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

BARRIERS AND STRATEGIES TO TRANSLATE ASSISTIVE TECHNOLOGY RESEARCH INTO PRACTICE IN THE UK

ABSTRACT

Rising global disability rates necessitate efficiently translating assistive technology (AT) research into accessible and assistive products and services. However, several challenges persist.

This report examines the existing literature journey from an AT's inception in research to its use with a disabled end user, identifying key factors and proposing improvements based on narratives within the existing academic literature. The findings from the literature are corroborated and further enhanced by a thematic analysis of interviews with stakeholders in AT research translation, including two researchers, start-up founders, AT users, and a technology transfer officer. Focusing this work on the UK, we find that academic systems need to train better, incentivise, and support the translation of lab-based research to real-world applications.

Based on the findings, the report presents practical strategies and critical insights for the different technology readiness levels (TRLs) and charts a comprehensive roadmap for translating research into marketable products and impactful solutions.

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INTRODUCTION

It is estimated that more than one billion people around the world live with a disability, making up around 16% of the world's population (WHO, 2023).

According to the World Report on Disability (WHO, 2011), the number of people with disabilities worldwide is increasing due to a general increase in population, ageing, and an increase in chronic health conditions, such as diabetes, cardiovascular disorders and mental illness. The increase in injuries caused by road traffic accidents, natural disasters and conflicts also contributes to the growing number.

People typically require Assistive Technology (AT) support to maintain or improve their function. AT refers to products or systems that support and assist the daily functional needs of people, especially those with disabilities. AT can sometimes be a medical device if it serves a curative, therapeutic or wellness purpose, primarily to support physical, mechanical or mental function and well-being (MHRA, 2023).

An estimated 24% of the UK population lives with a disability (GOV.UK, 2022). The UK has implemented significant measures to promote the rights and inclusion of people with disabilities. For example, the Equality Act 2010 guarantees the right of disabled individuals to access AT that enables their participation in daily life (The Equality Act 2010, n.d.). The UK Department for Health and Social Care reported that approximately £1.2 billion was allocated to research funding from 2022 to 2023 (DHSC, 2023). This includes substantial investments to develop, implement, and evaluate AT to empower older and disabled individuals to live more independently. Specifically, over £60 million was invested by organizations such as the NIHR, UKRI, HCRW, and the Chief Scientist Office of the Scottish Government Health Directorates to advance AT research in various areas. These include adaptive and smart home technologies, interventions for COPD management and improved sleep, home-based rehabilitation for older adults, gamification to support socially isolated individuals, and advancements in hearing aids to benefit people with hearing loss.

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Additionally, projects target support for individuals with learning difficulties and autism. This diverse research investment highlights the UK's commitment to creating innovative solutions that enhance the quality of life for people across different disability categories.

With its substantial national spending to support people with disabilities, a rights-based policy framework, significant investments in disability-related research, strong government backing, and a thriving entrepreneurial ecosystem for AT start-ups (ATLAS, 2022), the UK is a global leader in disability innovation and AT development. The country has been pivotal in advancing AT research, contributing over 150 insight papers to the Global Report and leveraging international tools to gather robust evidence (GDI Hub, n.d.).

Despite these achievements, the delivery systems in the UK, while providing high-quality products with a positive impact on users' lives, often face slow and cumbersome processes. This creates an access gap, with 31% of disabled individuals unable to obtain the assistive products they need to thrive, participate in daily life, or reach their full potential (Austin et al., 2023).

Innovation transforms ideas into goods and services that generate commercial or social value, serving as a critical driver of economic growth. Technological developments, improved healthcare, and sustainability initiatives are essential in order to improving productivity, creating new markets, and advancing societal progress. Innovation typically occurs in universities and corporate research labs, where knowledge creation, experimentation, and technology development thrive, fostering environments conducive to groundbreaking discoveries.

A significant challenge in promoting innovation is bridging the gap between research and commercialisation, often called the "valley of death." This gap arises when promising ideas fail to reach the market due to insufficient funding, inadequate resources, or a lack of strategic direction. Overcoming this challenge is essential for ensuring innovative concepts achieve their full potential and drive meaningful change.

Overcoming the "valley of death"—the gap between research and commercialisation—is essential for translating AT research into products and services that benefit disabled people. This translation involves developing replicable, reliable, cost-effective technologies and devices that address current challenges, fill technological gaps, and improve user experiences with existing systems. The process includes several iterative steps.

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Overcoming the **"valley of death"**—the gap between research and commercialisation—is essential for translating AT research into products and services that benefit disabled people. This translation involves developing replicable, reliable, cost-effective technologies and devices that address current challenges, fill technological gaps, and improve user experiences with existing systems. The process includes several iterative steps.

Step 1

It begins with research conducted in academic institutions, research organisations, or the R&D departments of commercial companies. This stage involves conceptualising new technologies, often starting with a user-centred design process to understand potential users' needs and generate requirements for a successful product. Researchers develop and refine multiple prototypes, testing their concepts with small user samples. These prototypes undergo several iterations based on feedback and initial technical assessments.

Step 2

For some ATs, rigorous clinical trials are necessary to demonstrate efficacy and safety, as they must meet stringent regulatory approvals such as those from the MHRA and FDA and comply with existing medical product standards. The regulatory process is long and expensive, requiring extensive validation tests and documentation. Protecting intellectual property becomes crucial at this stage to enable commercialisation. Alternatively, new technologies can be made open and public without commercial protection but with appropriate accreditation, allowing anyone to replicate them (Creative Commons, n.d.).

Step 3

To bring validated, tested, and reliable technology to market, researchers conduct product-market fit studies, understand adoption and usage patterns, and adjust designs based on user feedback to address grievances and needs. Ensuring user acceptance is critical for success. Without insight into translating research into marketable products, innovation may not achieve its full potential impact on people with disabilities.

This report examines AT's journey from research labs to practical solutions in users' hands, focusing on identifying key factors that influence the successful translation of AT research into market-ready products. Drawing on insights from expert interviews, we recommend strategies to overcome existing challenges and accelerate the translation process. Based on these findings, we outline a roadmap to guide researchers in navigating the complex journey from innovation to impact, ensuring their projects deliver meaningful and tangible benefits for people with disabilities.

A systematic understanding of the roadmap for translating AT research into the general market remains to be seen.

DEFINING AT TRANSLATION

Significant academic research on the medical device market has been conducted, relevant to certain AT products. Studies from the US, European, and UK markets have explored various aspects, including market forces, collaboration dynamics, grant funding, and intellectual property barriers. However, a systematic understanding of the roadmap for translating AT research into the general market remains to be seen.

Specifically, it is still being determined whether AT translation follows the medical device model or general engineering innovation pathways or requires a distinct approach tailored to the unique characteristics of the AT market. This gap highlights the need to explore and potentially optimise an AT-specific translation model.

AT industry is often perceived as serving small and fragmented disability markets, making technology translation unique and challenging. Research highlights barriers to AT technology transfer, such as limited funding, insufficient preliminary assessments, and regulatory and intellectual property (IP) challenges (Leahy & Lane, 2010). Similarly, Bauer (2003) emphasised the limited impact of technology transfer in the AT industry and proposed a "demand-pull" approach to address this issue.

Examples of successful collaborations, such as the NHS and Medipex in the UK, underline the importance of commercialisation expertise in driving medical innovations (Smith & Clark, 2010). However, challenges like regulatory compliance and the critical role of IP protection remain significant (Cudd, 2012).

DEFINING AT TRANSLATION

Existing studies further reveal fragmented research efforts in AT translation. For instance, analyses of assistive robotics companies in France and the UK uncovered barriers, including financial constraints, institutional hurdles, and cultural market failures (Noury et al., 2021). Similarly, reports such as those by KTN Innovate UK Business Connect on neurotechnology highlight the need for targeted, context-specific strategies (Mathieson et al., 2021). These studies underscore the multifaceted challenges in AT research translation, spanning regulatory, financial, and institutional domains.

Adding to this complexity, the term "assistive technology" has been inconsistently applied, limiting research cohesion. Although the WHO refined the definition of AT in its Priority Assistive Products List (2016, 2022), much of the research remains disconnected, focusing on specific subsets such as wearable technologies (Moon et al., 2019), brain-computer interfaces (Nijboer, 2015), and assistive robotics (Noury et al., 2021; Shore et al., 2018). This lack of a unified framework hinders the systematic analysis and development of effective solutions, calling for a more cohesive and structured approach.

To address this, frameworks like the Technology Readiness Level (TRL) can provide an organised pathway for AT translation. Building on WIPO's analysis of AT technology trends (WIPO, 2021), the TRL framework divides the process into four phases: research concept, proof of concept, minimum viable product (MVP), and commercialisation. WIPO's report on patent filings from 1998 to 2019 identified key growth areas in AT, such as mobility aids and emerging technologies like AI-driven prosthetics and IoT-enabled devices.

Despite these advancements, challenges, including regulation, manufacturing, and accessibility—especially in low- and middle-income countries—impede commercialisation and adoption. Patent filings are concentrated in regions like China, the U.S., Japan, and Europe, with universities and public institutions driving much of the innovation. The report argued that the convergence of AT with mainstream consumer products offers opportunities for broader adoption but introduces concerns such as data privacy, ethical considerations, and IP management.

Building on these findings, this study will review existing literature on barriers and enablers in AT research translation, using the TRL framework to provide actionable insights and reduce fragmentation. This approach aims to create a roadmap for researchers and stakeholders, guiding the development of impactful, market-ready solutions.

TECHNOLOGY READINESS LEVELS (TRLS)

According to WIPO’s Technology Trends 2021: Assistive Technology report, most emerging ATs are concentrated at the MVP stage, with only 18% achieving commercialisation.

To identify the enablers and barriers in translating AT research into market-ready solutions, we adopt the Technology Readiness Levels (TRLs) as a structured framework (WIPO, 2021). Initially developed by NASA in the 1970s to assess technology maturity, TRLs range from the initial research phase (TRL1) to fully operational technologies (TRL9) (Mankins, 1995).

WIPO adapted this framework for AT, categorising development into four stages: research concept, proof of concept, minimum viable product (MVP), and commercialisation.

Fully commercialised examples of AT include cochlear implants, non-invasive bone conduction devices, and multifocal intraocular lenses, demonstrating successful navigation of the complex pathway from research to market.

TRL FRAMEWORK

Significant barriers persist in translating AT research.

These include regulatory hurdles, limited funding for scaling, market fragmentation, intellectual property challenges, and insufficient user-centric design. These challenges create a gap between patenting activity and commercialisation, slowing the adoption of AT innovations. The TRL framework helps identify these barriers at different stages and provides a shared language for researchers, funders, and policymakers to align efforts.

TRL	Description	Product Level	Financing	Responsibility
1	Basic research - Basic principles observed and reported	Research concept	Grants	Universities, R&D institutions
2	Technology formulation - Concept and application are formulated.			
3	Applied research - First laboratory tests completed; proof of concept.	Proof of concept		
4	Small scale prototype - Prototype built in a laboratory environment.			
5	Large scale prototype - Prototype tested in intended environment.	Minimum viable product (Valley of Death)	Grants, Venture Capitals (VCs) Investors, Corporate Grants, Corporate investments	Startups
6	Prototype system - Prototype tested in context close to expectations.			
7	Demonstration system - System operating as expected.			
8	First commercial system - Manufacturing issues solved.	Commercial product		Bigger companies
9	Fully commercial application - available for consumers.			

