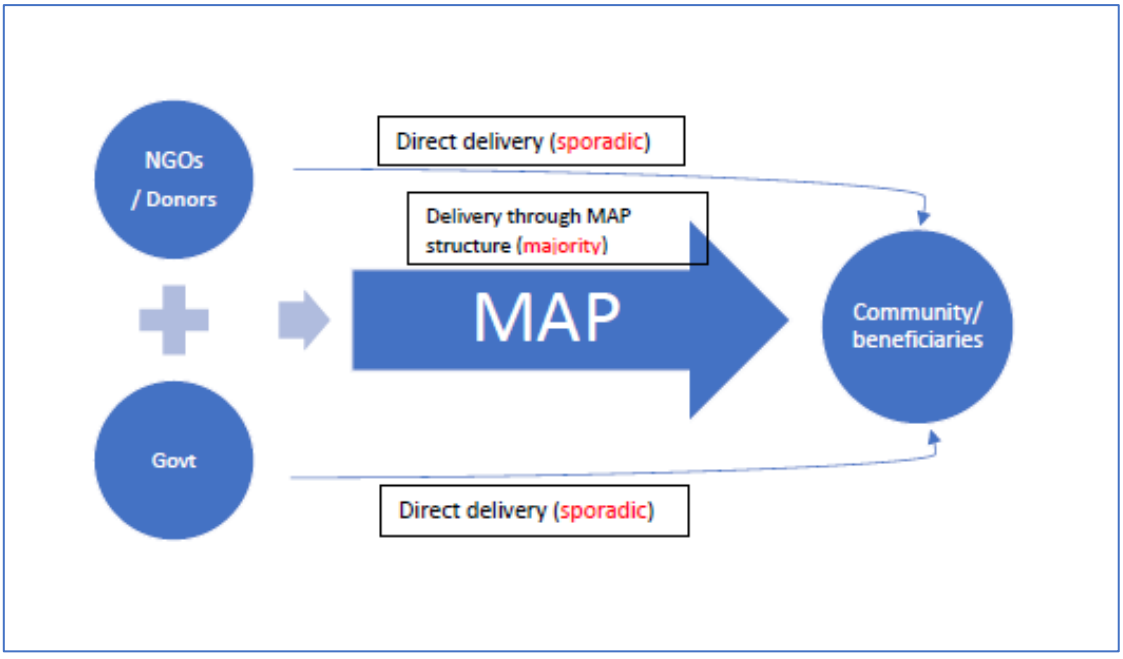

Figure 2: A high-level delivery structure of AT and where MAP is positioned.

The government representatives (through the Department of Disabilities under the Ministry of Gender and Community Affairs) further corroborated this in separate interviews, acknowledging that the ministry solely relied on the MAP structure and lacked proper structures to deliver AT innovations to communities or end users.

In the past, MAP used to have a national outreach programme that the government fully funded. It used to be credited as the hallmark of MAP as it represented the primary mode of delivery for its services since its organisation's birth in 1979. It entailed holding clinics in the rural community, offering physiotherapy services, and providing the rural populace with different APs within mission hospitals suitable for diverse types of disability. However, due to funding challenges, the national outreach programme that supported MAP was eventually phased out in 2013, and the same year, core funding was also phased out. As a result, MAP is now reaching fewer local communities with a wide range of APs than it previously did.

It is important to note that while MAP has a community-level structure for efficient delivery of its own produced antitoxins (AT) and some donated antivenom products (APs), the organisation's impact areas have shrunk over the years since the national outreach programme was phased out. MAP can no longer reach all the locations it used to work in when the outreach was flourishing. Consequently, MAP must rely on some of its partners operating in remote, hard-to-reach rural communities where MAP is absent.

8.6 Process workflow

During the interviews, the MAP personnel outlined the design and processes workflow they follow for making their mobility products, which they have adopted from the United States Agency for International Development (USAID) and the WHO. The workflow steps in the figure below have been specifically designed for wheelchairs. However, it is worth noting that these steps generally apply to all the mobility APs currently manufactured or assembled by MAP. So, whether it is a wheelchair or any other mobility device, the same workflow steps are followed to ensure consistency and quality in the manufacturing process.

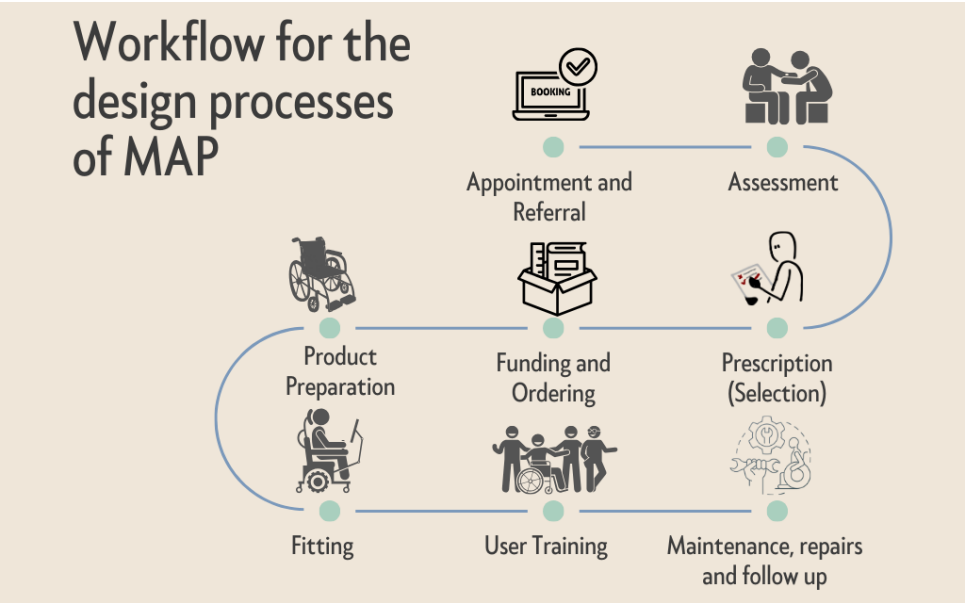

Figure 3: A diagram describing a MAP design workflow step for MAP.

1. The first step involves a referral or appointment with the client, during which we try to understand their requirements. Clients approach MAP independently or are referred by a local NGO, DPO, or international organisation working locally.
2. This first step would lead to the next step, which would involve spending time with the client to assess the specific needs thoroughly.
3. Next, a solution is identified, and the wheelchair design that fits the analysed requirements (or the most suitable design for other mobility aids) is selected for the prescription.
4. The next step involves securing funding, mainly the raw materials used to manufacture the AP.
5. Depending on the availability of resources, the next step is where the actual manufacturing and assembling processes are implemented at the MAP workshop.
6. After the AP has been manufactured or assembled, the next step involves fitting the AP on the client and making fitting adjustments accordingly.
7. After the fitting, the next step involves user training, whereby the client is trained on the basics of using the AP appropriately.
8. The final step involves guiding the client in repairing the AP and making follow-ups where possible.

