

Assistive Technology: Enhancing Health Management for Inclusive Services

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Abstract. Competent healthcare management is fundamental in promoting facilitated and equitable access to products and services provided to the population. Among the products offered, Assistive Technologies (ATs) can be mentioned. These technologies contribute to the daily lives of people with temporary or chronic disabilities. It is a multidisciplinary field encompassing products, resources, and services to facilitate the daily lives of people with disabilities (PWD). Thus, researching such technologies contributes to accessibility, efficient adherence, social participation, independence, and improvement in the quality of life of these individuals. This work aims to understand the relationship between ATs and health management regarding their influence in the political, economic, social, legal, technological, and environmental perspectives. In the methodological process of this study, journals with themes related to AT were searched in the Scopus and Web of Science databases, resulting in 11,317 papers. Subsequently, papers were selected using exclusion criteria, including verification of duplicate documents, papers written in languages other than English, papers with Q1 and Q2 impact factors, and relevance criteria through a Likert scale, totaling 33 papers for PESTLE analysis. The research demonstrated that effective management significantly contributes to increased accessibility and incorporation of AT for people with limited functional capacity. Additionally, it is noted that, through PESTLE analysis, the relationship between Assistive Technology and the Environment needs to be more widely discussed in the literature, representing a gap to be explored.

Keywords: Assistive Technology, Health Management, Accessibility, Stakeholders, Technological Solutions

1. Introduction

Assistive Technology (AT) is a concept that only some understand very well. The ATs are products objecting to increase, maintain, or improve the functional capabilities of people with disabilities. Based on this, AT proposes devices to compensate for body function impairments. Thus, it can help further self-care, reduce healthcare costs and empower end-users [1]. According to OMS [2], the absence of AT use could result in social exclusion, reduction in participation in the labour market and, consequently, stagnation and poverty. Therefore, AT is an important tool because it can help people with disabilities achieve independence, promoting social integration, better life quality, and inclusion in the labour market [3].

There is a small number of studies that correlate health management and AT. However, it is very important once those technologies promote higher health quality to end-users. According to [4], at least 20 % of the population aged 60 and older needs some AT. Based on this, the products must be available, accessible, affordable, appropriate and safe to users. Therefore, it is necessary for political and health management to guarantee access to devices by those populations. Based on this, the study's objective is to analyse the role of AT in health management. AT is a relatively new concept referring to various strategies (devices, equipment, services, etc.) aimed at improving the quality of life and independence of people with disabilities, thus serving as a transformative tool in healthcare management, playing an essential role in promoting inclusive and accessible services [5].

The incorporation of AT into healthcare management contributes to the social inclusion of people with physical or mental limitations, assisting in communication, mobility, and interaction, enabling active participation in society, reducing marginalisation, and promoting a diverse and integrated community [6]. AT facilitates access to products and services for people with disabilities. By providing customised solutions and tools, physical and cognitive barriers are overcome so everyone can receive adequate medical care [7]. The non-use of this technology for people with special needs can lead to social exclusion, reduced participation in the labour market, and consequently, stagnation in poverty [2]. Conversely, the accessibility

of AT assists in positive functional outcomes, such as obtaining employment, increased social and psychosocial interaction, adaptation to acquired disability, and learning new skills. This improves quality of life, independence, and return to work [3].

Therefore, this work aims to understand the relationship between ATs and health management regarding their influence from the political, economic, social, legal, technological, and environmental perspectives.

2. Methodological Procedures

To achieve the objective of this research, a Systematic Literature Review (SLR) was carried out to delimit bibliographic sources based on systematic procedures, seeking comprehensive and scientifically valid results. Searches were conducted on the Scopus and Web of Science platforms [6] to explore articles focused on AT using filters based on the publication period (1989-2024), language (English), knowledge areas (engineering and health), and keywords ("Assistive technology" OR "Self-care technology" OR "Assistive User Interfaces" OR "Ambient Assistant Living" OR "Work Assistance and adaptive work assistance systems"). Following the filtering process, 11,317 documents were exported. Duplicate documents were removed using Mendeley, and subsequently, titles and abstracts were analysed to select articles with high impact and quartiles 1 and 2, resulting in 172 potentially relevant articles. With the research objective defined, 33 articles over 25 years were selected.