TRL 1 - 4: EARLY DEVELOPMENT

AT at TRLs 1–4, which encompasses the early stages of research and concept validation, is typically led by universities and research groups/institutes. These entities are often supported by grants, which are pivotal in enabling foundational research. For instance, studies focused on the UK have examined the wide-ranging impacts of funding mechanisms provided by UKRI (UK Research and Innovation) and other major institutions.

Abreu and Grinevich (2013) analysed ESRC (Economic and Social Research Council) funded projects to identify incentives and obstacles for researchers engaging in entrepreneurial activities. Their findings strongly emphasised the economic impact of funding calls alongside demographic influences, research types, and prior entrepreneurial experience or training. Scandura (2016) further assessed EPSRC (Engineering and Physical Sciences Research Council) funded university-industry collaborations, revealing their positive impact on fostering partnerships, driving innovation, addressing market inefficiencies, and enhancing the skills of both academic and industry stakeholders.

These studies underscore the critical role of public funding in the early stages of AT development. They also highlight the importance of collaborative efforts between universities and industries in advancing research and building the capabilities required to transition AT from conceptual research to proof-of-concept stages. Combined with structured collaborations, public grants can effectively bridge gaps in resources and expertise, ensuring foundational research evolves into tangible innovations.

TRL 5 - 9: OVERCOMING BARRIERS AND FOSTERING COLLABORATION

Start-ups play a crucial role in advancing AT from small-scale prototypes to demonstration models, often relying on venture capital or investment from larger companies to navigate the “Valley of Death” (VoD). This challenging phase typically occurs when transitioning from technology validation in a lab environment (TRL 4/5) to demonstration in an operational environment (TRL 6/7) (Nwaka, 2021; Gbadegeshin et al., 2022). Larger companies, with their established technological and financial resources, often lead the commercialization phase when products enter the market. However, in recent years, many large organizations have embraced responsibility for accessibility and equity throughout the development process, emphasizing inclusion as part of their corporate strategy (Biyikli & Bhawalkar, 2022).

Interdisciplinary collaboration is essential in AT research translation, involving a wide range of stakeholders. Policymakers are encouraged to engage early in the process to address regulatory and policy challenges (Jones et al., 2021). Research institutions often collaborate with industry partners to ensure research is transferable and has practical applications (Leahy & Lane, 2010; Page & John, 2019). Companies are also increasingly engaging users throughout the development process to ensure their products meet real-life needs and usability standards (Langley et al., 2020).

Among these stakeholders, users are consistently highlighted as the most critical in shaping AT research and design. Studies have emphasized the importance of user engagement across various contexts. Nijboer (2015), for example, identified a lack of user-centred design and innovative business models in the development of brain-computer interfaces. Hallewell Haslwanter and Fitzpatrick (2017) highlighted insights from the HandyHelper project for ageing populations, stressing the importance of user inclusion and public funding. Similarly, Ward et al. (2017) explored older adults as target users, advocating for tailored business models to attract this growing demographic. A project for older individuals with dementia further proposed a transdisciplinary framework that included collaboration between academia, industry, government, and users (Boger et al., 2017).

An example of successful interdisciplinary collaboration is the co-creation model developed for upper-limb prosthetics design. This model facilitated both academic publication and industrial output by prioritising user engagement and teamwork across disciplines (Jones et al., 2021). It also addressed the limitations of laboratory-based research by emphasizing the inclusion of users as active stakeholders throughout the process. The VoD remains a critical bottleneck in AT development. Enterprises attempting to transition research outcomes into commercial products face significant barriers during this phase, including high development costs, fragmented markets, and regulatory hurdles (Debois et al., 2015; Upadhyayula et al., 2018).

These challenges highlight the need for interdisciplinary collaboration to bridge resource gaps, enhance funding opportunities, and streamline the pathway from research to market.

While significant research has addressed the ‘Valley of Death’ in general technology transfer, limited studies focus specifically on AT development. Barrable et al. (2014) examined spinal cord injury research, identifying two distinct VoDs in medical technology development. They proposed a praxis model to overcome these challenges, emphasising early stakeholder coordination, securing funding, fostering customer engagement, and building collaborative networks. Although this model applies to ATs developed as medical devices, it may not fully address the unique phases of non-medical AT development.

VALLEY OF DEATH (VOD)

VoD is a widely used term to describe the barriers encountered in the technology transfer process, particularly during the transition from research to commercialisation. Upadhyayula et al. (2018) analysed the challenges faced by academia in overcoming the VoD, emphasising the limitations of researchers in bridging this critical gap. Similarly, Gbadegeshin et al. (2022) conducted a systematic literature review on high-technology startups, identifying barriers such as funding shortages, inadequate business management, and ineffective customer creation. They proposed strategies to manage the VoD, including IP protection, networking, revenue modelling, targeted marketing strategies, and enhancing customer engagement.

Industry insights also provide valuable lessons. IBM's experience (Colyer, 2000) highlighted challenges in technology transfer, including financial constraints, customer engagement issues, and risk management. Practical strategies, such as improving customer interactions and risk mitigation frameworks, were proposed to address these barriers. Additionally, Larsson et al. (2006) explored university-industry collaborations, advocating using demonstrative tools to communicate ideas effectively and entrepreneurial mindsets to expand user bases and overcome commercialization barriers.

A notable example of overcoming the VoD is the collaboration between the IT University of Copenhagen and Exformatics A/S, which introduced a framework involving small funding and an industrial PhD model. This approach successfully bridged technological and financial gaps during translation (Debois et al., 2015). On a policy level, the House of Commons Science and Technology Committee (2013) produced a report analysing the innovation landscape in the UK, emphasising the importance of strengthening research-industry connections and positioning the government as a lead customer to promote small business research. These insights provide valuable political strategies for accelerating AT research translation in the UK.

This study addresses the gap in research on VoD in AT development by analysing medical and non-medical ATs using the TRL framework. We examine barriers and strategies throughout the development process, providing specific insights into the causes and solutions for VoD in AT. By contextualising these findings within the TRL framework, we aim to comprehensively understand the challenges and opportunities in translating AT research into impactful, user-ready solutions.

METHODS

This research aims to address critical challenges in translating AT research into practical solutions by focusing on the following objectives

Challenges

Identify Challenges Across the TRLs, including the VoD: Explore the barriers encountered at different AT development stages, and the VoD.

Strategies

Assess Existing Strategies: Analyse strategies proposed in the literature and gathered from expert interviews to overcome these barriers.

Roadmap

Develop a Roadmap for AT Translation: Based on insights from the literature and stakeholder input, propose a structured pathway for effectively translating AT research into impactful products.

To achieve these objectives, this research addresses the following questions:

1. **What are the barriers in different phases of AT research translation?**
2. **What strategies can different stakeholders employ to overcome these barriers?**

This research employs a mixed-methods approach, combining scoping reviews and expert interviews to provide a comprehensive understanding of the challenges and strategies in AT research translation.

METHODOLOGY

Scoping Reviews

Scoping reviews were conducted to examine the current state of AT research translation and identify gaps in the field. Scoping reviews benefit emerging areas, offering a broad overview of existing challenges and strategies (Munn et al., 2018). This approach helped uncover key barriers associated with regulatory requirements, funding limitations, and market fragmentation and revealed strategies from diverse contexts.

Expert Interviews

To complement the findings from the scoping reviews, expert interviews were conducted with stakeholders across academia, industry, policymaking, and user communities. These interviews provided firsthand insights into the obstacles identified in the literature and allowed stakeholders to propose practical strategies for overcoming them. By capturing diverse perspectives, the interviews offer actionable recommendations for researchers and developers aiming to bridge gaps in AT research translation.

SCOPING REVIEW

The scoping review aimed to systematically identify and analyse barriers and strategies in assistive technology (AT) research translation, focusing on the UK and other developed countries in Europe and North America. The review followed a structured approach involving keyword searches, paper screening, and thematic analysis. Three databases were used for the literature search: Google Scholar, Web of Science, and grey literature sources, including market reports, news articles, and government legislation. The search strategy combined three thematic keyword types—innovation processes, products, and stakeholders—with their alternate keywords, using various combinations:

Innovation Processes

Research translation, translational research, knowledge translation, product development, commercialisation, marketing, investment, innovation, invention, patent, intellectual property, startup, Valley of Death.

Products

Assistive technology, assistive products, health services, distribution, provision, mobility, cognition, vision, communication, hearing, environment, self-care, TRL.

Stakeholders

Stakeholders include the government, SMEs, manufacturers, clinicians, therapists, funders, investors, researchers, universities, users, policymakers, accelerators, incubators, the ageing population, and the NHS.

Inclusion Criteria

Literature published in English from 2010 onward.

Papers focused on barriers to AT research translation or disability-related research translation.

Studies examining the Valley of Death and strategies for overcoming it.

Contexts in the UK, with a broader scope extending to developed countries in Europe and North America.

Exclusion Criteria

Papers focused on low- and middle-income countries.

Studies solely address assistive product needs and designs, without examining research translation.

Screening and Selection

The initial search yielded 108 papers screened based on relevance to the research focus. After applying inclusion and exclusion criteria, 33 papers were selected for full-text review and analysis.

Data Extraction and Analysis

Each of the 33 selected papers was reviewed in detail. Barriers to technology translation and strategies described in the literature were extracted and categorised according to the phases of the TRL framework discussed in the literature review.

During analysis:

- Barriers and strategies were mapped to specific TRL phases.
- Closely related barriers and strategies were grouped and merged.
- General barriers and enablers that spanned multiple TRL phases were categorised separately.

This process allowed for a systematic understanding of the barriers encountered in the AT development process and the strategies proposed to overcome them. The insights from this analysis informed the research roadmap, which addresses the challenges of AT translation in the UK context.

EXPERT INTERVIEWS

This study obtained ethical approval from the UCL Research Ethics Committee (UCLIC_1920_011_Staff_Holloway_Williams). Six participants with experience translating AT research in the UK were recruited through the TIDAL network. Before the interviews, all participants received an information sheet and provided signed consent.

Interview Design and Purpose

The interviews were designed to complement and validate the findings of the scoping review. Questions were informed by the literature review and tailored to each participant, enabling a deeper exploration of the barriers and enablers in AT research translation. The interviews provided valuable insights, including rationales, real-world examples, and case studies to contextualise the challenges identified in the literature.

Participant Backgrounds

The participants included a diverse group of stakeholders involved in AT research translation:

One researcher focused on commercial activities, having developed a non-medical wheelchair in the TIDAL N+ project.

One researcher focused on academic research, having developed a medical device AT in the TIDAL N+ project.

Two startup CEOs whose innovations originated from university projects.

One wheelchair user, contributing user-centric perspectives

One associate business manager from a university technology transfer office.