8.7 Technical challenges

For at least ten years, MAP has used most of its equipment from the Kanjedza workshop without any upgrades. This has been identified as a significant challenge for the organisation. The use of obsolete machinery has resulted in MAP's inability to keep up with the ever-changing industrial landscape, limiting its productivity and efficiency.

To remain competitive and meet client demands, MAP needs to upgrade its equipment. One example of workshop equipment that needs upgrading is the manual pipe bender machine that MAP uses to bend steel pipes while making several types of mobility APs. According to the MAP officials, their manual pipe bender, which they have had in their workshop for many years, is considered outdated compared to the modern electric pipe benders they wish to acquire.

For instance, they claim that the manual pipe bender is rigid and increasingly cumbersome to work with and requires a lot of energy to operate, resulting in slower fabrication processes. In contrast, electric pipe benders are powered by electricity, driven by a motor, and have speed changers, making them much more flexible to operate.

Ironically, in the UK, some models of the electric pipe bender, which is shown in Figure 4 below, are not as expensive as they were portrayed during the interview, with some models costing as little as £250 on eBay UK marketplace (The Lamp Post Electrical Supplies Ltd, 2024).

Below is an interview excerpt from one of the informants interviewed at the MAP premises:

> *"In addition to enjoying the government's main funding, we used to receive substantial financial support from other sources, mainly international donors. These donations enabled us to purchase the necessary equipment whenever we needed it. However, due to donor fatigue and the government's decision to withdraw its primary funding, we have been unable to upgrade our equipment for over a decade."*

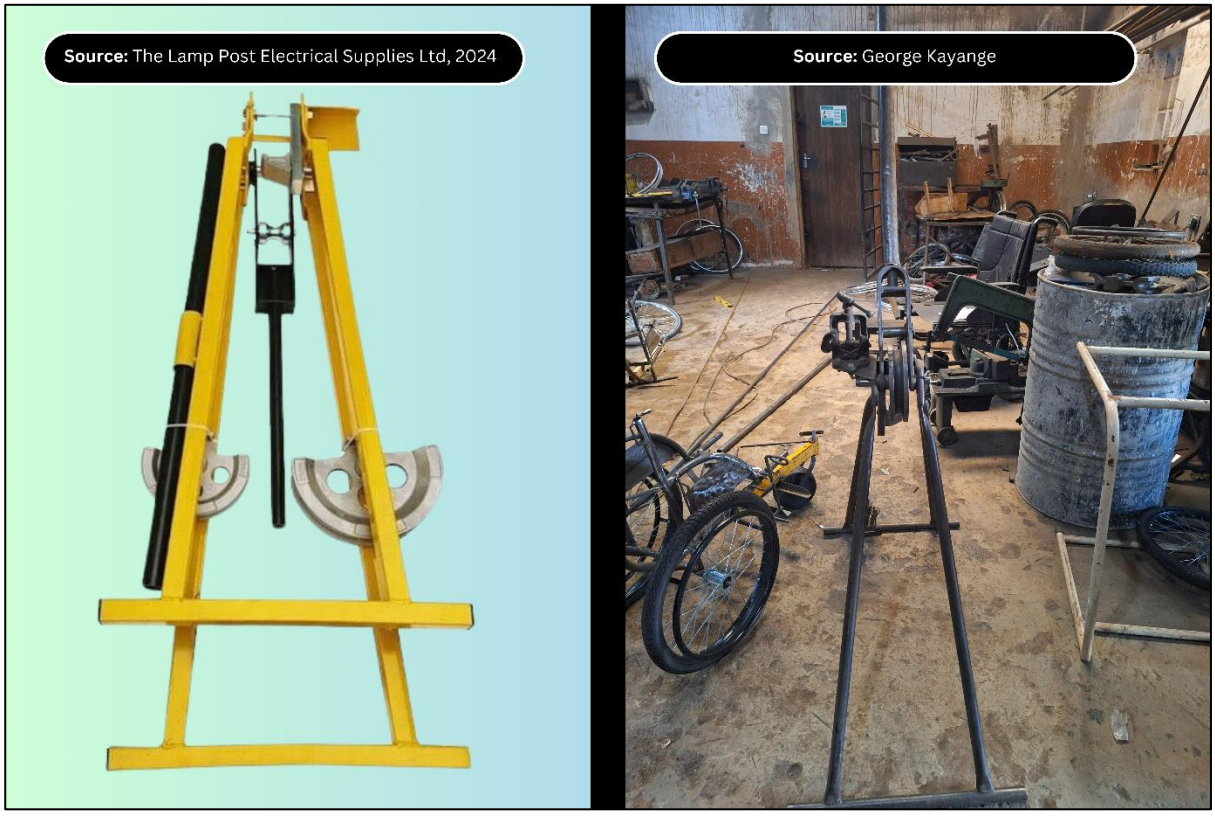

Figure 4: This figure consists of two pictures; a modern pipe bender on the left available for sale on eBay, and an outdated one available at MAP workshop.

Consequently, MAP has been struggling to meet the growing demand for its mobility APs due to outdated technology. As the leading manufacturer of many APs found in Malawi, MAP's inability to keep up with demand has presented significant challenges for the organisation.

Another manufacturing tool that was cited as outdated is the lathe machine, which is used to shape wooden or metallic products that are used to form part of various mobility assistive products (APs). Just like the case with the manual bending machines, the outdated lathe machines have outlived their usefulness with declining efficiency when fabricating some wooden and metallic APs.

8.8. Funding challenges

When the government funded MAP 100% in the past, the organisation gave out all its APs to communities at no cost. However, as soon as the government drastically reduced funding, covering operating expenses like payroll, MAP was forced to sell some of its APs and donate only those that the donors and other ad hoc funding sources supported. Nonetheless, considering that the primary motive for sales is cost recovery rather than making profits, MAP’s APs remain the most reasonably priced on the Malawi market.

One of the consequences arising from the significant decrease in Government funding to MAP is that clients can no longer receive the kind of support they used to access from MAP directly in their own communities since the Government stopped funding the outreach programme in 2013. Instead, communities needing MAP’s support must now visit any of the country's three rehabilitation centres in the North, South, and Central regions. This poses a problem for people living in ultra-poor

conditions, particularly those with disabilities and others requiring AT, who hardly travel to the centres and receive the support they need.

MAP utilises three additional methods to raise funding. However, the current funding sources have proven insufficient to meet the demand. Firstly, the Kachere Rehabilitation Centre has private wards that allow the organisation to collect fees from inpatients. Additionally, the centre has an outpatient department that also collects fees.