Table 1. Search filters used

	Filters used
Database	Scopus and Web of Science
Publication year	1989 – 2024
Document type	Articles
Language	Limit to English
Subject areas	Speech Language Pathology; Robotics; Computer Science Software Engineering; Engineering Multidisciplinary; Multidisciplinary Sciences; Health Policy Services; Social Sciences Interdisciplinary; Psychology Multidisciplinary; Psychology; Automation Control Systems; Otorhinolaryngology; Linguistics; Materials Science Multidisciplinary; Pediatrics; Psychology Developmental; Orthopedics; Medicine General Internal; Nursing; Psychiatry; Ophthalmology; Ethics ; Psychology Clinical; Psychology Educational; Social Sciences Biomedical; Sociology; Education Scientific Disciplines; Psychology Applied; Social Issues ; Business; Engineering Mechanical; Surgery; Communication; Social Work; Economics; Humanities Multidisciplinary; Transportation; Construction Building Technology; Rehabilitation; Computer Science; Engineering; Education Educational Research; Neurosciences Neurology; Telecommunications; Geriatrics Gerontology; Psychology; Public Environmental Occupational Health ; Medical Informatics ; Health Care Sciences Services; Sport Sciences; Audiology Speech Language Pathology; Robotics; Science Technology Other Topics; Social Sciences Other Topics; Materials Science; Orthopedics; Biomedical Social Sciences; Business Economics; Social Issues.
Keywords	"Assistive technology" OR "Self-care technology" OR "Assistive User Interfaces" OR "Ambient Assistant Living" OR "Work Assistance and adaptive work assistance systems"

The selected articles were read in full, and an Excel spreadsheet was prepared. This spreadsheet identified the health management correlated to AT in various sectors (institutions, human resources, finances, information, quality, risks, policies, and technologies). A coding system of "0" and "1" was adopted, with "1" indicating a citation of a specific management variable and "0" indicating no citation [7]. Just as it has been done in other studies [41], a meta-analysis was conducted using the political, economic, social, technological, legal, and environmental aspects (PESTLE Analysis) to provide a comprehensive overview of AT, enabling an understanding of the interrelationships, and highlighting the roles of mediators at each link in the AT network.

3. Results and discussion

In this section, the results of the SLR are presented, providing a cross-sectional view of the AT's approach to the different views of health management with the PESTLE analysis. Table 2 was designed to

understand how the management of Assistive Technologies is referenced in the studied articles, in the institutions, human resources, quality, risks, finances, information, technology, and health policies[8][9].

Originally, the PESTLE tool was applied to evaluate characteristics that may affect a certain product or service, limited to the business sector. However, today its use can be seen in engineering projects to delimit potential barriers and perspectives [10].

Table 2. Health Management Areas

HEALTH MANAGEMENT AREAS	REFERENCES	TOTAL
Health Policy Management	[11] [12] [13] [14] [15] [16] [17] [18] [19] [20] [21] [22] [23] [24] [25]	15
General Aspects	[26] [27] [28] [29] [30] [31] [32] [33] [34] [35] [36]	11
Health Finance Management	[11] [12] [15] [3] [17] [18] [21] [23] [24] [25]	10
Human Resources Management in Health	[15] [14] [20] [19] [37] [22] [23] [38] [24]	9
Health Technology Management	[39] [14] [15] [20] [24]	5
Management of Healthcare Institutions	[15] [17] [22] [23]	4
Quality Management in Healthcare	[40] [41] [38]	3
Health Risk Management	[42] [38]	2
Health Information Management	[15] [24]	2

Table 3 provides an overview of the discussions of each article, relating them to the PESTLE aspects.

Table 3. PESTLE analysis

AUTHOR		P	E	S	T	L	E
(Greenhalgh et al., 2015)	[39]	X	X		X	X	
(Layton et al., 2021)	[42]	X				X	
(Karki et al., 2023)	[11]	X	X	X		X	
(Smith et al., 2022)	[12]	X	X	X	X		
(Morash & Siu, 2017)	[13]	X	X	X		X	
(Cleland et al., 2023)	[26]		X	X			
(Chen, 2020)	[27]				X		
(Melkas, 2013)	[14]	X	X	X	X	X	
(Lersilp et al., 2018)	[15]	X	X	X	X	X	
(Thawisuk et al., 2022)	[16]	X	X	X		X	
(Monden et al., 2023)	[3]	X	X	X		X	
(Khaksar et al., 2017)	[28]		X	X			
(Balasubramanian et al., 2021)	[29]			X			
(Layton et al., 2020)	[17]	X	X	X		X	
(Luisa Toro-Hernandez et al., 2019)	[18]	X	X	X	X	X	
(Watchorn & Layton, 2011)	[30]	X	X	X		X	
(Sugawara et al., 2018)	[19]	X	X	X		X	
(Okoro et al., 2014)	[20]	X	X	X	X	X	
(Gallagher et al., 2022)	[21]	X	X	X	X	X	
(Pedersen, Söderström, et al., 2021)	[31]	X	X	X			
(Beneteau et al., 2023)	[32]	X	X	X			
(Rasouli et al., 2021)	[37]		X	X			
(Asghar et al., 2018)	[33]		X	X	X		
(Löfqvist et al., 2016)	[34]	X	X	X			
(Borg & Östergren, 2015)	[35]	X	X	X	X		
(Rios et al., 2014)	[22]	X	X	X	X	X	
(Pedersen, Kermit, et al., 2021)	[23]	X	X	X	X	X	

(Tuazon & Jutai, 2021)	[40]	X	X			
(Moxham et al., 2019)	[36]		X	X		
(Hughes et al., 2014)	[41]	X	X	X		
(Kabacinska et al., 2023)	[38]	X	X	X		
(Saborowski & Kollak, 2015)	[24]	X	X	X	X	X
(Austin et al., 2021)	[25]	X	X	X	X	X

3.1. Political aspects

Politics is a common term in the selected articles. For efficient and effective accessibility of AT by its dependents, the development of concise and standardised policy management is necessary according to local, regional, and global realities. From this perspective, the WHO published a worldwide report aimed at policymakers, other entities, and individuals, such as funding agencies, suppliers, academic centres, non-governmental organisations, the private and public sectors, older people, and people with disabilities.