Data Collection and Analysis

The interviews were conducted online via Microsoft Teams or Zoom and lasted approximately 30 minutes each. Video recordings were automatically transcribed. The transcripts were systematically organised and reviewed to generate initial codes, which the research team collaboratively refined. The transcripts were manually coded, and emerging themes aligned with the literature review findings. These themes were further categorised according to the TRL framework, ensuring consistency with the study's analytical structure. This process allowed for a comprehensive synthesis of insights from both the scoping review and interviews, providing a robust understanding of the barriers, enablers, and strategies involved in AT research translation.

OVERVIEW OF BARRIERS AND STRATEGIES FOR AT TRANSLATION

Next, we provide an overview of the barriers and strategies over the TRL levels of 1 – 9.

TRL 1 - 4: RESEARCH PHASE

Barriers	Strategies
Lack of motivation for commercialisation Researchers focus more on publishing academic papers than translating research into practical applications.	**Parallel assessment criteria** Add commercialisation criteria in academic performance evaluations and grant applications to encourage entrepreneurial activities.
Limited public grants Public funding is fragmented and insufficient to support AT development beyond the research stage.	**AT-specific grants** Create more targeted grants for long-term AT development, from research to commercialisation.
Ambiguous grant calls Grant requirements are unclear, making it difficult for researchers to find suitable funding.	**University-based competitions** Promote innovation through university competitions and provide entrepreneurial training for researchers.
Lack of user involvement Early-stage research often excludes user input, leading to solutions that do not meet real-world needs.	**Incorporate users early** Engage users in the early development stages to align products with real-life needs.

TRL 4 – 5: TECHNOLOGY VALLEY OF DEATH

Barriers	Strategies
Gap between lab research and real-life practice Laboratory metrics often do not match real-world experiences, leading to poor product fit.	**User participation** Involve users early to improve product design and adoption. Create platforms to engage disabled participants efficiently for research and trials.
Intellectual property (IP) conflicts Researchers and industrial partners often face disputes over IP ownership.	**Raise TTO awareness** Promote the role of Technology Transfer Offices (TTO) in helping researchers with IP and commercialisation support. **Business training** Provide entrepreneurial skills training to researchers and AT startups to enhance their ability to attract investment.
Difficulty securing investment Researchers struggle to prove their product's potential to investors during this stage.	**Produce accessible research outputs** Use plain language, infographics, and exhibitions to communicate research outcomes to a broader audience. Employ translational designers to translate academic results into practical insights that businesses can act on.

TRL 5 – 7: MINIMUM VIABLE PRODUCT

Barriers	Strategies
Regulatory hurdles for medical devices Meeting medical device regulations can be time-consuming and expensive.	**Non-medical product development** Start with non-medical AT products that bypass stringent regulations and test the market before pursuing medical versions. Enhance university-industry collaboration
Limited user reach Recruiting sufficient target users for large-scale testing is difficult.	**Leverage social media and events** Use social media, conferences, and disability communities to engage users and gather feedback. Build networks of stakeholders, including charities and clinicians, to validate products and support future research.
Cost of multiple prototype iterations SMEs struggle with the expenses of developing and testing prototypes.	**Simplify manufacturing** Design products for easy assembly and reduce manufacturing costs to make AT more affordable.

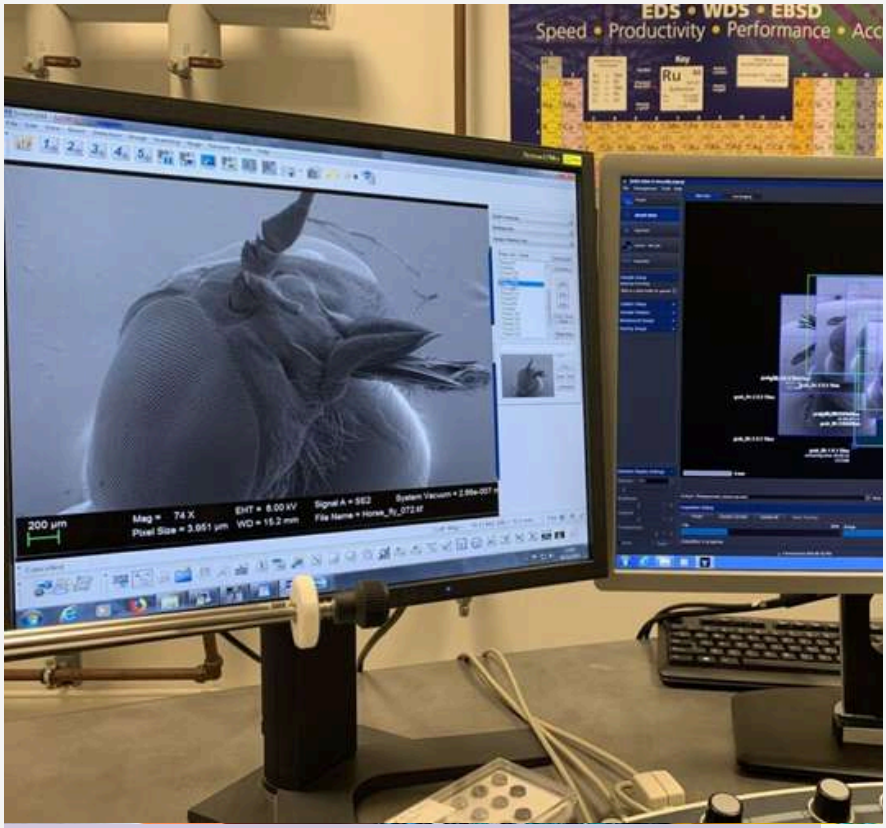
TRL 6 – 7: COMMERCIAL VALLEY OF DEATH

Barriers	Strategies
Commercialisation challenges AT developers often struggle to pitch their product to customers and commercialise their ideas.	**Build commercialisation teams** Support team-building activities to bring in commercialisation expertise alongside technical knowledge, and offer training in business and commercialisation skills, including mentorship and connections with investors.
Lack of funding Securing investment for large-scale production and marketing is difficult.	**Public procurement improvement** Strengthen public procurement processes to support SMEs' participation in government contracts and AT purchases.

TRL 8 – 9: COMMERCIAL PRODUCT

Barriers	Strategies
Lack of awareness among healthcare professionals and policymakers Limited knowledge of emerging AT products hinders their adoption.	**Train healthcare professionals** Provide up-to-date training on emerging AT products to healthcare providers.
Cost barriers Many AT products are expensive, and public funding is often insufficient to cover all needs.	**Policy improvements** Include diverse stakeholders in policy-making to create inclusive and practical AT-related policies. **Expand market focus** Recognise the purchasing power of a broader user base, including older adults and people with chronic conditions. **Frugal production strategies** Explore international sales and production to reduce costs and expand market opportunities.
AT abandonment High rates of AT abandonment due to poor fit, lack of personalisation, or insufficient after-sales services.	**Strengthen after-sales service** Invest in comprehensive after-sales services and training for AT users to ensure continued use and satisfaction.

RESEARCH PHASE (TRL 1 - 4)



The research phase typically occurs within universities. It comprises the development of research concepts and proofs of concept. Researchers explore valuable topics and conduct laboratory tests to validate their findings.

Researchers in academia are primarily motivated by publications, with the quantity and ranking of these publications often serving as critical indicators of success and reputation (Wright et al., 2009). While this system encourages the dissemination of research findings, it deprioritises activities such as licensing inventions or pursuing venture plans (Huszár et al., 2015; Leahy & Lane, 2010). For many researchers, filing patents is mainly a means of securing resources to sustain further research efforts (Olaya Escobar et al., 2017).

Academia offers an environment that researchers find appealing, with friendly colleagues, flexibility between projects, and opportunities for continuous learning. These factors often motivate researchers to prioritise academic careers over commercial ventures (Lam & de Campos, 2015). Additionally, traditional researchers usually prefer to translate their findings into practical inventions in a less rigid and more supportive academic setting (Huszár et al., 2015).

RESEARCH PHASE (TRL 1 - 4)

Barriers to Translation

Despite focusing on impactful research, many researchers lack the training and skills to translate their work into practical applications. These skills include effective communication with external organisations to form partnerships, navigating regulatory requirements, and commercialising products derived from their research (Page & John, 2019). The current academic system does not adequately equip researchers to engage in these activities, leaving many unaware of the commercial potential of their work (Huszár et al., 2015).

Our interviews revealed that many researchers in AT are driven by the desire to make a tangible societal impact rather than seeking financial rewards. However, the academic focus on pure research often prevents them from exploring the practical applications of their achievements. This gap underscores the need to shift the academic ecosystem to better support researchers in acquiring the diverse skills needed for effective technology translation.

The research phase of AT development faces systemic challenges that hinder the transition from conceptual research to practical application. While researchers are motivated by societal impact, the lack of training and support for translation activities limits their ability to commercialise their findings. Addressing these gaps by integrating translational skills into academic training programs and fostering stronger university-industry partnerships is essential for bridging the divide between research and commercialisation.

STRATEGY 1

Introduce Parallel Assessment Criteria to Encourage Commercialisation in Academia

Academics can broadly be categorised into two groups based on their aspirations in research: traditional researchers, who focus on generating knowledge, and entrepreneurial researchers, who aim to translate their research into commercial outcomes (Huszár et al., 2015). However, current academic success metrics predominantly emphasise publications, neglecting the diverse contributions of entrepreneurial researchers.

One of our interviewees, a researcher actively involved in commercialisation activities, proposed a parallel assessment system. This system would measure the commercial impact of entrepreneurial researchers separately, reducing the dual burden of producing high-impact research papers and commercial outcomes. By tailoring evaluation criteria, such a system could better support researchers with diverse career aspirations.

Another practical approach is incorporating commercialisation criteria into funding call requirements. For example, researchers highlighted that the TIDAL N+ project, with its emphasis on commercialization, encouraged participants to consider the practical impact of their studies. Including commercialisation goals in grant, criteria raise awareness and standards for AT development, creating a stronger push for research translation into market-ready solutions.

However, it is essential to recognise that not all researchers aspire to engage in commercialisation. One interviewee noted that academics who are more focused on research should be allowed to participate in commercialisation activities. Instead, they recommended delegating tasks to individuals better suited for these roles, such as entrepreneurial researchers or dedicated commercialisation professionals. A university-industry collaboration model provides a practical solution, enabling each partner to focus on their strengths. Researchers can concentrate on their academic expertise while industry partners lead commercialisation efforts.

Such collaborations are particularly effective during the MVP phase, where expertise in research and market adaptation is critical. The MVP phase and its role in commercialisation will be further explored in the following section.

RESEARCH PHASE (TRL 1 - 4)

“When you look at prosthetics from the outside, it looks like a very crowded market when, in fact, it's not the part I want, which is the high functionality accessible cheap ones. So that is a barrier no matter how much I try and explain… you don't understand the challenges faced by people (with disability) because you just see a market full of prosthetics.”

Limitations in public grants

Early-stage research often remains theoretical and lacks the maturity required to attract industrial investment, as industry partners prioritize certainty and rapid returns on investment. Consequently, funding for this phase primarily relies on government grants. However, even with such funding opportunities, some organisations struggle to secure suitable grants despite their extensive efforts (Noury et al., 2021).