Secondly, the staff at MAP have observed that the organisations that refer clients to the Kanjedza workshop for assessment or prescription contribute financially. However, they believe that the workshop has the potential to generate more funding if it can attract more significant financial investment to upgrade it into a fully equipped AT factory, complete with modern facilities and expertise.

Thirdly, the Kachere Medical Rehabilitation School offers two diploma courses in RT and OTT, which present a potential opportunity for MAP to diversify its income sources. However, MAP personnel have noticed that student enrolment for these two courses is significantly lower than the demand and the institutional responsibilities. They cite introducing an additional (third) course on AT and expanding intake by leveraging eLearning facilities as two feasible solutions for diversifying income sources.

8.9 Policy-related challenges

The main policy-related challenge that was identified, which MAP personnel attribute to a lack of a robust policy framework, relates to the local organisations and international organisations that continue to distribute APs to communities imported from abroad for charitable purposes. MAP personnel argue that importing these APs, which can be manufactured and assembled within the MAP workshops, is counterproductive to local capacity efforts. They further argue that instead, international organisations and stakeholders should consider diverting the funds to import such APs into the country to fund any MAP workshops that can make such APs cheaply, using locally available materials.

Figure 5: Imported wooden crutches at the MAP workshop in Kanjedza Township

Wooden crutches, imported from Europe and donated to MAP by one of the international development partners to be distributed locally, were seen at the MAP workshop in Kanjedza Township, as shown in Figure 3. However, the informants at MAP perceive this act of kindness as paradoxical, given that the only component of the crutches that may not be available locally as a raw

material is the plastic support at the very bottom of the crutches. During an interview, at their premises, one of the MAP officials said:

> *"Although we do not always agree with the quality of some of the imported APs we receive from certain international donors, we still accept them to maintain good relationships. They rely on us to help them distribute their products and services in areas with little presence. Likewise, we need their support to reach remote locations where they are more established than we are. To strike a compromise, we feel stuck between a rock and a hard place."*

Figure 6: Figure 4: An imported wheelchair donated to MAP.

MAP received a wheelchair donation, shown in Figure 4, from the Church of Jesus Christ of Latter-Day Saints to be distributed to local communities to help people with disabilities needing such support. However, MAP personnel recommend using them in hospitals instead to support patients' mobility as these wheelchairs do not conform to the local terrains of most communities where they would have been distributed. This is because, in MAP's assessment, they were not designed to suit the intended purpose for which they were donated.

MAP personnel claimed they have repeatedly expressed similar concerns in various forums and platforms. However, there has been no change in the situation, as these APs continue to be imported in large numbers into the country. They stated that the main challenge centres around the absence of a structured policy framework that discourages the importation of these APs while concurrently promoting local production and even making the support of the local output or innovations mandatory. Here is how a MAP official expressed his frustrations during an interview:

"We have had several opportunities to interact with government personnel, including the Minister of Disability Affairs. We have engaged with them during seminars, national budget consultations, and one-on-one lobby meetings, where we have been raising concerns about the lack of policies that support local production instead of importing mobility APs. Sadly, all our efforts have been futile so far, as no policy changes have been made to address our concerns as we speak."

They further suggested that only when local production of the APs is not feasible would the policy or a piece of legislation make it an exception; but even in this context, evidence of infeasibility would have to be provided on a case-by-case basis.

9.0 Key Recommendations

Founded on the principles of mutual respect, Malawi and the UK have enjoyed a deep historical relationship. While the Malawi Government, being the primary duty bearer and custodian of policy, has a social responsibility to address the challenges outlined in this report based on the country's own Constitution, it should also be pointed out that the UK Government is obligated by its foreign policy to collaborate with, and support, the Malawi Government in fulfilling its mandate. In this regard, the UK Government is guided by its Strategy for International Development (IDS), which positions development as the focal point of British foreign policy.

One of the three main objectives of the IDS includes the UK's commitment to supporting the Malawi Government in driving the provision of quality public services to address the underlying causes of poverty and develop Malawi's human capital. Health (Njoroge et al., 2021) and education (Al-Samarrai et al., 2002) are among the main domains or development outcomes in which the UK Government supports its counterpart in providing services at the national and local levels, devoting special attention to women and girls, and leveraging Malawi's demographic shift.

In this context, the Malawi and UK governments, including other cooperating partners and other stakeholders, should consider the following recommendations:

9.1 Capacity-building Strategy for MAP

To address the challenges related to local production of AT and mobility APs, MAP should review its institutional strategic plan to identify and validate capacity gaps and devise viable strategies for diversifying income that would enable it to sustain its operations and fulfil its vision. Based on interactions with MAP personnel and government informants, it has been observed that despite the government's withdrawal of most of its funding to MAP, the organisation still retains a significant community structure and valuable physical assets. These include workshops in all three regions of the country, the Kachere Rehabilitation Centre at its headquarters in Blantyre, and a school that offers two diploma courses.

However, despite these apparent opportunities, the organisation has been unable to leverage them effectively to move forward and remain independent of Government support. This indicates a lack of a clear and comprehensive organisational strategy for leveraging these assets to raise resources from various funding sources. These resources would enable MAP to successfully pursue its vision,

which includes upgrading the Kanjedza workshop to a fully-fledged AT factory or hub instead of anticipating the government and other stakeholders establishing such a hub in Malawi from scratch.

The vision also includes introducing more academic courses at its school to increase enrolment, expand its impact within communities, and generate more income. Finally, the diversification of funding would help MAP fulfil its vision of reviving the abandoned community outreach programme that was once perceived as its hallmark blueprint.

9.1.1 Recommend roles of the Malawi Government

Considering that the Malawi government maintains its stance on withdrawing funding support to MAP toward its community outreach programme, the government should, therefore, have put in place a proper exit strategy that would have empowered MAP to stand on its own feet. Part of that strategy should have included a resource mobilisation framework.

However, even though the withdrawal of the funding occurred over ten years, the government should still assume the role of supporting MAP in designing and implementing a framework for reviving and enhancing local manufacturing of the mobility APs, as explicitly recommended by officials at the Ministry of Gender and Community Affairs.

Figure 5 below suggests a typical five-step resource mobilisation framework that could support MAP in identifying and implementing strategies for diversifying income to enhance its local manufacturing capacity.