AT involves civil rights, public funding, investment, and regulation. As a benchmark in investments and funding, a study conducted in Africa [33] exposes a deficit in financing and investments in products, systems, and services. Such funding can come from ministries (health, education, labour, and social welfare), the private sector (insurance and social security schemes), or a joint model between the public and private sectors.

Regarding the fundamental rights of people with disabilities, the United Nations Convention on the Rights of Persons with Disabilities (CRPD) is frequently mentioned as a guiding principle for public policies [9] [11] [15]. It is a legal document characterising disability regarding rights, determining the fundamental human right to equitable access to conventional, social protection, and specialised programs for persons with disabilities, such as rehabilitation and assistive technologies [9].

Based on regulation, consultation and implementation of the International Organization for Standardization (ISO) is noted to provide technical guidance for purchasing assistive products [32]. ISO 9999:2016 establishes standards for assistive products for sector standardisation worldwide. In this, 945 items were annexed and classified according to the functionality of AT [2].

Thus, public policy management [28] aligns with other areas, such as information and technology management [27] [16], through the adoption of measures to strengthen data and information management to ensure the needs of the target population while monitoring supply, service provision, and legislative compliance [2].

3.2. Economical aspects

To obtain AT, users can receive it through three means: by acquiring it directly from a private supplier, through the government, or from charitable institutions. Without access to AT, users are often excluded socially and trapped in poverty, increasing the impact of illness and disability on the family and the community [9].

The WHO report [2] shows an estimated growth in the global AT market from \$14 billion in 2015 to between \$26 billion and \$31 billion by 2024. The same report estimates that billions will need assistive products by 2050. Thus, investments in the assistive products market are promising.

AT enables potential users to be economically and professionally active. However, many obstacles hinder access to employment for AT users. A study conducted in Russia [42] reported that employers are unwilling to adapt to the corporate environment for people with disabilities. At the same time, it points out that the government introduces mandatory quotas to motivate employers to hire people with disabilities, along with sanctions for non-compliance with the quotas. However, this measure could be more efficient in Russia. In the same study, experts pointed out that the size of the quotas is insignificant (in Moscow, it is 2 a 4 % for an organisation with 100 or more employees), there is inefficient control over the fulfilment of quotas, and fines are illusory (fines range from 5,000 to 10,000 rubles, or about \$77 to \$154).

From an economic perspective, it is evident that collaborative work with policy and finance management benefits AT users. Implementing loans, instalments, discounts, vouchers, and reduction or waiver of taxes and tariffs for assistive products of local or international production contributes to increasing accessibility [2].

Furthermore, assistive technologies play a role in integrating people with disabilities into the workforce. AT users aspire to work and state that employment positively impacts the quality of life and financial independence. However, some barriers hinder access to employment, such as the absence of adapted

transportation, employer discrimination, policies regarding disability benefits, anxiety about difficulty securing employment, and fear of losing government benefits [30].

3.3. Social aspects

In the social aspect, there is unanimity among the articles. This demonstrates that, even though there are political, economic, legislative, technological, and environmental aspects, the literature prominently focuses on social integration and accessibility issues.

For the equal provision of assistive technology services, providers must consider the age, gender, type of disability, and economic income of users. Thus, to serve the most vulnerable groups, one study suggested the Community-based Rehabilitation (CBR) strategy to sensitise service provision at the public and socioeconomic levels [33], which other nationalities could adopt.

Access to quality AT at affordable prices promotes the social inclusion of users, enabling them to live with dignity, autonomy, and health. In addition to rationalising healthcare costs, accessibility reduces the demand for health services and social assistance, improving service provision and reducing the burden on healthcare professionals. Therefore, it represents a sum of consequent benefits, which has also increased the potential opportunities of users in other secondary aspects, such as access to education and the job market [15][43].

The United Nations Convention on the Rights of Persons with Disabilities (CRPD) proposes including people with disabilities in social life. The participation of assistive device users on equal terms with the non-disabled population is considered a right. Participation in activities such as sports and leisure produces positive outcomes for people with disabilities, characterised by improving their psychosocial conditions, as the quality of life is directly proportional to social interaction and interpersonal relationships [29]. Another benefit of AT is the guarantee of formal and informal citizenship for its users [11] [23].