One major issue is the ambiguity of research grant titles and calls for proposals, which often fail to articulate the scope, supported aspects, and application requirements clearly (REF review). As a result, researchers expend significant time and effort deciphering grant guidelines and crafting applications, diverting their focus from core research activities. This inefficiency complicates access to public funding, particularly for projects in emerging fields like AT.

Another challenge is the lack of alignment between public grant criteria and the interests of end-users who directly benefit from the research. Many funding calls emphasise scientific or technological innovation but neglect the ultimate costs and accessibility of the resulting products (Hallewell Haslwanter & Fitzpatrick, 2017). This disconnect can hinder the development of user-focused AT solutions. As one interviewee noted, articulating the practical impact of their research when applying for grants was particularly challenging, as the existing grant frameworks often undervalue real-world applications and social impact.

These challenges underscore the need for better-defined grant calls that clearly outline their focus and requirements, reducing the burden on researchers during the application process. Additionally, integrating user-centric criteria into funding frameworks could help align research outcomes with societal needs, making the eventual products more impactful and accessible. Addressing these issues would not only streamline the funding process but also encourage innovations that better serve end-users.

“We're looking at the next round because then I think we've probably got towards the end of traditional research grant projects. I think we're almost out of scope for the funding now.”

Limitations in public grants

This finding aligns with the REF report, which highlights that funders often prioritise technologies already on the market. However, when the project focus is on existing technologies. This misalignment between the types of projects that attract funding and the needs of end-users underscores a fundamental gap in the understanding of AT by funding bodies. Public funding programs are frequently restricted to the research stage, lacking a cohesive framework to support projects across various development phases, particularly the critical Valley of Death (VoD) stages.

As one interviewee noted, this fragmentation creates significant challenges for researchers and developers, leaving promising projects without the necessary support to bridge the gaps between research, development, and commercialisation. The lack of continuity in funding not only slows down the translation process but also risks leaving end-user needs unmet, further emphasising the need for more adaptive and inclusive funding mechanisms.

Current funding programs are typically short-term and fragmented, often supporting only specific stages of research and development. To address this limitation, a long-term funding program should be established to support AT translational research across all phases, from initial research to commercialisation (Gill et al., 2024). Such a program could be developed through partnerships between public authorities and industrial investors, forming a collaborative foundation to ensure continuous financial support.

Key features of this funding framework include:

Phase-Based Funding Distribution: Funds should be allocated in stages, with regular progress assessments to ensure projects are meeting milestones.

Continuous Financial Support: Grantees demonstrating expected progress would receive ongoing funding, reducing the administrative burden of applying for separate grants at each research stage.

Collaboration Between Public and Private Sectors: Public authorities and industrial investors could co-contribute, leveraging complementary expertise and resources to maximise the funding program's impact.

RESEARCH PHASE (TRL 1 - 4)

STRATEGY 1

Develop AT-Specific Grants Supporting Long-Term Development and Market Translation

The introduction of AT-specific grants with long-term support is crucial to facilitate the translation of AT research into market-ready solutions. Research on improving funding efficiency (Osório & Bornmann, 2022) indicates that narrowing the focus of grant calls to specific, active subject areas can significantly increase funding success rates. Tailored funding programs for AT research translation would address existing gaps. Key Recommendations:

Inclusion of AT-Specific Research Translation Grants: Public funding programs should incorporate dedicated sections for AT research translation.

Clear Articulation of Grant Requirements: Grant calls should clearly define their requirements, focusing on supporting translational research aimed at bringing AT outcomes to market.

Expert Review Panels: Grant review groups should include AT experts and users who understand the current demands and challenges in the AT landscape.

Instructional Feedback During Peer Review: AT specialists on review panels should provide constructive feedback to applicants, identifying strengths and weaknesses in their proposals (Gill et al., 2024).

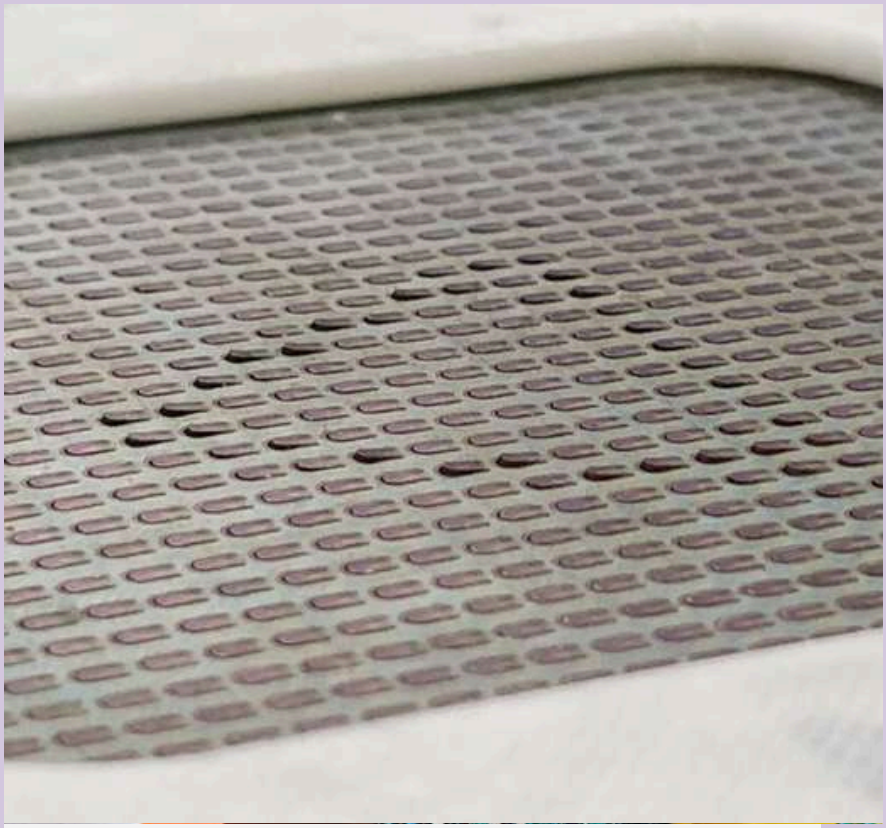
STRATEGY 2

Set up more university-based grants and competitions for AT innovation

Extracted from the experience of two AT startups that originated from UK universities, the universities provided their first financial support. The founders of the startups participated in competitions to win prize money to start a business and receive entrepreneurial training from the university. As many research ideas originate from the university, the university should encourage and support the growth of AT innovation from research to business development. Therefore, more competition for follow-up skills training and financial support should be established in universities as the nursery for AT innovation.

RESEARCH PHASE (TRL 1 - 4)

TECHNOLOGY VALLEY OF DEATH (TRL 4 - 5)



The technology VoD arises when research outcomes are ready to move beyond the controlled laboratory environment into real-world application.

Prototypes are typically developed and tested as proof of concept during the research phase under controlled conditions to support research publications. However, these controlled settings often differ significantly from the complexities of real-life practice, creating a critical gap in translating technology into viable, user-centered solutions.

Laboratory-based research is characterised by strict control of variables to ensure precision and reproducibility. While valuable for academic validation, evidence suggests that laboratory findings are not always aligned with real-world experiences (Jones et al., 2021). This disconnect reduces the likelihood of research being translated into practical applications that meet end-users needs.

Studies focusing on user and caregiver perspectives reveal that many assistive technologies (AT) developed through emerging research are impractical or fail to address their actual needs.

For example, Alqahtani et al. (2021) found that current AT solutions often lack usability and adaptability, reflecting a misalignment between research outputs and real-world requirements. This gap highlights the need for AT research to prioritise user-centred approaches and consider real-life variables to enhance practical adoption.

Bridging this gap requires a shift in focus during the translation phase, emphasising the demonstration of novel technologies in real-life scenarios to showcase their potential and return on investment. Such an approach can attract the financial and stakeholder support necessary to overcome the VoD and drive impactful AT solutions into the hands of those. who need them.

STRATEGY 1

Incorporate Users in the Early Stages of AT Product Development

Involving users early in AT product development is critical for creating solutions that meet real-world needs. Building long-term relationships with users and incorporating their voices into early design decisions enhances product relevance and raises user awareness of available AT options (Langley et al., 2020). Key considerations for user engagement are:

Encouraging Remote Participation: Remote participation is essential to accommodate users' time constraints and mobility requirements (Jones et al., 2021). To ensure effective remote collaboration, online accessibility and digital literacy training must be provided. Future research should focus on improving the efficiency and inclusivity of remote user collaboration, addressing barriers such as limited access to technology and varying levels of digital proficiency.

Addressing Ethical Concerns: Ethical considerations are crucial in user engagement, particularly in balancing research needs with users' everyday lives. Key issues include:

- **Defining Research Boundaries**: Ensuring that the integration of research into users' daily routines does not negatively impact their well-being.
- **Eliminating Biases**: Ensuring that blinded experiments are free of researcher or participant biases to maintain objectivity (Jones et al., 2021).
- **Informed Consent**: Providing a clear, neutral understanding of the research purpose and obtaining explicit consent from users before participation (NIHR, 2021).

Fostering Trust and Transparency: Long-term user engagement requires trust, which can be established through clear communication, transparency about research goals, and regular feedback loops. Users should feel valued and empowered as contributors to the design and development process, rather than as passive participants.

Incorporating users early in the AT development process ensures that products are designed with practical applications in mind. This user-centered approach not only increases the likelihood of adoption but also reduces the gap between research and real-world use. By addressing logistical and ethical challenges, researchers can create an efficient and equitable collaborative environment, ultimately leading to more impactful and user-friendly AT solutions.

STRATEGY 2

Develop Recruitment Platforms for Engaging Disabled Participants

Recruiting people with disabilities for user research can be challenging due to logistical and trust barriers. The UK Government Digital Service's experience in researching with individuals requiring special access highlighted the difficulty of manually identifying and contacting relevant organisations, many of which may be unaware of or distrustful of research intentions (John & Huert, 2018). Platforms like Disability Rights UK have proven valuable, offering trusted networks and connections to disability-related organisations for participant recruitment.

Recommendations for Recruitment Platforms:

- **Centralised and Accessible Platforms**: Develop widely known, centralised platforms to connect AT researchers with disabled participants. These platforms should facilitate trust and mutual benefits by offering transparency and clear communication about research intentions and outcomes.
- **Ensuring Mutual Benefits**: Participants should be fairly compensated for their time and contributions. From the perspective of AT users we interviewed, disabled participants value knowing how their input will influence research outcomes. Providing regular updates on how their feedback is implemented enhances engagement and trust.
- **Comprehensive Accessibility Information**: Recruitment platforms should provide clear and detailed information about the research process, including accessibility support and accommodations. Researchers must also effectively communicate why the study is worth participants' time, addressing practical concerns about the value of their involvement.

Barriers to Effective Communication

The ability to effectively communicate project objectives across diverse stakeholders is a significant barrier in translating AT research into practical solutions. Research outcomes from universities are often published in academic journals, requiring access rights and advanced literacy levels to interpret (Dew & Boydell, 2017). This limits the accessibility of novel findings to non-academic stakeholders, including enterprises and end-users, thereby restricting collaboration and the broader dissemination of cutting-edge technology.