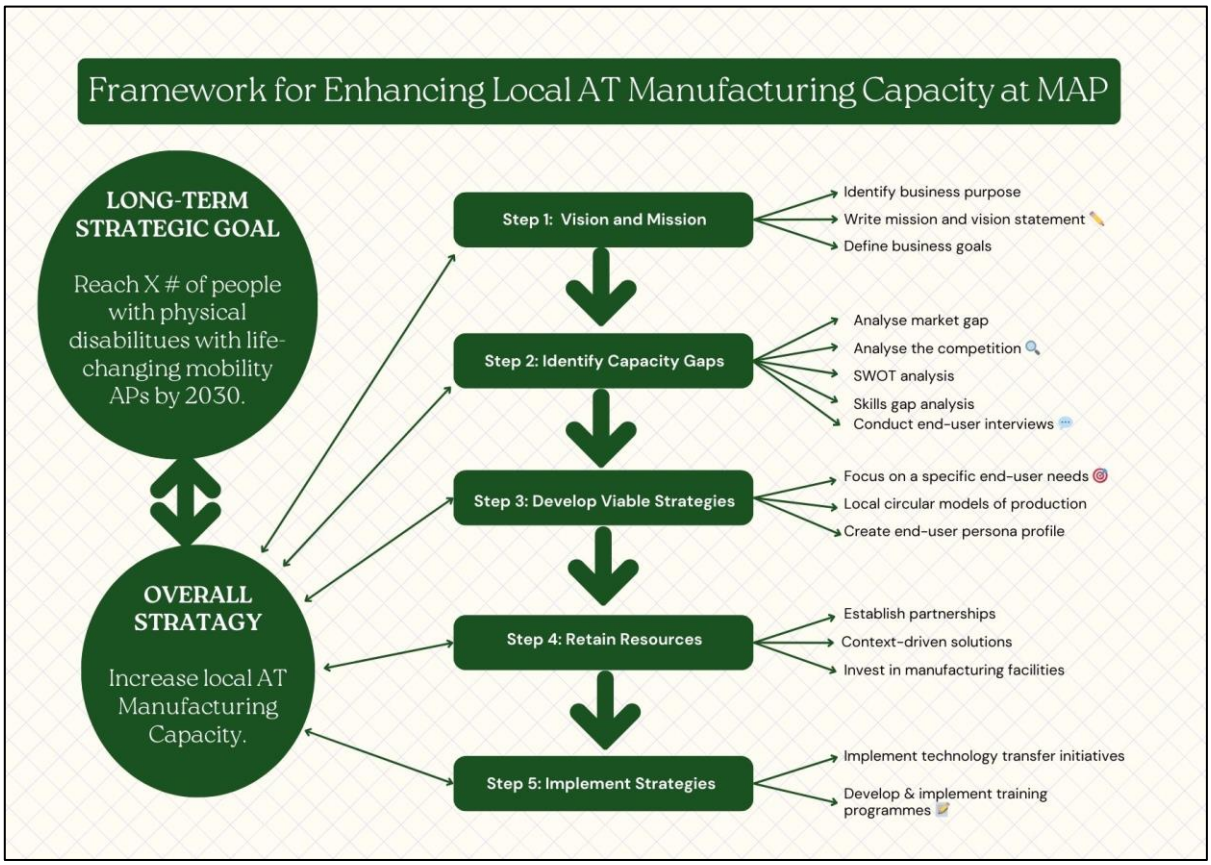

Figure 7: A diagram of the proposed MAP framework for enhancing local AT manufacturing, outlining five steps it can adopt.

By following the steps outlined in the framework depicted in Figure 5 above, MAP can potentially optimise its operations by conducting a strategic review. This review can identify any capacity gaps in its local AT manufacturing processes. By doing so, MAP can implement sustainable strategies to enhance its AT manufacturing capacity. This approach will ensure that MAP is well-equipped to meet the growing demand for mobility APs, thereby improving the quality of life of the individuals who rely on these devices.

The suggested five steps are further clarified as follows:

Step 1: Clarify Vision and Mission:

Review the organisation's vision and mission statement to ensure that they support MAP's objectives of helping people with physical disabilities access mobility APs across the country. This step would involve identifying the business purpose and defining the business goals.

Step 2: Identify Capacity Gaps:

Identify capacity gaps in designing, producing, and maintaining AT solutions in the institutional strategic plan review. To evaluate the gaps effectively, the processes would include analysing market gaps, scrutinising the competition, undertaking a Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis to uncover skills gaps, and conducting end-user interviews.

Step 3: Develop Viable Strategies:

Apply knowledge from the literature on models of sustainable AT provisioning to develop plans for increasing the capacity of local AT manufacturers. Consider implementing local circular manufacturing models, emphasising context-driven solutions, repair, and maintenance. Through iterative approaches involving cooperation with end-users, this process could culminate in creating end-user persona profiles.

Step 4: Retain Resources:

Establish partnerships with international experts to facilitate technology transfer initiatives to enhance local capabilities in AT manufacturing. Invest in modern manufacturing facilities to boost efficiency in the manufacturing processes and ensure the retention of resources.

Step 5: Implement Strategies:

Develop and implement training programmes in collaboration with local research institutions and international experts to enhance the skills of local manufacturers in AT design and maintenance. Encourage joint research and development projects between local manufacturers and international partners to foster innovation in AT manufacturing.

9.1.2 Recommend roles of the UK Government

The UK government can play a vital role in supporting the Malawi government and MAP in enhancing the country's local manufacturing capacity, inspired by the former's foreign policy obligations highlighted in its IDS above. One area in which the UK government should focus its support would facilitate a capacity-building initiative that involves skills transfer in the AP design approaches from universities and other strategic institutions in the UK.

For instance, UK institutions are known for pioneering ground-breaking research in AT design for a disability that can benefit both MAP and the Malawi Government. An example is Graham Pullin's "Design Meets Disability," revolutionary research that promulgated the concept of "resonant design," which focused on the needs of some individuals with a specific impairment as well as those without who could encounter comparable situations (Friedner, 2013).

In addition, Malawi can benefit immensely from the user-centred design (UCD) theories and practices advocated by UK institutions such as the Bath Institute of Medical Engineering (what is now known as Designability), as documented by Harris (2017). These lessons can also be drawn from Milton Keynes, which focused on AT and accessibility design approaches that are strategically responsive to the overall urban and town planning goals (Luck, 2022).

9.2 Policy Review and Formulation

It has been established that it is essential to establish a structured policy that promotes local production of APs and discourages importation when local production is feasible, thereby ultimately nurturing economic development and sustainability in Malawi. A typical policy of this nature would include measures that mandate foreign NGOs to source AT locally or at least impose a specific minimum quantity of AT to be acquired locally.

Incorporating such clauses within the policy or legislation would have a far-reaching impact in dissuading foreign NGOs and other international stakeholders from unnecessarily importing AT and promoting collaboration with and empowering strategic local NGOs like MAP.

9.2.1 Recommend roles of the Malawi Government

On the one hand, the Malawi Government, through its line ministry, the Ministry of Gender and Community Affairs, should lead the review and consolidation of relevant policies and legislation focused on governing AT supply chain systems, standardising AT financing mechanisms, including the APL list, integrating AT into healthcare systems, and restructuring the AT regulatory environment. The aim is to develop a comprehensive national policy and strategy that supports local production of AT and APs.