In light of this, it is perceived that analysing the socio-economic characteristics of a population contributes to the planning of more competent public policies and the construction of an inclusive society based on civil rights.

3.4. Technological aspects

With technological advances today, there is potential to improve the independence, quality of life, and social inclusion of people with disabilities [2]. Technological innovations in AT extend beyond traditional engineering advances in devices such as prosthetics, wheelchairs, crutches, etc. They encompass a wide array of devices leveraging artificial intelligence of things and machine learning developed to improve life quality [38]; in other words, they are very important innovations and technologies [44] for people with disabilities.

The artificial intelligence of things is a combination of IoT and Artificial Intelligence (AI); IoT is devices, as sensors, able to interconnect and collect data in real-time. Research utilising these technologies demonstrates their importance across many types of disabilities, such as visually impaired people, paralysed patients, Alzheimer's patients, Parkinson's patients, hearing deficiency, cognitive deficiency, Autism Spectrum Disorder, etc. [45] [46].

For instance, [47] developed an IoT device capable of capturing images, identifying them, computing distances, and converting this information into audio to assist visually impaired people. Similarly, research involving a LEGO Mindstorms EV3 was built to help children with autism spectrum disorder to teach the basic concept of place value in mathematics. The study concluded that the device increased attention, focus, engagement, communication, and a happy and fun learning environment for users [46]. However, a study by [48] sought to determine whether digital technologies promote social inclusion among individuals with disabilities. They concluded that there are no concrete conclusions or results regarding improving technologies and technological trends to support social inclusion. Many technological devices have been developed recently, but most people with disabilities have no access to them yet; maybe this is why this study does not have concrete results on the positive impact of social inclusion. Based on this, health information management and political programs are very important to promote access to those devices by individuals with disabilities.

3.5. Legal aspects

The importance of AT is evident, as already discussed in this study; however, according to WHO [2], it is estimated that in poor countries, only 5 a 15 % of people with disabilities have access to AT. Each country has its laws regarding people with disabilities; however, the United Nations Convention on the Rights of

Persons with Disabilities (CRPD) was created to guarantee minimum rights for these people worldwide [47]. The CRPD was created to ensure that people with disabilities experience equal circumstances with people without disabilities [12].

The need for more research on the legal aspects of AT is noticeable, often limited to institutional documents and government reports. This gap hinders understanding of the legal challenges users face and the effectiveness of existing policies. Further research would enhance the protection of users' rights and assist in developing more effective legislation.

3.6. Environmental aspects

There are no studies involving the environment and AT. However, there are some foundations worldwide with some initiatives. The most common is recycling bread tags and bottle tops to convert them into wheelchairs for people without access to them due to the high cost. According to Associação Brasileira Beneficente de Reabilitação (ABBR), 195 thousand bottle tops or 420 thousand bread tags can be changed to one wheelchair. In Rwanda, there is a project that produces recycled wheelchairs; the idea is to fix wheelchairs by using simple metallic corners and screws to fix the seats to the wheels, making a sustainable and cheaper product [49]. In Brazil, a project at the Santa Maria University Hospital recycled thermoplastic masks that were usually discarded at the end of the treatment and made orthoses and prosthetics [50].

Another way to reduce environmental impact is the development of projects objecting to the reuse of AT products. Many people use AT dispositives for a specific time, and after they drop them in the garbage, those dispositives could be reused by another person. This way, it is possible to make them accessible to low-income people and also help the environment.

The absence of discussion regarding recycling end environmental in AT review articles suggests a gap in the literature. Therefore, even without research discussions, finding relevant initiatives to promote sustainability by re-using and renting dispositive and recycling is possible. Those initiatives help the environment by reducing electronic trash and extending the device's life; even with little discussion in the reviewed literature, it is an essential subject for a sustainable AT. Nowadays, sustainability is a very important point to consider; recycling and reuse can also reduce energy consumption, which is very important to preserve the environment [51][52].

In the context of people with disabilities, it is important to discuss the neighbourhood's physical environment, focusing on accessibility. One of the rights highlighted in the CRPD is accessibility, which ensures mobility for people with disabilities [12]. In many cases of disability, individuals require AT such as wheelchairs, walkers, crutches, etc. However, without accessibility for this type of AT, it is impossible to guarantee mobility and, consequently, independence for people with disabilities.

4. Conclusion

In this study, we conducted a Systematic Literature Review (SLR) to examine articles on AT and its relationship with the healthcare field. We utilised PESTLE analysis to evaluate the political, economic, social, technological, legal, and environmental factors related to AT. The results and discussions highlighted the importance of public policy management in promoting the accessibility of assistive devices, ensuring equitable access and social inclusion for individuals with disabilities. Additionally, the role of economic aspects in the availability and accessibility of assistive products was discussed, as well as the obstacles users face in seeking employment.