Furthermore, developers often struggle to articulate product functionalities to potential users, creating a disconnect between what the technology offers and how users perceive its value (Hallewell Haslwanter & Fitzpatrick, 2017). Interviewees also highlighted the differing paces and priorities between academic and industrial projects, further complicating effective collaboration.

STRATEGY 1

Produce Research Outputs in Plain Language to Engage Target Users

Research outputs should be presented in plain language and accessible formats that resonate with a broader audience to bridge the communication gap between researchers, industry, and end-users.

Recommendations:

- **Diverse and Visual Formats**: Research findings can be translated into visually engaging formats such as posters, infographics, and short films.
- **Exhibitions and Public Engagement**: Regular exhibitions or showcase events for AT research can help present non-academic research outputs.
- **Focus on User Engagement**: Tailoring outputs to the needs and preferences of target users ensures greater accessibility and relevance. For example, user-friendly summaries or videos highlighting practical applications of AT innovations can attract interest from potential adopters and investors.

STRATEGY 2

Establish New Roles for Designers to Bridge Academia and Industry

Creating job opportunities for translational designers can address the disconnect between academic research and industrial application. Business partners often criticize academic research outcomes as impractical or difficult to understand, compounded by project development's differing paces and objectives in academia and industry. Translational designers act as interpreters, facilitating communication between disciplines and aligning goals to promote effective collaboration.

Role of Translational Designers:

- **Bridge Disciplines**: Translational designers translate complex academic findings into actionable, real-world insights, ensuring they are accessible and relevant to industry stakeholders.
- **Facilitate Communication**: They mediate between researchers and industry partners, helping to negotiate objectives, align timelines, and manage expectations.
- **Produce Non-Traditional Outputs:** Translational designers are instrumental in creating user-friendly outputs, such as prototypes, simplified reports, infographics, and practical frameworks, that accelerate innovation and industrial adoption (Owen et al., 2023).

Benefits:

- **Accelerating Innovation**: Translational designers reduce the time lag between research and commercialisation by transforming academic research into applicable insights.
- **Improving Collaboration**: Their role enhances mutual understanding between academia and industry, fostering partnerships that drive innovation.
- **Supporting Research Translation**: Translational designers enable researchers to focus on their strengths while ensuring that academic outputs are effectively positioned for industrial use.

Introducing translational designers as dedicated professionals can bridge critical gaps in AT development, aligning academic research with industrial needs. This strategy enhances the practicality of research outcomes and facilitates smoother collaborations, ultimately accelerating the journey from research to impactful AT solutions.

TECHNOLOGY VALLEY OF DEATH (TRL 4 - 5)

“I’ve had a project for two years, been awarded it, and I haven’t been able to start it because no one can agree on IP. The university can’t. The company can’t, and it’s just stuck.”

Intellectual Property (IP) Ownership Conflicts

The ability to effectively communicate project objectives across diverse stakeholders is a significant barrier in translating AT research into practical solutions. Research outcomes from universities are often published in academic journals, requiring access rights and advanced literacy levels to interpret (Dew & Boydell, 2017). This limits the accessibility of novel findings to non-academic stakeholders, including enterprises and end-users, thereby restricting collaboration and the broader dissemination of cutting-edge technology.

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STRATEGY 1

Increase Awareness of TTOs Among Researchers

TTOs, typically housed within universities, play a crucial role in providing IP-related support and facilitating negotiations between researchers and industry partners (WIPO, n.d.). Despite their importance, many researchers are unaware of the services and benefits TTOs offer, leading to missed opportunities to address IP issues and accelerate research translation. Raising awareness of TTOs is essential to maximising their impact and supporting researchers in navigating the complexities of commercialisation.

Recommendations:

- **University Roadshows and Drop-In Sessions:** These events provide opportunities for face-to-face interaction, allowing TTO staff to explain their functions, answer questions, and demonstrate how they can support researchers with IP management and commercialisation efforts.
- **Build Close Connections with Departments:** Regular communication with department heads and researchers can help TTOs proactively support promising innovations before IP-related barriers arise.
- **Showcase Success Stories**: Highlighting real-world examples of IP resolution, licensing, or commercialisation success demonstrates the practical benefits of working with a TTO.

Difficulty in securing investment

Securing funds from private investors is a critical step for organisations aiming to advance their innovations from the laboratory to real-life practice. Industrial investors and venture capitalists (VCs) are particularly motivated by products with high potential to progress through the VoD and reach the next phase of the TRL framework (Upadhyayula et al., 2018). However, a significant barrier is the inability to convincingly demonstrate the project's future potential for profitable industrial-scale production. If organisations fail to articulate this potential effectively, they struggle to attract investment from private entities focused on returns on investment (Boger et al., 2017).

Best Practices

- **Government-Funded Training Initiatives:** The UK Government's Innovation Knowledge Centre, supported by EPSRC, offers entrepreneurial training for startups in collaboration with higher education institutions. This includes mini-MBA courses that equip startups with practical business skills (Owen et al., 2023).
- **University-Led Programs:** The University of Birmingham's Medici program trains research staff to explore the commercial potential of their innovations.

STRATEGY 1

Build Business Management Skills for AT Startups

To address startup's challenges in advancing AT innovations, public grant programs and AT accelerators should incorporate business management skill-building as a core support component. Equipping startups and researchers with entrepreneurial skills can help them effectively navigate commercialisation challenges, articulate their value proposition, and engage with industry stakeholders.

Developing an AT-Focused Business Program

An AT-specific business program should be designed to address the unique challenges AT startups face. Key components of the program could include:

- **Management Skills**: Leadership, strategic planning, and financial management training tailored to the AT sector.
- **Team Building**: Guidance on structuring multidisciplinary teams, integrating expertise from engineering, design, and user advocacy.
- **Funding Utilisation**: Initial grants should cover team-building expenses, enabling startups to assemble the resources needed for sustained growth.

By integrating business management training into grant programs and accelerators, AT startups can develop the skills needed to scale their innovations effectively.

TECHNOLOGY VALLEY OF DEATH (TRL 4 - 5)

“I’m trying to build networks of clinicians, people that use prosthetics, charities, and companies. They are really likely to show there is a need for my research, and that does help.”

STRATEGY 2

Invest in Building a Network of Stakeholders

Creating a robust network of stakeholders in assistive technology (AT) is essential for overcoming the VoD and demonstrating the potential of research projects. As one researcher highlighted in an interview:

Benefits of a Stakeholder Network

- **Demonstrating Project Viability:** A diverse network—including clinicians, end-users, charities, and industry partners—helps validate the need for research and enhances its credibility. Researchers can strengthen their case when seeking funding or partnership opportunities by showing tangible demand for innovation.
- **Supporting User Research:** Engaging stakeholders early in the process enables researchers to design user-centred studies. This collaboration ensures that the technology aligns with real-world needs and expectations, increasing its potential for successful adoption.

Funding for Stakeholder Network Development

Researchers often rely on small grants from multiple sources to build these networks, bridging the gap caused by fragmented funding at different stages of AT development. Investing in the creation of such networks provides several advantages:

- **Encouraging Collaboration:** Facilitates partnerships across academia, industry, and the nonprofit sector.
- **Proving Research Value:** Provides data and testimonials demonstrating the project's relevance and potential impact.
- **Overcoming Fragmentation:** Helps researchers navigate gaps in the funding pipeline by pooling resources and building momentum for larger-scale funding.

Implementation

Public funding bodies and accelerators should prioritise initiatives supporting stakeholder network formation. Small grants aimed explicitly at network-building can enable researchers to engage diverse stakeholders and establish a foundation for long-term collaboration and project sustainability.

This report, led by Weiran Zhou at the Global Disability Innovation Hub, presents practical strategies to foster entrepreneurial approaches in research, translating academic innovations into impactful real-world applications. The project was funded by the Engineering and Physical Sciences Research Council [grant number: EP/W00717/1] through TIDAL Network Plus - Transformative Innovation in the Delivery of Assisted Living Products and Services, with internal review conducted by the TIDAL N+ investigator team.

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STRATEGY 3

Leverage Student Projects to Develop Prototypes

A practical strategy for advancing AT research is to adapt potential research topics into student projects. This approach provides students with valuable hands-on experience but also aids researchers in progressing their work from proof of concept to functional prototypes. By creating prototypes, researchers can better communicate their project's potential to stakeholders, including funders, users, and industry partners.

Benefits of Using Student Projects

- **Skill Development for Students:** Students gain practical experience in AT development, honing their engineering, design, and problem-solving skills while contributing to meaningful research.
- **Advancing Research Prototypes:** Through student collaboration, research concepts can be transformed into prototypes with partial engineering functionality. These prototypes demonstrate the innovation's feasibility and potential and can be used as tangible evidence to secure additional funding or partnerships.
- **Stakeholder Communication:** Prototypes act as a bridge between researchers and stakeholders, providing a visual and functional representation of the research. This improves understanding, builds credibility, and showcases the potential for real-world application.

Implementation

- **Integrate Projects into Academic Curricula:** Collaborate with universities to align AT research topics with student coursework or capstone projects.
- **Supervised Research Opportunities:** Researchers should be allowed to mentor students, ensuring alignment with the broader research goals while fostering innovative ideas from student contributions.
- **Leverage Multidisciplinary Teams:** Students from engineering, design, and business disciplines should be included to create well-rounded prototypes and accompanying business plans.

Using student projects to develop AT prototypes creates a win-win scenario: students gain valuable experience, and researchers progress their work to a stage where it can effectively engage stakeholders. This strategy accelerates the development process and strengthens the research's potential to secure funding and move closer to commercialisation.

MINIMUM VIABLE PRODUCT (TRL 5 - 7)

During this stage, various prototypes will be developed to test the products. The development of AT might also include meeting regulations for medical devices, which adds tasks alongside the development of presentation prototypes.

During the development stage of AT, prototypes undergo several iterations, often requiring substantial investment and time, particularly for small and medium-sized enterprises (SMEs). For AT products classified as medical devices, regulatory compliance adds further complexity, cost, and time, significantly impacting developers and end-users.

Compliance with NHS Standards: The National Health Service (NHS) is the primary customer of medical devices in the UK, requiring AT products to meet stringent standards. Programs such as EPSRC mainly fund AT projects to comply with these standards (Gill et al., 2024). This creates pressure on companies to dedicate long-term resources to regulatory compliance, often without a corresponding return on investment (Cudd, 2012).

Patent and Design Rights: Only 5% of applications achieve patent approval without professional support in the UK (Shore et al., 2018).

“...design itself and manufacture of it is low cost. What I don't know is what's gonna happen when we put all of the cost of getting medical approval on top of it.”

Regulatory Hurdles

Medical Approvals: The cost of obtaining medical device approvals is often underestimated during the research phase. Developers frequently express concerns about the added financial burden of regulatory compliance.