Another component of this policy or regulation might involve implementing tax benefits for international non-governmental organisations that actively partner with local NGOs to manufacture and distribute assistive technology rather than settling on imported AT.

It is, therefore, common knowledge that while ideally, the development of such a policy should be the responsibility of all stakeholders through an inclusive process, the Government of Malawi, being the ultimate custodian, should take the lead.

9.2.2 Recommend roles of the UK Government

On the other hand, the UK Government, alongside other international partners, should consider providing financial and technical support to formulate and implement the policies and pieces of legislation referred to above. This funding can be allocated to help connect relevant UK-based institutions with experience in AT-related policy formulation to assist in building Malawi's capacity to formulate policies that strengthen its AT ecosystem through research, infrastructure, and design innovations.

Studies have stressed the importance of governments and other investors investing in LMICs by incorporating AT into the broader development agendas of developing countries like Malawi to leverage the social power of AT. “Once embedded, public funds will be needed to tilt the economic playing field to enable AT to be commercialised promptly and to ensure APs are affordable and available (Holloway et al., 2021).”

9.3 Strengthening private sector investments and sustainable development aid

International development partners and the private sector should invest in building the local AT manufacturing capacity—whether in the presence or absence of national policy—enabling local manufacturers of AT solutions such as MAP to use mostly locally available materials rather than procuring and importing AT from abroad, especially those that they can make locally.

“Capacity” in this context refers to the ability of local organisations like MAP to efficiently design, produce, and maintain AT solutions locally. To do this, the targeted local organisations should possess the essential skills, knowledge, infrastructure, and resources to sustainably manage an AT manufacturing ecosystem.

In this context, capacity building can be tailored towards skills development and training. For example, financing training programmes that enhance the skills of local manufacturers in designing and maintaining environmentally sustainable AT solutions is essential for building a thriving AT ecosystem (Oldfrey et al., 2021).

9.3.1 Recommended roles of the UK Government

The UK government should facilitate partnerships between the Malawi government and other local stakeholders on the one hand and the private sector entities and development partners in the UK on the other hand who may be willing to invest in sustainable AT in Malawi. Beyond investments, the partnerships should incorporate strategies for capacity building and technology transfer to ensure sustainability.

They can support or fund international experts to facilitate technology transfer seminars, for example, to disseminate best practices that can enhance local capabilities and even “reshoring” AT manufacturing to local settings (Cosimato and Vona, 2021).

9.3.2 Recommended roles of the Malawi Government

The Malawi Government should create an environment that allows for increased uptake of the investments made by UK-based private sector entities and development partners in modern manufacturing facilities and equipment for AT production. In particular, the knowledge transfer on harnessing local materials sustainably is crucial for improving local manufacturing capacity, as evidence suggests a causal link between implementing fifth-generation industrial technologies and promoting sustainable manufacturing development (Patalas-Maliszewska and Łosyk, 2024).

The following would be the key benefits of supporting the AT manufacturing capacity of local organisations:

(i) In the long run, development partners would spend less on providing AT that can be made locally if local capacity is increased. That means they would potentially impact more

communities with ATs, reducing the burden on other duty bearers such as the Government.

(ii) For commercial entities within the private sector, increasing the capacity of local manufacturers such as MAP would mean that in the long term, they would no longer rely on spending more to import expensive APs that can be produced locally cheaply. This would increase commercial entities' profitability and increase AT availability, distribution, and access for people with disabilities and others who need AT.

(iii) For a local manufacturer and service provider like MAP, their impact on communities would be significantly enhanced while its institutional sustainability would be boosted.

9.4 Bolstering Collaborative Research

Researchers and academic institutions in Malawi have the potential to significantly advance AT innovations and strengthen the country's ecosystems, including mobility products. They can provide support in understanding, creating, and implementing AT solutions. Research can help generate empirical data based on the requirements of individuals with impairments and other assistive needs. Researchers play a crucial role in enhancing the quality of life and autonomy of individuals in need of AT support.

For this reason, academic institutions in Malawi should strategically collaborate with similar institutions in the UK to conduct research projects aimed at emerging advancements in global AT innovations and locally developed solutions.

9.4.1 Recommend roles of the UK Government

The UK Government should assist in identifying UK-based research institutions and universities and, where feasible, finance collaborative research in the spirit of the IDS principles that can lead to cost-effective and contextually appropriate AT solutions.

These collaborative research projects would support building a comprehensive data collection system that measures the needs of people requiring APs. For instance, Ebuenyi et al. 2023b have described a strength-based framework for policy development and implementation at the national level. The framework comprises seven guiding principles for an effective policy process, including collaborative, participatory, and evidence-informed processes.

Therefore, this framework provides an opportunity for enhanced collaboration and participation among researchers. The principle of evidence-informed justifies the need for more research to inform policy formulation, building on the empirical research undertaken in the past, whose data may not be adequately utilised by researchers and policymakers (Ebuenyi et al., 2023a).

9.4.2 Recommend roles of the Malawi Government

Collaborative research projects should also involve establishing exchange programmes between Malawian and UK-based research institutions and universities that seek to integrate data to inform sustainable interventions in AT. Research institutions in developed countries like the UK, the USA, and China have demonstrated enormous achievements in Research Data Management (RDM) compared to African countries (Chawinga and Zinn, 2020) albeit the latter boasting a wealth of research data (Anane-Sarpong et al., 2018). This, therefore, underlines the importance of exchange programmes.

The Malawi Government, through the Centre for Social Research (CSR), should identify research capacity gaps with research institutions that UK-based counterparts, through facilitation from the UK Government, can help address. This is because CSR is currently the leading research institution that has already been involved in most studies related to disability and AT in Malawi. Thus, the CSR should coordinate academic exchange programmes that bring together researchers, students, and professionals between Malawian research institutions and UK-based institutions to leverage expertise and resources.

Specific areas that Malawian researchers, in collaboration with their counterparts in the UK, should consider focusing on include impact assessment of AT interventions, in this context, mobility APs. This will evaluate the effectiveness of existing services and interventions and understand their impact on the quality of life of people with disabilities and others who require mobility APs. The key domains of such evaluation may include education, health, employment, and AT regulation.

Learning from the regulatory system of medical devices is essential in AT regulation, which is a significant part of AT elsewhere. For instance, recent research in Uganda has identified the best strategies for translating medical device innovations to market. Despite medical device innovations, disparities between LMICs in translating them to the market pose challenges, impacting healthcare services as seen in Uganda (Matovu et al., 2023; Nakandi et al., 2023). Therefore, cross-learning opportunities for research organisations in Malawi and the UK could even extend to Uganda to help shape how regulatory policies are formulated and implemented and how the said policies affect the private sector, government agencies, nonprofits, communities, and other key players within the AT ecosystems.