From the social aspect, it was evident that social inclusion and accessibility positively impact the quality of life and autonomy of people with disabilities. Participation in inclusive social and sports activities was crucial to promoting integration, well-being, and a sense of belonging among AT users. Regarding legal aspects, the importance of the CRPD in promoting the rights of people with disabilities and ensuring equitable access to assistive devices was highlighted. Finally, regarding the environmental aspect, despite the scarcity of articles on the topic, some relevant practices were discussed, such as reuse, recycling, and renting of devices, which contribute to promoting sustainability in AT.

The contributions of this study highlight the importance of public policy management and economic and social aspects in promoting the inclusion and accessibility of individuals with disabilities. However, some limitations were encountered, such as the need for more research on AT's legal and environmental aspects. As future research, it is suggested that studies be conducted addressing these gaps and investigating the impact of emerging technologies on the social inclusion of people with disabilities.

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Publishing Agreement

for Contributions in Edited Works

This Publishing Agreement (this “**Agreement**”) has been approved by and entered into between:

[Names + Addresses of all co-authors of the chapter, including the corresponding author (where possible with ORCID)]

(the “**Author**”)

whereas, in the event that the Author is more than one person, **[Name of the Corresponding Author]** serves as corresponding author

(the “**Corresponding Author**”)

on the one part and

Springer Nature Switzerland AG
Gewerbstrasse 11, 6330 Cham, Switzerland

(the “**Publisher**”)

on the other part;

together hereinafter referred to as the “**Parties**”.

The Publisher intends to publish the Author’s contribution in a collected work provisionally titled:

Industrial Engineering and Operations Management -XXX IJCIEOM, Salvador, Brazil, June 26–28, 2024

(the “**Work**”)

edited by: **João Carlos Gonçalves dos Reis, Francisco Gaudêncio Mendonça Freires, Milton Vieira Junior, Rafael Garcia Barbastefano, Ângelo Márcio Oliveira Sant’Anna**

(the “**Editor**”)

The Publisher intends to publish the Work under the imprint Springer .

The Work may be published in the book series **Springer Proceedings in Mathematics & Statistics**.

1. Contracting Authors

When the Author is more than one person then, unless otherwise indicated in this Agreement or agreed in writing by the Publisher:

(a) the expression “**Author**” as used in this Agreement will apply collectively for all such persons (each a “**co-author**”);

(b) the Corresponding Author hereby warrants and represents that all co-authors of the contribution

have expressly agreed that the Corresponding Author has full right, power and authority to sign this Agreement on their behalf, that the Corresponding Author is entitled to act on their behalf, and that they shall be bound by the Corresponding Author, with respect to all matters, responsibilities, notices and communications related to this Agreement; the Corresponding Author shall obtain authorisations and make them available to the Publisher on request; and
(c) each co-author is jointly and severally responsible for the Author's obligations under this Agreement which apply to each co-author individually and to the co-authors collectively and the Publisher shall not be bound by any separate agreement or legal relationship as between the co-authors.

2. Subject of the Agreement

2.1 The Author will prepare a contribution provisionally titled:

[Title of the Contribution]

The expression "**Contribution**" as used in this Agreement means the contribution as identified above, and includes without limitation all related material delivered to the Publisher by or on behalf of the Author whatever its media and form (including text, graphical elements, tables, videos and/or links) in all versions and editions in whole or in part.

2.2 The Contribution may contain links (e.g. frames or in-line links) to media enhancements (e.g. additional documents, tables, diagrams, charts, graphics, illustrations, animations, pictures, videos and/or software) or to social or functional enhancements, complementing the Contribution, which are provided on the Author's own website or on a third party website or repository (e.g. maintained by an institution) subject always to the Author providing to the Editor, at the latest at the delivery date of the manuscript for the Contribution, an accurate description of each media enhancement and its respective website or repository, including its/their owner, nature and the URL. The Publisher is entitled to reject the inclusion of, or suspend, or delete links to all or any individual media enhancements.

2.3 In the event that an index is deemed necessary, the Author shall assist the Editor in its preparation (e.g. by suggesting index terms), if requested by the Editor.

3. Rights Granted

3.1 The Author hereby grants to the Publisher the perpetual, sole and exclusive, worldwide, transferable, sub-licensable and unlimited right to publish, produce, copy, distribute, communicate, display publicly, sell, rent and/or otherwise make available the Contribution in any language, in any versions or editions in any and all forms and/or media of expression (including without limitation in connection with any and all end-user devices), whether now known or developed in the future, in each case with the right to grant further time-limited or permanent rights. The above rights are granted in relation to the Contribution as a whole or any part and with or in relation to any other works.

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The Publisher also has the right to commission completion of the Contribution in accordance with the Clause "**Author's Responsibilities – Delivery and Acceptance of the Manuscript**" and of an updated version of the Contribution for new editions of the Work in accordance with the Clause "**New Editions**".