Training and Support Deficiencies: Studies indicate that university-based research is not adequately supported to meet medical device regulations in the UK (Hendricusdottir et al., 2021). The TIDAL N+ Training Report also highlights a gap in training AT professionals in regulatory compliance, leaving researchers and developers to address these requirements independently, often without sufficient resources or expertise.

Brexit-Induced Regulatory Changes: Brexit has introduced new challenges for AT developers. Starting in July 2024, AT products must carry a UK marking instead of a CE marking to enter the UK market (RREAL, 2023). Companies already compliant with CE marking must invest additional effort to meet UK-specific requirements, increasing regulatory costs and complexity.

The burden of regulatory compliance significantly impacts the timeline, cost, and feasibility of AT projects, particularly for SMEs. These challenges obstruct AT innovation and raise costs for end-users, limiting accessibility and market adoption. Addressing these regulatory hurdles is essential to advancing AT development.

MINIMUM VIABLE PRODUCT (TRL 5 - 7)

STRATEGY 1

Expand TTO Support Beyond IP Management

TTOs' role in universities is often stereotyped as limited to intellectual property (IP) support. This perception may discourage researchers from engaging with TTOs, reducing their impact on technology translation. To address this, TTOs should broaden their scope to provide holistic support across the entire AT research translation process.

Comprehensive Support from TTOs
Interviews with stakeholders in AT research translation identified key areas where TTOs could expand their services:

- **Mentorship and Accelerator Programs:** Offering guidance and structured programs to help researchers navigate the complexities of commercialisation and entrepreneurship.
- **Integrated Funding Support:** Centralizing access to internal funding opportunities and assistance in applying for external funding.
- **Entrepreneurial and Commercialisation Advice:** Providing tailored support for informal and non-patent-based commercialisation activities more aligned with natural practices in the AT space.
- **Broader IP Support Options:** Educating researchers about diverse IP protection strategies, such as copyrights, trademarks, and Creative Commons licenses, rather than focusing solely on patent filing.

Expanding TTO support beyond patent-based activities will better serve the needs of AT developers, and encourage higher engagement from researchers.

IP and Research Conflicts

The interviews also highlighted a conflict between the priorities of AT developers and the IP-centric focus of many TTOs:

Patent Constraints: AT developers often view patenting as time-consuming and expensive, which conflicts with their goals of rapidly publishing findings or achieving practical impacts. TTOs frequently recommend delaying publications until patents are filed, which clashes with academic performance metrics that emphasise open research and publishing.

Alternative IP Approaches: Many developers prefer open-access or creative commons models, particularly in AT, where broader accessibility can lead to a more significant societal impact. TTOs should consider supporting these alternative models to align with open research and non-commercial innovation goals.

“(Industrial partners will work on) getting all of the medical approvals… They know how that works, and researchers don't necessarily have that knowledge at the moment.”

STRATEGY 3

Promote University-Industry Collaboration for AT Development

Collaborations between universities and industry partners leverage the strengths of both sectors, combining academic innovation with industry expertise in commercialisation. Such partnerships accelerate the development of AT by providing researchers with entrepreneurial knowledge and enabling faster technology translation.

Benefits of University-Industry Collaboration

- **Knowledge Exchange:** Working with industry, university researchers gain managerial and entrepreneurial experience, enhancing their ability to navigate the commercialisation process (Huszár et al., 2015). Industry partners, in turn, benefit from access to cutting-edge research and novel technologies.
- **Accelerated Development:** Collaboration helps researchers overcome gaps in expertise, particularly in navigating complex regulatory processes.
- **Enhanced Product Performance:** Industry partners often work faster and bring a commercialisation experience that boosts the quality and performance of AT products, as shown by collaborative projects improving R&D outcomes (Scandura, 2016).

Implementation

- **Incentivise Collaboration**: Encourage universities to establish formal programs that connect researchers with industry partners through industrial-PhD models, internships, or joint projects.
- **Streamline Processes:** Support setting up agreements like IP-sharing frameworks to facilitate smoother collaboration.
- **Expand Funding Opportunities:** Introduce co-funded initiatives where public grants support collaborative efforts between universities and industry to bridge the gap between research and commercialisation.

MINIMUM VIABLE PRODUCT (TRL 5 - 7)

“I would say one of the biggest challenges is speaking to people who use the assistive technology that I want to research.”

Success Models

Industrial-PhD Programs: The IT University of Copenhagen’s industrial-PhD model demonstrates how combining academic research with industry mentorship equips researchers with entrepreneurial skills and expedites technology development (Debois et al., 2015).

Proof-of-Concept Support: Partnerships often begin at the proof-of-concept stage, where industry involvement ensures designs meet market requirements and regulatory standards.

University-industry collaboration offers a practical pathway for researchers to commercialise their innovations without leaving the academic field. By leveraging industry expertise in regulatory approval and market dynamics, these partnerships ensure faster development, higher-quality products, and a more seamless transition from research to market-ready solutions.

Reaching a Sufficient Target User Base

In the MVP phase of AT development, researchers and developers face significant challenges in reaching and engaging a broad enough user base to test prototypes and collect valuable feedback. This process often involves explaining product concepts and usage to end-users, which is no easy task.

Practical barriers, such as the time and effort required to travel or participate in research, can further limit engagement. AT users we interviewed expressed disappointment with current research practices, emphasizing the need for comprehensive information and respect from researchers. They stressed the importance of clear reasons for dedicating their time and effort, given the additional challenges posed by their disabilities.

MINIMUM VIABLE PRODUCT (TRL 5 - 7)

"People are already using social media. That's a really powerful way to do it. Rightly or wrongly, it's a trusted source of information."

STRATEGY 1

Leverage Social Media, Conferences, and Events for Product Outreach

Social media platforms are a powerful tool for engaging users with disabilities and promoting AT products. AT users often rely on social media as a trusted source of product information.

Startups and SMEs can utilise online disability communities to:

- Share product concepts and gather feedback.
- Advertise through disability-related campaigns.
- Create online shops to promote and sell their products.

Conferences and Events:
Conferences and events provide an opportunity to demonstrate AT technologies to a wider audience, including potential users, partners, and investors. AT users noted their willingness to engage in such settings, answering questions and providing feedback. These events can also connect startups with larger companies interested in collaboration or co-development opportunities.

STRATEGY 2

Engage Disability Communities for Broader Outreac

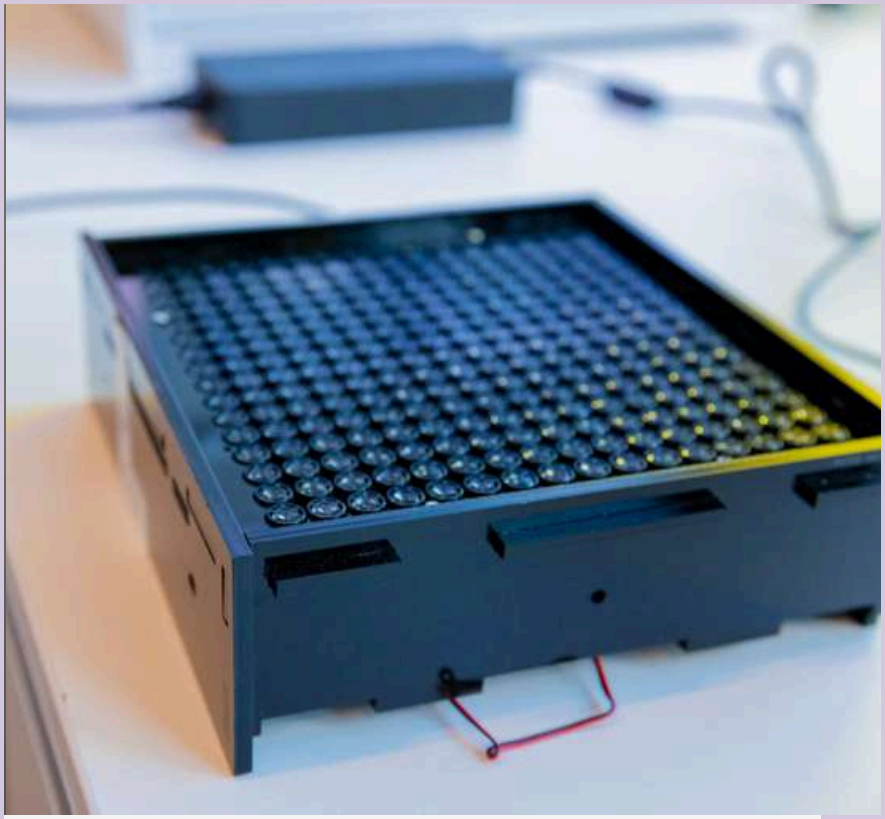
While social media and events are effective, they may result in a biased user group, as only those with digital access or an active interest are likely to participate. Disability communities and organizations offer a more inclusive channel to connect with a broader range of users.

Key Action is to collaborate with disability organisations that have established networks of AT users across the UK. These organisations can spread information and gather diverse feedback. Partner with disability charities or donors to raise awareness and streamline the user engagement process.

One startup highlighted the importance of networking with such organisations, as it not only increased awareness of their product but also simplified the process of reaching target users and securing funding.

MINIMUM VIABLE PRODUCT (TRL 5 - 7)

COMMERCIALISATION VALLEY OF DEATH (TRL 6 - 7)



The second VoD occurs when a prototype transitions to a demonstration system for a pre-commercial setting. This stage demands substantial financial investment and marketing efforts while carrying high risks.

One of the critical challenges at this stage is the difficulty AT developers face in effectively pitching their products to customers. According to a TTO officer, many developers fail to distinguish between customers (those purchasing the technology) and beneficiaries (those using it). Early academic commercialisation teams often focus too heavily on the technology itself without addressing customer pain points.

Moreover, finding a suitable individual to support commercialisation activities is a challenge. This person must possess a deep understanding of the technology, align well with the inventors, and share a clear vision for the company's growth.

By focusing on team building and commercialisation skill development, AT startups can overcome the challenges of the second VoD. A well-structured team and strong commercial expertise enhance their ability to secure funding, attract broader user groups, and scale their products.

“It is crucial to understand the customer's specific needs and how to address their pain points, rather than simply telling a story to the beneficiaries who may not be the ones paying for the technology.”

COMMERCIALISATION VALLEY OF DEATH (TRL 6 - 7)

STRATEGY 1

Support Team Building for Commercialisation Activities

Building a strong commercialisation team is essential for AT startups aiming to scale their business. Such a team can bridge the gap between developer’s technical expertise and customers’ needs, enhancing the startup's ability to cater to unfamiliar markets.

- **Importance of Teams:** A study involving over 800 venture capitalists (VCs) revealed that VCs prioritise the quality of the team over the business idea when making investment decisions (Gompers et al., 2020). This highlights the critical role of team-building in sustaining and growing AT startups.
- **Role of Accelerators and TTOs**: Accelerator programs, funding bodies, and TTO services should prioritise supporting startups in forming commercialisation teams. These teams should include commercial specialists who understand the company's technology and can effectively connect with customers and investors.

STRATEGY 2

Invest in Commercialisation Skills Training for AT Startups

Commercialisation skills are crucial for AT entrepreneurs to navigate the challenges of this VoD. Training and mentorship can equip startups with the tools to articulate their value proposition, connect with customers, and attract investors.