9.5. The Role of the UK Engineering and Assistive Technology Research Community in Global AT Provision

Assistive technology (AT) plays a crucial role in enabling individuals with disabilities to live independently, participate in education and employment, and access essential healthcare services. While significant strides have been made globally, challenges persist, especially in low- and middle-income countries (LMICs) like Malawi. These challenges include limited local manufacturing capacity, insufficient funding, and a lack of user-centred, context-specific solutions. The UK engineering and AT research community, supported by institutions like the Engineering and Physical Sciences Research Council (EPSRC), has an opportunity to address these gaps by fostering innovative solutions, transferring technical expertise, and promoting sustainable practices. This section explores how the UK research and funding ecosystem can engage with Malawi's AT challenges, advancing global equity in AT provision while driving cutting-edge research and development in the field.

9.5.1. Local Production vs. Imported AT: Opportunities and Challenges for UK Innovators

This case study of the AT ecosystem in Malawi highlights an aspirational vision for local production of AT, aiming to address the country's needs while building local capacity and fostering economic independence. However, meeting all AT requirements solely through local production presents significant challenges, including limited industrial infrastructure, a lack of skilled workforce for

advanced manufacturing, and financial constraints. Consequently, imported AT products will likely continue to play a role in Malawi's ecosystem, creating a critical intersection for collaboration with international partners, including the UK engineering and AT research community.

For UK innovators, this dynamic offers opportunities and challenges. LMICs like Malawi represent the largest potential markets for AT globally, with the highest levels of unmet need. To succeed in these markets, UK researchers and manufacturers must address specific demands, such as designing AT products that are affordable, robust, and easily repairable within local contexts. Innovations should prioritise simplicity in design, modularity, and the use of locally available materials to facilitate maintenance and repair.

The role of the UK AT community, supported by funding channels of UK Research and Innovation (UKRI), could extend beyond product design to include systems thinking and engagement with global supply chains. For instance, UK engineering research could focus on hybrid approaches that combine local assembly, customisation or repair/re-engineering, with imported components, leveraging the comparative advantages of both systems. This model would enable Malawian stakeholders to build production capacity incrementally while addressing immediate needs through strategic imports.

Moreover, UK research institutions could play a vital role in testing and refining prototypes in diverse settings to ensure usability and relevance. Partnerships with Malawian institutions like MAP could facilitate co-design processes and real-world feedback loops, ensuring that imported products complement rather than compete with local initiatives. This collaborative approach aligns with sustainable development goals by fostering technology transfer and strengthening local ecosystems.

Despite these opportunities, challenges remain. The economic feasibility of producing affordable AT for LMICs often clashes with the commercial interests of private manufacturers. Furthermore, the disparity in infrastructure between the UK and Malawi raises questions about how to adapt advanced engineering innovations for settings where electricity, internet, and technical expertise may be limited. Addressing these gaps requires targeted funding mechanisms and incentives for UK innovators to invest in scalable, context-specific solutions.

9.5.2. Understanding User Needs: A Key to Relevant and Marketable AT for Global Markets

The report findings underscore the critical issue of unsuitable AT being distributed, such as imported wheelchairs that fail to function on Malawi’s uneven terrain. This mismatch highlights the necessity of understanding users’ needs in their full context, including the physical, social, and economic environments where AT is used. For the UK AT engineering and research community, this represents a call to action to prioritise user-centred design and invest in research collaborations that illuminate the diverse needs of global AT users.

Developing marketable products for global markets requires a deep understanding of not only the end-users' immediate functional requirements but also the broader ecosystems in which those

products will operate. For example, AT designed for high-income countries often assumes access to smooth roads, reliable electricity, or professional repair services—conditions that are scarce in LMICs like Malawi. Without adapting to these realities, even the most innovative AT risks becoming impractical or obsolete, failing to address the needs of the world's largest AT markets.

To address this, UK researchers and innovators can invest in participatory research methods, working directly with disabled people, caregivers, and community organisations in LMICs. Such collaboration ensures that the voices of those who will use the technology shape its development. Research funding bodies like EPSRC can play a pivotal role in supporting projects that embed co-design practices, fostering mutual learning between UK researchers and global AT users. Initiatives like these not only lead to more relevant and effective AT solutions but also empower disabled people by recognising their expertise in identifying their own needs.

Research collaborations can also uncover systemic barriers that hinder the usability and adoption of AT in LMICs. For example, understanding how cultural perceptions of disability intersect with AT usage could inform strategies to increase adoption rates. Similarly, insights into supply chain and maintenance challenges could lead to the design of modular or self-repairable products, reducing dependency on costly and logistically complex repairs.

Moreover, by investing in research to better understand users' needs globally, the UK AT engineering community can position itself as a leader in developing solutions that bridge diverse markets. Products designed to meet the rigorous demands of LMICs often prove more robust and cost-effective, potentially gaining traction in high-income countries where affordability and durability are increasingly valued. This cross-market appeal strengthens the case for continued funding and innovation in global AT development.

9.5.3. Building Capacity Through Accelerators: Strengthening AT Research Translation and Market Readiness

This case study highlights Malawi’s unique innovation challenges, which are not easy to address, and illustrates the pressing need to build local capacity to meet the AT needs of underserved populations effectively. Capacity building encompasses developing local expertise in manufacturing, distribution, and maintenance while fostering innovation to create sustainable solutions. Accelerators—programs designed to support early-stage ventures—can be instrumental in this process, serving as a bridge between research and market-ready AT products.

Accelerators could help address Malawi’s unique challenges by nurturing local talent, providing technical training, and supporting market-focused AT innovation. These programs could equip local entrepreneurs with the tools and knowledge necessary to develop and scale AT solutions tailored to the Malawian context. For example, accelerators can:

1. Provide Entrepreneurial Training: By offering workshops on business management, product development, and scaling, accelerators prepare entrepreneurs to navigate the complexities of AT innovation in resource-constrained settings.

2. Facilitate Networking Opportunities: Linking local innovators with international stakeholders, including researchers, manufacturers, and funders, fosters collaborative approaches and knowledge sharing.
3. Promote Inclusive Design Practices: Embedding user-centred design principles, as outlined in the section above, ensures that AT solutions meet real-world needs and align with local cultural, economic, and environmental conditions.

The UK AT research community, supported by funding bodies like EPSRC, is well-positioned to lead the development and trialing of accelerator models that address the unique challenges of AT research translation. Insights from the TIDAL N+ Early Career Researcher (ECR) Accelerator emphasise the importance of tailored interventions across different stages of technology readiness levels (TRLs), from ideation to commercialisation. Applying these lessons to the global context, particularly in LMICs like Malawi, can yield impactful outcomes:

1. Overcoming the Valley of Death: Accelerators can mitigate the risks associated with transitioning from prototype development (TRL 4-5) to market-ready products (TRL 6-7), addressing funding and resource gaps that often hinder progress.
2. Facilitating Co-Design and Validation: Research collaborations between UK institutions and Malawian stakeholders could ensure that AT solutions are rigorously tested and optimised for local use cases, as discussed in the prior section.