3.2 The copyright in the Contribution shall be vested in the name of the **Author**. The Author has asserted their right(s) to be identified as the originator of the Contribution in all editions and versions, published in all forms and media. The Author agrees that all editing, alterations or amendments to the Contribution made by or on behalf of the Publisher or its licensees for the purpose of fulfilling this Agreement or as otherwise allowed by the above rights shall not require the approval of the Author and will not infringe the Author's "moral rights" (or any equivalent rights). This includes changes made in the course of dealing with retractions or other legal issues.

4. Self-Archiving and Reuse

- 4.1 **Self-Archiving:** The Publisher permits the Author to archive the Contribution in accordance with the Publisher's guidelines, the current version of which is set out in the **Appendix "Author's Self-Archiving Guidelines"**.
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5. The Publisher's Responsibilities

- 5.1 Subject always to the other provisions of this Clause below, the Publisher will undertake the production, publication and distribution of the Contribution and the Work in print and/or electronic form at its own expense and risk within a reasonable time after acceptance of the Work unless the Publisher is prevented from or delayed in doing so due to any circumstances beyond its reasonable control. The Publisher shall have the entire control of such production, publication and distribution determined in its sole discretion in relation to any and all editions and versions of the Contribution and the Work, including in respect of all the following matters:
- (a) distribution channels, including determination of markets;
 - (b) determination of the range and functions of electronic formats and/or the number of print copies produced;
 - (c) publication and distribution of the Contribution, the Work, or parts thereof as individual content elements, in accordance with market demand or other factors;
 - (d) determination of layout and style as well as the standards for production;
 - (e) setting or altering the list price, and allowing for deviations from the list price (if permitted under applicable jurisdiction);
 - (f) promotion and marketing as the Publisher considers most appropriate.
- 5.2 All rights, title and interest, including all intellectual property or related rights in the typography, design and/or look-and-feel of the Contribution shall remain the exclusive property of and are reserved to the Publisher. All illustrations and any other material or tangible or intangible property prepared at the expense of the Publisher including any marketing materials remain, as between the Parties, the exclusive property of the Publisher. The provisions of this subclause shall continue to apply notwithstanding any termination of, and/or any reversion of rights in the Contribution to the Author, under this Agreement.
- 5.3 Without prejudice to the Publisher's termination and other rights hereunder including under the Clause "**The Author's Responsibilities**", it is agreed and acknowledged by the Parties that nothing in this Agreement shall constitute an undertaking on the part of the Publisher to publish the Contribution unless and until: (i) any and all issues in relation to the Work (including all necessary revisions, consents and permissions) raised by the Publisher have been resolved to the Publisher's satisfaction, and (ii) the Publisher has given written notice of acceptance in writing of the final manuscript of the entire Work to the Editor. If following (i) and (ii) above the Publisher has not published the Contribution in any form within a reasonable period and the Author has given written notice to the Publisher requiring it to publish within a further reasonable period and the Publisher has failed to publish in any form, then the Author may terminate this Agreement by one month's written notice to the Publisher and all rights granted by the Author to the Publisher under this Agreement shall revert to the Author (subject to the provisions regarding any third party rights under any subsisting licence or sub-licence in accordance with the Clause "**Termination**").
- The Author may also give such written notice requiring publication on the same terms as above if the Publisher has published the Contribution but subsequently ceases publishing the Contribution in all forms so that it is no longer available.
- This shall be the Author's sole right and remedy in relation to such non-publication and is subject always to the Author's continuing obligations hereunder including the Clause "**Warranty**".

6. The Author's Responsibilities

- 6.1 ***Delivery and Acceptance of the Manuscript***

- 6.1.1 The Author shall deliver the Contribution to the Editor (or, if requested by the Publisher, to the Publisher) on or before 08-Jan-2025 (the “**Delivery Date**”) electronically in the Publisher's standard requested format or in such other form as may be agreed in writing with the Publisher. The Author shall retain a duplicate copy of the Contribution. The Contribution shall be in a form acceptable to the Publisher (acting reasonably) and in line with the instructions contained in the Publisher's guidelines as provided to the Author by the Publisher. The Author shall provide at the same time, or earlier if the Publisher reasonably requests, any editorial, publicity or other information (and in such form or format) reasonably required by the Publisher. The Publisher may exercise such additional quality control of the manuscript as it may decide at its sole discretion including through the use of plagiarism checking systems and/or peer review by internal or external reviewers of its choice. If the Publisher decides at its sole discretion that the final manuscript does not conform in quality, content, structure, level or form to the stated requirements of the Publisher, the Publisher shall be entitled to terminate this Agreement in accordance with the provisions of this Clause.
- 6.1.2 The Author must inform the Publisher at the latest on the Delivery Date if the sequence of the naming of any co-authors entering into this Agreement shall be changed. If there are any changes in the authorship (e.g. a co-author joining or leaving), then the Publisher must be notified by the Author in writing immediately and the Parties will amend this Agreement accordingly. The Publisher shall have no obligation to consider publication under this Agreement in the absence of such agreed amendment.
- 6.1.3 If the Author fails to deliver the Contribution in accordance with the provisions of this Clause above by the Delivery Date (or within any extension period given by the Publisher at its sole discretion) or if the Author (or any co-author) dies or becomes incapacitated or otherwise incapable of performing the Author's obligations under this Agreement, the Publisher shall be entitled to either:
- (a) elect to continue to perform this Agreement in accordance with its terms and the Publisher may commission an appropriate and competent person (who, in the case of co-authors having entered into this Agreement, may be a co-author) to complete the Contribution; or
 - (b) terminate this Agreement with immediate effect by written notice to the Author or the Author's successors, in which case all rights granted by the Author to the Publisher under this Agreement shall revert to the Author/Author's successors (subject to the provisions of the Clause "**Termination**").
- 6.1.4 The Author agrees, at the request of the Publisher, to execute all documents and do all things reasonably required by the Publisher in order to confer to the Publisher all rights intended to be granted under this Agreement.
- 6.1.5 The Author warrants that the Contribution is original except for any excerpts from other works including pre-published illustrations, tables, animations, text quotations, photographs, diagrams, graphs or maps, and whether reproduced from print or electronic or other sources ("**Third Party Material**") and that any such Third Party Material is in the public domain (or otherwise unprotected by copyright/other rights) or has been included with written permission from or on behalf of the rightsholder (and if requested in a form prescribed or approved by the Publisher) at the Author's expense unless otherwise agreed in writing, or is otherwise used in accordance with applicable law. On request from the Publisher, the Author shall in writing indicate the precise sources of these excerpts and their location in the manuscript. The Author shall also retain the written permissions and make them available to the Publisher on request.