- **Mentorship and Networking:** Business support programs should connect startups with experienced mentors and industry professionals who can guide them in market engagement and commercialisation strategies.
- **Pre-Accelerator Programs:** These programs can provide foundational training in pitching, marketing, and customer engagement, preparing startups for full-scale accelerators or direct engagement with investors.
- **Investor Connections:** Facilitating interactions with investors not only helps startups understand market expectations but also enables them to refine their pitches and business strategies.

COMMERCIAL PRODUCT (TRL 8 - 9)

Regarding the commercial product, the manufacturing issues have been solved so the product can be produced on an industrial scale and is fully functional for consumers. Problems may occur when the company cannot make profits quickly enough.

Healthcare professionals play an important role in facilitating access to AT for potential users, and their knowledge decides the quality of AT service for the users (Jans & Scherer, 2006). However, a survey taken in the UK on AT knowledge and experience revealed that healthcare professionals had little knowledge in choosing AT, with no more than 40% of respondents believing themselves capable of monitoring the use of AT in the long term (Parkin et al., 2019). The fact aggravated the situation of emerging AT entering the market.

Moreover, AT development is undergoing the trend of integration into everyday life, and assistive functions will increasingly be embedded in daily-use products rather than appearing in the form of separate assistive devices (Moon et al., 2019). With more AT products appearing as non-medical devices, people with disabilities have more initiative to choose the AT they want, avoiding healthcare professionals as gatekeepers in providing access to AT.

However, reaching users and increasing awareness of newly developed AT remains a problem when a company starts to commercialise the AT product. Studies showed that some emerging ATs outside health and social care were abandoned due to the lack of awareness and slow uptake by people with disabilities. (Gibson et al., 2016; Moon et al., 2019).

Policy-making can potentially improve the implementation of novel AT in the healthcare sector and impose public education on the awareness of AT. Nevertheless, policymakers usually do not fully understand the challenges faced by people with disabilities and assistive technology provision (MacLachlan et al., 2018), resulting in a gap between policy and users' needs.

STRATEGY FOR HEALTHCARE PROFESSIONALS

Provide up-to-date training on the AT for professionals.

Training is essential in optimising AT usage and raising awareness (Wallis et al., 2017). While training on AT is broadly provided for healthcare professionals, there needs to be more training on specific emerging AT products (Long & Perry, 2008). The lack of suitable training on AT for professionals is a significant barrier to AT professionals' access to training [TIDAL Training Report]. Studies emphasised the importance of providing regularly updated training for healthcare professionals in improving clinical services and AT user experience (Manship et al., 2024). In this case, the emerging AT in the market can be recognised by professionals and introduced to potential users through clinical practice.

“I see assistive technologies as social devices. And for that reason, I don't believe that healthcare professionals should be involved in it… you can put the power of assistive technology back into the disabled community.”

STRATEGY FOR USERS

Provide up-to-date training on the AT for professionals.

Healthcare professionals, as gatekeepers in deciding whether a person is suitable to use an AT product, may lead to biased decision outcomes. Clinical experience, understanding of clients’ situations, and knowledge of assistive products can affect professionals' decision-making regarding interventions for their clients (Baxter et al., 2012). Therefore, there should be flexible space for people with disabilities to have access to information and choose their products. According to the interview, people with a disability would think of their AT as social equipment, which does not need a prescription from healthcare professionals. People with disability rely more on their community in the absence of appropriate policies and processes for AT provision. They believe their communities are supportive and include people knowledgeable in AT products and services. Therefore, disability communities are precious sources for connecting with users and commercialising AT products.

STRATEGY FOR POLICY MAKERS

The policy-making process should be more inclusive with different stakeholders who have experience with AT and disability inclusion involved.

To make the policy practical for AT provision, the policy-making process should include stakeholders in AT. Every new policy related to AT should ask for advice from people with disabilities before being implemented. In addition, scholars and professionals should be encouraged to utilise their research results to trigger policy change. For example, they can use evidence concerning AT's social, economic, and well-being benefits to attract the government's and policymakers' attention to improve AT-related policy (MacLachlan et al., 2018).

“We’re trying to avoid it being a medical product… what we’re trying to do is create it much more as a play toy.”

STRATEGY 2

Prioritise Non-Medical Devices to Open Markets and Support Medical AT Development

MINIMUM VIABLE PRODUCT (TRL 5 - 7)

Developing and commercialising non-medical AT devices can provide a practical pathway for startups and SMEs to enter the market, generate revenue, and support the later development of more complex medical AT products. Non-medical devices are increasingly popular for their affordability, usability, and inclusivity, offering significant advantages for both users and developers.

- **Benefits of Non-Medical AT Development**: Lower Barriers to Market Entry non-medical devices bypass the lengthy and costly regulatory processes required for medical devices, enabling quicker time-to-market. This reduces financial and logistical burdens, making it easier for startups to establish themselves (Cudd, 2012).
- **Inclusive Design and Reduced Stigma**: Built-in accessibility features in mainstream devices—such as voice assistants or screen readers—are attractive to users because they blend into widely used products, reducing stigma and fostering inclusivity (Senjam et al., 2021). An AT researcher highlighted the appeal of these features, noting they help disabled users feel less differentiated from others.
- **Diversified Funding Opportunities**: Non-medical AT products can attract funding from outside the medical sector, providing additional avenues for investment and sustainable growth (Mathieson et al., 2021). This approach supports startups in maintaining financial stability while developing their offerings.

One interviewee developing a wheelchair for children chose to design it as a play toy to avoid regulatory barriers. This decision allowed the product to be benchmarked against everyday items, making it more accessible to consumers.

Pilot Products: Early non-medical devices can act as pilot products to test user acceptance, refine features, and gather valuable feedback. For instance, a heart rate monitoring wearable could first be marketed as a sports product, providing a foundation for future development as a medical device.

Sector Integration: Aligning non-medical and medical product development supports complementary growth. National strategies integrating gaming and health sectors, for example, foster innovation by leveraging cross-sector synergies (Mathieson et al., 2021).

“It's a system where if you know how it works then you're able to get more from that system than people who don't know how it works and don't have certain capabilities.”

COMMERCIAL PRODUCT (TRL 8 - 9)

Cost and purchase barriers of AT

Although many assistive products are provided through the National Health Service (NHS), barriers, including reduced public funding and the complex process of eligibility application, leave the potential AT users with long periods of waiting list, which leaves the stress of purchasing the product to the users (Ward et al., 2017). The current government service for AT applications is thought to be inequitable by AT users.

In addition, a certain amount of AT is not partially or fully covered by public health insurance or private insurance (Mishra et al., 2022). In England, most AT products were bought from the private sector, and more than 50% of purchases were paid out-of-pocket. The inability to afford AT has become the first barrier for people with disability to access AT (Austin et al., 2023), which limits the commercial value of AT products.

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STRATEGY 1

Improve the public service for AT provision

To ease the burden that individuals pay for their own AT, public service for AT provision should be improved at the first place. According to a position paper from the first global research, innovation, and education on assistive technology (GREAT) summit, optimal AT provision is determined by several elements, including people's awareness, professional services, follow-up services, maintenance, etc. (de Witte et al., 2018).

Evidence (Tedesco Triccas et al., 2019) showed the complexity of the assessment and referral process can lengthen the waiting time for AT. Therefore, an improved professional support procedure should be created to increase the efficiency of AT provision.

Voices have also been raised for redesigning the public service for AT provision. An AT user criticised the inequitable process of AT public service in their interview. A qualified public service system should ensure that everyone with diverse abilities and knowledge backgrounds can acquire the information needed at the same level to receive due service.

STRATEGY 2

Discover effective manufacturing strategies

Effective manufacturing strategies are frequently mentioned during interviews with Researchers and startup CEOs, as it is crucial to reduce the price for AT users. Three different manufacturing strategies were identified in this study.

- Simplify the manufacturing techniques to manufacture products in-house.
- Design the components to be easily assembled so the cost of assembling and shipping can be reduced.
- Utilise manufacturing techniques that cost little, even with small batch sizes.

Kayanga and Hajas (2024) also mention investing in developing effective manufacturing and coordinating international cooperation to research and develop novel manufacturing methods.

COMMERCIAL PRODUCT (TRL 8 - 9)

STRATEGY 3

Encourage frugal production international and sales

Instead of sticking to the local market, SMEs can hold a global vision of production and selling. There are possibilities of exporting their products to other countries in Northern Europe and North America, where product prices can be higher, and the market is more significant than that in the UK.

The startup we interviewed that developed a braille printer has switched its business strategy to focus more on the USA market, with the manufacturing still in the UK. They mentioned active engagement with charities based in the USA and a higher potential to connect with more distributors in the USA with the support of local charities than solely operating in the UK.

Another startup that develops bespoke prosthetics focuses on designing for low- or middle-income countries (LMIC). They emphasised the importance of tailoring the products according to different cultural backgrounds, such as disability stigma and disability as a self-identity. They manufacture the UK products and assemble them in the local markets. However, they also consider suitable ways to manufacture in other countries worldwide to reduce the cost related to the previous strategy of discovering effective manufacturing methods.

Users do not use AT sustainably

The AT abandonment rate is estimated to be between 20% and 70% (Howard et al., 2020), which can lead to the failure of operating a business in the long term. Lack of user-centred design can be the main reason for rejection or abandonment of AT (WIPO, 2021). Users may refuse to use AT when they think the design cannot improve their quality of life. The aesthetic aspect also counts when people with a disability consider using AT products. In addition, poor after-sales services also contribute to the loss of long-term users (Tedesco Triccas et al., 2019).

Moreover, the lack of a standardised assessment for the fitness of potential users into AT leads to the unsuitability of AT usage, resulting in ultimate abandonment. It was reported that less than 50% of healthcare professionals aligned with the guidelines during assessment. Meanwhile, about 45% of healthcare professionals still need to carry out a follow-up assessment for the AT provided, contributing to the abandonment of AT (Tedesco Triccas et al., 2019).

COMMERCIAL PRODUCT (TRL 8 - 9)

STRATEGY 1

Develop usability standards for AT design and ensure its application during the early development of AT

A person-centred design is highlighted for AT design, which involves user participation throughout the design process (E. M. Smith et al., 2018). Personalisation, aligning with cultural background and design with users were actively mentioned during the interviews. Although designing for disability is not a one-fits-all task, there is specific empirical knowledge to follow from the initial phase to ensure usability for the ultimate design outcomes. Stakeholders should develop a usability standard for AT design for future high-quality and low-cost AT development instruction.

STRATEGY 2

Invest in the development of AT service, especially after-sales service and user training, constantly iterate the products from the user feedback

The current follow-up service for AT is not receiving adequate funds to ensure the long-term usability of assistive products (WHO, 2022). The after-sales service should be integrated into the product to ensure timely support for AT users. Moreover, the personnel involved in the service should also be well-trained to provide a positive experience for AT users.

STRATEGY 3

Impose a standardised assessment for assistive device provision and ensure long-term evaluation of the suitability of AT.