9.5.4. Strengthening Collaborations Through Knowledge Exchange Programs

Building capacity for AT provision in LMICs like Malawi requires more than local infrastructure and expertise—it also demands robust global collaborations. Knowledge exchange programs can bridge gaps between the UK and LMICs, catalysing mutual learning while showcasing UK AT engineering innovations and addressing specific challenges faced by LMICs.

Knowledge exchange programs offer a structured platform for UK researchers, engineers, and clinicians to collaborate with counterparts in LMICs. These initiatives provide several key benefits:

1. Showcasing UK Expertise: UK universities and research institutions lead the world in engineering innovation and user-centred AT design. By sharing this expertise, they can influence and inspire solutions tailored to LMIC contexts, such as modular and repairable AT designs.
2. Learning from LMIC Innovations: LMICs like Malawi have pioneered circular economy approaches in AT repair and reuse. As highlighted in workshops on wheelchair and prosthetics repair delivered through the EPSRC funded TIDAL N+ project, LMICs often develop resourceful repair systems out of necessity, such as using locally sourced parts or repurposing existing components. These practices offer valuable lessons for the UK, where circular economy principles in AT are still emerging.

Repair-focused practices in LMICs demonstrate the feasibility and importance of integrating repairability into AT design from the outset. UK research on sustainable repair, such as the TIDAL Network's initiatives on repair data and modular design, aligns well with these principles. A bidirectional flow of knowledge can:

- Improve UK repair systems by incorporating LMIC insights on repair logistics, user engagement, and cost-effective solutions.
- Enable UK-designed AT products to better serve global markets by prioritising affordability, repairability, and modularity.

For example, workshops on wheelchair repair highlighted challenges such as lack of standardisation in parts and the absence of repair data systems. Addressing these issues collaboratively can lead to innovations that benefit both LMICs and high-income countries like the UK.

UK research translation funding, such as that provided by the EPSRC, can also support trial programs to test knowledge exchange models. These could include:

- Short-term Exchanges: Pairing UK engineers with Malawian practitioners to co-design solutions and identify gaps in repair systems.
- Joint Repair Workshops: Events like the TIDAL N+ workshops on repair can focus on specific challenges like improving repair data collection and designing for repairability, targeting solutions relevant to specific LMIC contexts, such as energy access, climate barriers, or cultural stigma.
- Data-Driven Interventions: Using AI and data tools to track repair needs and outcomes across regions, refining repair strategies to optimise both environmental and user-centred impacts.

9.5.5. Reimagining UKRI Funding Strategies to Address Global AT Challenges

A strategic restructure: a research and innovation funding strategy to focus resources on global AT provision would offer substantial potential to advance innovation, address unmet needs, and position the UK as a leader in equitable AT development. By targeting key challenges highlighted in this report—repairability, sustainability, research translation, and capacity building—UKRI could unlock significant impact, while enabling UK researchers to engage in meaningful, globally relevant work.

Allocating UKRI funding could accelerate innovation in repairable and sustainable AT. Research investments in modular, durable, and repairable AT designs would address systemic barriers to adoption in LMICs. These innovations, tailored for challenging contexts, could inform designs for high-income markets, ensuring cross-market relevance. Furthermore, strategic funding could build global research networks through international collaborations, such as bilateral workshops and long-term placements. These networks would foster mutual learning, particularly in areas like circular economy practices in LMICs, which could also benefit the UK’s AT systems.

Revising funding priorities to accelerate access to affordable and high quality AT in low resource settings would offer several advantages. Aligning with LMIC needs would make UK research more globally relevant, contributing to equitable AT access. Repair-focused and modular AT designs developed for LMICs could also drive sustainability and cost-effectiveness in both high- and low-resource settings. Building long-term partnerships would enhance trust and collaboration between UK and LMIC stakeholders, creating pathways for future joint ventures. Additionally, solutions tailored for LMIC contexts could open new markets and enhance the competitiveness of UK-designed AT globally.

Establishing new funding streams and pilot programs requires significant initial investment, with uncertain short-term returns. Bridging cultural and systemic differences between UK and LMIC partners would demand careful planning and resource allocation. Expanding funding for global AT challenges could limit resources for other pressing research domains within UKRI's remit.

To mitigate these challenges and maximise impact, UKRI could adopt a phased approach. Dedicated calls for LMIC-focused AT projects could include themes like repairability, modularity, and sustainable design in its standard research grants. Expanding international collaboration grants would encourage projects that embed capacity building and knowledge exchange as core components. Supporting pilot accelerator programs would test research translation models in LMICs, generating insights that could scale globally. ECR-specific initiatives could provide mentorship, resources, and opportunities for fieldwork in LMICs.

Enhancing research translation mechanisms, by supporting the creation or adoption of accelerators and pilot programs in LMICs first trialed in the UK, would help bridge the gap between lab-based innovation and market readiness. UK researchers involved in these efforts would gain deep insights into global markets, ensuring their outputs are both impactful and commercially viable. As such, empowering early-career researchers through international collaboration grants would provide a vital platform for emerging talent to engage in transformative projects, developing future leaders in AT innovation who are equipped to tackle global challenges.

In summary, the UK engineering and AT research community plays a pivotal role in addressing global challenges in AT provision, particularly in low- and middle-income countries like Malawi. By leveraging resources, expertise, and funding mechanisms, such as those provided by EPSRC, UK researchers have the opportunity to tackle critical issues, including limited local manufacturing capacity, inadequate repair systems, and the need for user-centred, sustainable solutions.

Strategically targeting funding toward research on modular, repairable AT and circular economy practices could enable the UK to drive innovation while aligning with global equity goals. Collaborative initiatives—such as co-design workshops, accelerators, and knowledge exchange programs—offer pathways to build capacity in LMICs while enhancing the UK's ability to adapt and learn from resourceful approaches developed in these contexts. These efforts can address systemic barriers, optimise AT design for diverse environments, and ensure solutions are both globally relevant and marketable.

Embracing these responsibilities of the UK engineering and AT research community, the UK could position itself as a leader in equitable AT innovation, contributing to sustainable development while catalysing impactful international partnerships. The outcomes would not only enhance access to AT for underserved populations but also strengthen the UK's standing as a hub for cutting-edge, socially driven engineering solutions.

10.0 Conclusion

The UK and Malawi have enjoyed a long history of cordial relations characterised by their shared commitment to addressing Malawi's social challenges. These ties promote sustainable development that delivers public services to marginalised societies in Malawi. As highlighted in the UK's IDS, the emphasis on assisting Malawi's efforts in sectors like health and education demonstrates a commitment to reciprocal growth.