6.2 **Approval for Publishing**

- 6.2.1 The Author shall proofread the page proofs for the Contribution provided by or on behalf of the Publisher, including checking the illustrations as well as any media, social or functional enhancements and give approval for publishing, if and when requested by the Publisher. The Author's approval for publishing is deemed to have been given if the Author does not respond within a reasonable period of time (as determined by the Publisher) after receiving the proofs nor contacts the Publisher within three days after receipt of the last of three reminders sent by the Publisher via email. The Publisher shall not be required to send a second set of corrected proofs unless specifically requested by the Author in writing but in any event no further

amendments may be made or requested by the Author.

In the event of co-authors having entered into this Agreement the Publisher shall send the page proofs to the Corresponding Author only and all persons entering into this Agreement as Author agree that the Corresponding Author shall correct and approve the page proofs on their behalf.

- 6.2.2 If the Author makes changes other than correcting typographical errors, the Author shall bear all the Publisher's costs of such alterations to proofs including without limitation to alterations to pictorial illustrations. The Publisher shall have the right to charge and invoice these costs plus value added or similar taxes (if applicable) through its affiliated company Springer Nature Customer Service Center GmbH or Springer Nature Customer Service Center LLC, respectively, to the Author, payable within 14 days of receipt of the invoice.

6.3 **Cooperation**

Without prejudice to the warranties and representations given by the Author in this Agreement, the Author shall cooperate fully with the Editor and the Publisher in relation to any legal action that might arise from the publication or intended publication of the Contribution and the Author shall give the Publisher access at reasonable times to any relevant accounts, documents and records within the power or control of the Author.

7. **Warranty**

- 7.1 The Author warrants and represents that:

- (a) the Author has full right, power and authority to enter into and perform its obligations under this Agreement; and
- (b) the Author is the sole legal owner of (and/or has been fully authorised by any additional rights owner to grant) the rights licensed in the Clause "**Rights Granted**" and use of the Contribution shall in no way whatever infringe or violate any intellectual property or related rights (including any copyright, database right, moral right or trademark right) or any other right or interest of any third party subject only to the provisions in the Clause "**The Author's Responsibilities**" regarding Third Party Material (as defined above); and
- (c) the Contribution shall not contain anything that may cause religious or racial hatred or encourage terrorism or unlawful acts or be defamatory (or contain malicious falsehoods), or be otherwise actionable, including, but not limited to, any action related to any injury resulting from the use of any practice or formula disclosed in the Contribution and all of the purported facts contained in the Contribution are according to the current body of research and understanding true and accurate; and
- (d) there is no obligation of confidentiality owed in respect of any contents of the Contribution to any third party and the Contribution shall not contain anything which infringes or violates any trade secret, right of privacy or publicity or any other personal or human right or the processing or publication of which could breach applicable data protection law and that informed consent to publish has been obtained for all research or other featured participants; and
- (e) the Contribution has not been previously licensed, published or exploited and use of the Contribution shall not infringe or violate any contract, express or implied, to which the Author, or any co-author, who had entered into this Agreement, is a party and any academic institution, employer or other body in which work recorded in the Contribution was created or carried out has authorised and approved such work and its publication.