Healthcare professionals are major personnel in determining the suitable AT for their clients. Apart from AT companies' efforts, professionals should also take on the role of post-provision assessment to ensure the usability of AT and reduce AT abandonment. Professionals should implement the standardised assessment for the use of AT to ensure the appropriate adoption of AT so that the equipment can benefit users in the long term.

COMMERCIAL PRODUCT (TRL 8 - 9)

General barriers throughout AT Research and Development.

The AT market has been described as being small and fragmented (WHO, 2022). Throughout our research, we are still seeking an AT market report generated by disability-focused organisations. Existing market analyses are fragmented into specific assistive product types but do not see them as products under the umbrella of AT. This could be attributed to lacking a universally recognised definition of AT (WHO, 2022).

Manufacturers who intend to enter the AT market need more research and skilled personnel to conduct detailed market research (Bauer, 2003). Without a comprehensive understanding of the AT market, enterprises do not tend to enter the market, commonly thought of as lacking financial return, limiting financial support and commercial partners to AT research translation (Higgins et al., 2022).

Also, the lack of competitive products entering the market may result in weak bargaining power of users when facing the increasing cost of AT (Austin et al., 2023), which is not beneficial to a healthy marketplace.

STRATEGY 1

Encourage large organisations to lead the market research of AT

The current perception is that the AT market is small with limited consumers (Bauer, 2003), so a market analysis is crucial to provide a research basis to academics and present promising perspectives to attract industrial partners to cooperate with the academia in AT research translation. Although WHO has published a global report on AT (WHO, 2022), it focuses more on public values, which can hardly attract business partners. A market report focusing more on the commercial prospects should be made.

There are certain aspects suggested to be included in the AT market research:

- The categories of products count as AT and their current products, market value, etc. These will present a comprehensive landscape of AT for future reference and unite the fragmented sectors into distinct AT sectors.
- Investment from big companies in AT and accessibility features. Decisions by big companies will greatly influence AT's public judgement. With growing investment in accessibility by global-leading companies, the importance of AT will be recognised;
- The buying habits of possible user groups of AT include not only persons with disabilities but also older people and those who can benefit from AT.
- Identify capacity gaps in designing, producing, and maintaining AT solutions so the companies that want to enter the industry can identify the opportunities and needs in the market [Kayanga and Hajas 2024]

The market research can also centralise the terminologies used in AT, thus providing an integral landscape of AT and reducing the inefficiency of communicating with different languages among different stakeholders.

STRATEGY 2

Recognise the purchasing power of the entire user group of AT products.

Many business investors may underestimate the value of AT products because people with disability are thought to have lower incomes and are less likely to be employed than non-disabled people (Sparkes et al., 2022). However, the spending value of disabled people in the UK is evaluated to be around £274 billion, calling for improvements in accessible products and experiences (The Cabinet Office Disability Unit, 2021).

Moreover, the AT user group is not limited to people with disabilities but can be expanded to the ageing population. People now aged 50-70 years old who have maintained considerable household wealth are reported to be willing to accept technology in their daily lives (Ward et al., 2017). Existing research has also uncovered the possible user groups, including people with disability, older people, people with chronic conditions, children and people in humanitarian crises (WHO, 2022).

Catering to the needs of a broader range of users may increase the product's commercial value. By highlighting the purchasing power of their target users, AT startups can attract investment from venture capital and big companies. Therefore, organisations that intend to develop AT products should recognise all the possible user groups of their products. These design products meet the needs of a more extensive user base and impose different business strategies on them.

STRATEGY 3

Implement policy to regulate product prices in AT market. Implement policy to encourage the growth of AT market.

Policy can have a huge influence on the market. With the niche market in AT, the pricing of assistive products is high due to a lack of competitors. One wheelchair user we interviewed said some limited manufacturers grasp the production technology in certain areas of AT which is also the reason why the cost of AT cannot be reduced.

Policies should be established to encourage the industry to lower production costs and pricing while promoting increased competition by attracting more companies to this sector. For instance, tax incentives could be introduced for international NGOs that collaborate with local NGOs to produce and distribute assistive technologies locally, rather than relying on imported products [TIDAL Malawi Report].

The development of assistive technology requires navigating regulatory challenges, fostering user engagement, and balancing innovation with ethical and practical considerations.

Regulatory hurdles and strategies

Previous studies mentioned medical regulations as hurdles in translating AT research (Cudd, 2012, Gill et al., 2024) In this study, the review and interviews with researchers who develop AT also reveal that they only have a rough perception of applying medical approval as a time-consuming process but do not gain in-depth knowledge of it. This fact causes much AT research to terminate at the stage of MVP.

In the UK, the Medical Device Regulations (MDR) provide the legal framework for the marketing and sale of medical devices, which are classified into four classes (I, IIa, IIb, and III) based on the level of risk they pose to patients and users. All medical devices must undergo a clinical evaluation to demonstrate safety and performance (MHRA, 2020). For many assistive technologies, this includes clinical trials or studies, which can be a significant hurdle due to these devices' diverse and personalised nature. Moreover, regulatory requirements can slow down the pace of innovation, extending the product development timeline.

It should also be noted that the impact of Brexit forces AT developers to apply for another UKCA Mark (Rapid Research Evaluation and Appraisal Lab (RREAL), 2023), which causes extra time and effort in studying the new regulation. This reveals the barriers that occurred among international regulations. How medical device regulations will be revised to support AT translation is worth discussing. Future efforts can be made on the global harmonisation that simplifies the approval process and enables easy transition between national approvals such as the UKCA Mark, CE Mark and FDA approval. It should be noted that the conflict between the safety of users ensured by strict medical device regulations and barriers caused by medical device regulations in translating AT into the market should be balanced. Where practical, Develop and commercialise non-medical devices first to open the market and support the medical version to be developed.

Developing complimentary non-medical devices to open up the market

To avoid regulatory hurdles, several interviewees in this study mentioned developing and commercialising their complementary non-medical devices first. It echoes the strategy Innovate UK Business Connect (KTN) raised to underwrite the development of medical applications in neurotechnology (Mathieson et al., 2021). Any company that aims to develop innovative solutions in AT, such as medical devices, could consider this strategy as a mid-term goal. However, as mentioned above, this strategy should be noted to be only utilised in low-risk products as a counterplan for the long-term application of medical approval.

Although the pioneer AT that is not categorised as a medical device does not require strict verification, companies should also consider the ethical aspects of this strategy, such as the effectiveness and risks of the pioneer product, privacy issues and user transparency. Developers should prioritise safety and efficacy in their design and user experience to build trust and ensure a smooth transition to the medical version. As the pioneer product will be used for further development of the following medical devices, users should be notified what their data will be used for and given the flexibility of joining and withdrawing from the study.

Limited public awareness and difficulty of accessing clinical evidence of commercial AT

Previous studies attributed the difficulty of promoting commercial ATs to a broader audience to the limited awareness and knowledge of healthcare professionals (Parkin et al., 2019), AT users (Gibson et al., 2016; Moon et al., 2019) and policymakers (MacLachlan et al., 2018). However, it is also important to discuss the limited widespread clinical evidence of commercial ATs.

Although ATs classified as medical devices are subject to regulatory requirements, including the need for clinical evidence before they can be approved and commercialised. In practice, new medical devices are often approved before the publication of trials, and changes to their design or manufacture are frequently accepted without new clinical evidence (Fraser et al., 2018).

On the one hand, clinical evidence for ATs can be challenging to generate due to the personalised nature of these devices and the diversity of users, making it difficult to conduct standardized clinical trials. The evidence available may be based on small-scale studies or laboratory metrics, which is different from user experience in daily life (Jones et al., 2021), leading to the lack of knowledge by healthcare professionals in choosing suitable ATs for their clients.

On the other hand, clinical evidence may not always be easily accessible or well-publicised (Fraser et al., 2018). Manufacturers might not always publish full clinical study results, or the evidence might be available only in specialised journals that are not widely read by the public. In this case, manufacturers should take on the responsibility of producing easily accessible versions of clinical study results to ensure healthcare professionals know which medical device to recommend to their clients and interested users access information on the safe use of the device.

Reach out to disability communities

The barrier to accumulating clinical evidence in assistive technology (AT) development can be addressed by involving target users through co-creation. User engagement throughout the AT development process is strongly emphasised in various studies (Jones et al., 2021). However, disabled communities often face challenges in managing the volume of inquiries from students and academics seeking to recruit disabled participants.

Unlike larger and more established Public and Patient Engagement (PPE) communities, which are commonly involved in people-centric research, disabled communities tend to be smaller and more dispersed. This makes traditional recruitment methods more complex and less effective.

To overcome these challenges, innovative and inclusive recruitment approaches are needed. For example, building long-term partnerships with disability organisations and advocacy groups can help foster sustainable engagement. Additionally, utilising digital platforms or community-driven spaces may make recruitment more efficient and targeted while reducing the burden on disabled communities. These strategies facilitate smoother research processes and empower disabled individuals to take an active role in shaping AT development on their terms.

FUTURE ROADMAP

As AT research translation involves multi-disciplinary collaboration, the roles of stakeholders need to be discussed in the AT Research Translation Roadmap.

This SDG Progress Report is a continuous work in progress - a way for your organization to track its impact and improvements over time. This section outlines your strategy for continuing the good work done so far.

01 User Centred Across

First and foremost, user-centred principles should be implemented through all the processes involved, including research, design, marketing and policymaking. Policymakers should constantly act backstage for policy updates to support every phase of the research translation.

02 Targeted Funding

With more supportive long-term funding programs, researchers can concentrate on the project and have funds to drive future development, such as building a stakeholder network and setting up sub-projects. Translational designers should be hired to convert research into market ready products.

03 TTO Support

TTOs should extend their support from IP-focused to broader commercial activities, including training team-building support, medical approval support and any informal commercial activities. AT ventures can also trial a non-medical product to establish their markets.

04 Collaborations, Services

More funding should be allocated to disability organisations to purchase AT products from startups. AT businesses should also develop comprehensive after-sale services to provide the optimal experience for AT users and maintain long-term user groups which includes training and international expansion.

CONCLUSION

AT holds significant potential to improve the lives of disabled people, and there are numerous challenges in translating AT research into practical, market-ready solutions. This report identifies critical areas where improvements are needed by analysing various barriers across TRLs. These include strengthening academic incentives for commercialisation, increasing funding support across all stages of development, and fostering stronger collaborations between researchers, industry, and end users.

One of the most critical barriers is the “Valley of Death” faced during the transition from proof of concept to marketable products. Targeted funding, greater industry partnerships, and strategic user engagement are essential to overcome this. Long-term relationships with disability organisations can also significantly ensure that AT development is aligned with users' real-world needs. Furthermore, the regulatory hurdles, particularly for AT classified as medical devices, add complexity to the development process. A dual-track approach—focusing on non-medical AT first, where feasible, while preparing for regulatory approval for medical devices—can help to mitigate these delays and facilitate market entry.

This report provides a roadmap for future AT research translation, emphasising the need for multi-disciplinary collaboration, user-centred design, and the importance of policy and funding reforms. By addressing these barriers, bringing innovative AT to market can be significantly streamlined, resulting in greater accessibility and improved quality of life for people with disabilities.

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