The mapping exercise has revealed the intricacies and difficulties faced by the AT sector in Malawi. Notably, it has underscored the importance of the Malawi Against Physical Disability (MAP), in conjunction with its strategic partners, in delivering effective solutions and providing mobility APs in the country. It has also highlighted the pressing need for collaborative efforts towards policy reform to enhance the provision of efficient and effective AT services in the country, including mobility APs.

However, it has documented various challenges besetting the AT sector in general and those being experienced by MAP in particular, including the decreased direct involvement of private commercial entities in AT manufacturing advancements in Malawi, a lack of precise mechanisms for providing AT in Malawi, echoing findings from previous research such as Ngomwa 2019; a lack of effective AT policy and collaborative leadership, among others.

10.1 A Summary of Key Issues and Recommendations

Considering that policy formulation around issues related to AT has been one of the main recurring themes in the mapping and that other studies have recognised policy development and implementation as key to improving access to AT (Ebuenyi et al., 2023b), establishing structured policies that promote local production of APs and discourage unnecessary importation is, therefore, crucial for developing and nurturing the AT ecosystem in Malawi. In this context, this mapping recommends that the UK government and other international partners should offer financial and technical support for creating and implementing these policies. In contrast, the Malawian government should take the lead in reviewing and combining pertinent policies.

In addition, it is also imperative for both governments, alongside other stakeholders, to consider the following recommendations:

> **Capacity-building strategy for MAP:** To maintain operations and achieve its goals, MAP must thoroughly evaluate its institutional strategic plan to pinpoint capacity deficiencies and create plans for income diversification. To assist MAP in this attempt, the government of Malawi should facilitate resource mobilisation mechanisms and offer strategic assistance. In contrast, the UK Government should facilitate linkages with the UK-based institutions that can assist with capacitating MAP.

Strengthening private sector investments and sustainable development aid: Building Malawi's local AT manufacturing capability should be a priority for the private sector and international development partners in the UK. This would enable local institutions in Malawi, such as MAP, to effectively use available resources. Partnerships and technology transfer projects facilitated by the UK government can support Malawian sustainable manufacturing practices.

Bolstering Collaborative Research: To advance AT innovations and fortify the nation's ecosystems, cooperation between research institutions in Malawi and the UK is necessary. In addition to providing financial support, the UK government should help identify research institutions in the UK that may be willing to provide capacity building and information exchange.

Implementing these recommendations can help Malawi and the UK promote the sustainable development of the AT ecosystem in Malawi, enhance access to essential AT by people with disabilities, the elderly and anyone in need of life-changing AT, and ultimately improve the quality of life of communities by providing AT solutions to those who need them.

10.2 Dissemination of Research Findings:

This mapping report is a valuable resource that should inform stakeholders and policymakers in Malawi and the UK on how best to address the challenges and opportunities for providing AT solutions. It could be distributed to different stakeholders in the UK, such as government agencies and personnel directly concerned with foreign policy and international development, research institutions focused on AT innovations, disability rights NGOs, and the private sector that are willing to invest in sustainable development projects.

Some of the targeted channels through which the report could be disseminated include:

Government Agencies: The report should be distributed to relevant government departments, such as the Foreign, Commonwealth & Development Office (FCDO), to ensure that decision-makers are well-informed of the recommendations and can apply them to funding priorities and development plans.

Research Institutions: The report should be shared with academic institutions and other research institutions through events such as research conferences, seminars, workshops, and colloquiums that specialise in international development, disability studies, and AT research. These institutions could work together to identify key findings outlined in the report and build on the recommendations to inform more research that leads to potential breakthroughs of AT innovations.

NGOs: Targeting and engaging with NGOs focused on disability rights and development, particularly those with a track record of working in Malawi or similar contexts, will enable them to effectively implement evidence-based advocacy for policy changes. These NGOs can also play a critical role in supporting local initiatives aimed at improving access to AT solutions.

Private Sector Entities: The report should be disseminated to the private sector in the UK, particularly targeting companies that may be interested in corporate social responsibility or sustainable development. This could lead to investment opportunities in AT manufacturing capacity-building initiatives in Malawi.

10.3 Informing Stakeholders and Policymakers

This mapping report will help educate stakeholders and policymakers in the UK about key issues, challenges, and recommendations through the provision of evidence-based recommendations for policy formation and investment objectives. These stakeholders can gain from the study in several areas, such as collaborative research, policy review, and capacity building, which will guarantee that funds are allocated to projects that have the biggest impact.

The report will further inform stakeholders and policymakers about the importance of supporting initiatives that promote local production of AT solutions in developing countries like Malawi, aligning with broader international development goals and strategies. Overall, by disseminating the report widely and engaging with relevant stakeholders and policymakers in the UK, there is an opportunity to catalyse meaningful action and collaboration between the two nations to enhance access to AT solutions and promote sustainable development outcomes in Malawi and even beyond.

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11.0 APPENDIX: Interview Guide

Interview Guide for AT Ecosystem Mapping in Malawi

Introduction:

This interview guide aims to engage interviewees in a conversation that uncovers detailed information about the current state of the AT ecosystem in Malawi, the players involved, and how the community is engaged with AT.

The responses should help in developing a tailored ecosystem mapping methodology, identifying existing AT solutions, and cataloguing the service providers and their specialisations.

1. Could you list the AT solutions that have been developed locally in Malawi that you are aware of, or what your organisation has developed?
2. For each AT solution mentioned, can you describe its development process, target user group, and current stage of deployment?
3. Can you identify the main AT service providers operating in Malawi and describe their areas of specialisation?
4. In your opinion, how well do these service providers meet the needs of their target populations?
5. What gaps exist in the services current AT actors provide, and what could be done to fill these gaps?
6. How are the end-users involved in the development, testing, and feedback processes of AT solutions?
7. How would you describe the community's capacity to maintain and repair AT solutions they currently use?
8. Are there local initiatives or training programmes that empower users to adapt or innovate upon the AT solutions they have?
9. Can you share examples of the community successfully adapting or innovating upon existing AT technologies?
10. How interested is your organisation in investing resources into the AT sector, and what kind of AT-related activities or projects have you supported in the past?
11. What is the nature of partnerships do you seek to foster within the AT ecosystem?
12. Can you elaborate on the overarching structure of the AT ecosystem in Malawi and your organisation's role within it?
13. What are the key policies in place that affect the AT sector, and how do they influence service delivery?
14. Do you consider any specific AT innovations from Malawi ready for large-scale production or deployment, or how do you assess your own?
15. From an engineering perspective, what are the main technical challenges your organisation, or local AT developers in general, face?
16. What about other challenges such as policy-related, systems-based, etc.?
17. How are these challenges being addressed?
18. What changes or improvements (recommendations) would you like to see in the AT ecosystem in Malawi over the next five years?
19. How can international partners best support the growth of the AT ecosystem in Malawi?

Thank you for your time and insights.