- 7.2 The Author warrants and represents that the Author, and each co-author who has entered into this Agreement, shall at all times comply in full with:

- (a) all applicable anti-bribery and corruption laws; and
- (b) all applicable data protection and electronic privacy and marketing laws and regulations; and
- (c) the Publisher's ethic rules as laid down in the Book Authors' Code of Conduct currently available online at <https://www.springernature.com/gp/authors/book-authors-code-of-conduct>, as may be updated by the Publisher from time to time (provided that in the event of material changes the Publisher shall notify the Author by email) (the "**Applicable Laws**").

If the Author is in material breach of any of the Applicable Laws or otherwise in material breach of accepted ethical standards in research and scholarship, or becomes the subject of any comprehensive or selective sanctions issued in any applicable jurisdiction (e.g. being subject to the OFAC sanctions list) or if, in the opinion of the Publisher, at any time any act, allegation or conduct of or about the Author

prejudices the production or successful exploitation of the Contribution and the Work or brings the name and/or reputation of the Publisher or the Work into disrepute, or is likely to do so, then the Publisher may terminate this Agreement in accordance with the Clause "**Termination**".

- 7.3 The Publisher reserves the right to amend and/or require the Author to amend the Contribution at any time to remove any actual or potential breach of the above warranties and representations or otherwise unlawful part(s) which the Publisher or its internal or external legal advisers identify at any time. Any such amendment or removal shall not affect the warranties and representations given by the Author in this Agreement.

8. Author's Discount Electronic Access

- 8.1 The Author, or each co-author, is entitled to purchase for their personal use the Work and other books published by the Publisher at a discount of 40% off the list price, for as long as there is a contractual arrangement between the Author and the Publisher and subject to any applicable book price law or regulation. The copies must be ordered from the affiliated entity of the Publisher (Springer Nature Customer Service Center GmbH or Springer Nature Customer Service Center LLC, respectively). Resale of such copies is not permitted.
- 8.2 The Publisher shall provide the electronic final published version of the Work to the Author, provided that the Author has included their e-mail address in the manuscript of the Contribution.

9. Consideration

- 9.1 The Parties agree that the Publisher's agreement to its contractual obligations in this Agreement in respect of its efforts in considering publishing and promoting the Contribution and the Work is good and valuable consideration for the rights granted and obligations undertaken by the Author under this Agreement, the receipt, validity and sufficiency of which is hereby acknowledged by the Author. The Parties expressly agree that no royalty, remuneration, licence fee, costs or other moneys whatsoever shall be payable to the Author.
- 9.2 The Publisher and the Author each have the right to authorise collective management organisations ("**CMOs**") of their choice to manage some of their rights. Reprographic and other collectively managed rights in the Contribution ("**Collective Rights**") have been or may be licensed on a non-exclusive basis by each of the Publisher and the Author to their respective CMOs to administer the Collective Rights under their reprographic and other collective licensing schemes ("**Collective Licences**"). Notwithstanding the other provisions of this Clause, the Publisher and the Author shall each receive and retain their share of revenue from use of the Contribution under Collective Licences from, and in accordance with, the distribution terms of their respective CMOs. To the fullest extent permitted by law, any such revenue is the sole property of the Publisher and the Author respectively and, if applicable, the registration and taxation of that revenue is the sole responsibility of the respective recipient party. The Publisher and the Author shall cooperate as necessary in the event of any change to the licensing arrangements set out in this Clause.

10. New Editions

- 10.1 The Publisher has the sole right to determine whether to publish any subsequent edition of the Work containing an updated version of the Contribution, but only after reasonable consultation with the Author. Once notified by the Publisher that an update of the Contribution is deemed necessary, the Author agrees to deliver an updated manuscript in accordance with the terms of the Clause "**The Author's Responsibilities**" and the other relevant provisions of this Agreement, together with the material for any new illustrations and any other supporting content including media enhancements, within a reasonable period of time (as determined by the Publisher) after such notification. Substantial changes in the nature or size of the Contribution require the written approval of the Publisher at its sole discretion. The terms of this Agreement shall apply to any new edition of the Work that is published under this "**New Editions**" Clause.
- 10.2 If the Author, for whatever reason, is unwilling, unable or fails (including as a result of death or incapacity) to submit an updated manuscript that meets the terms of this Agreement within the above stated period, then the Publisher is entitled to revise, update and publish the content of the existing edition or to designate one or more individuals (which, where co-authors have entered into this

Agreement, may be one or more of the co-authors) to prepare this and any future editions provided that the new editions shall not contain anything that is a derogatory use of the Author's work that demonstrably damages the Author's academic reputation. In such case, the Author shall not participate in preparing any subsequent editions. The Author agrees that the Publisher shall be entitled but not obliged to continue to use the name of the Author on any new editions of the Work together with the names of the person or persons who contributed to the new editions. Should the Author or the Author's successors object to such continuing use then they must notify the Publisher in writing when first contacted by the Publisher in connection with any new edition.

11. Termination

- 11.1 In addition to the specific rights of termination set out in the Clause "**The Publisher's Responsibilities**" and the Clause "**The Author's Responsibilities**", either Party shall be entitled to terminate this Agreement forthwith by notice in writing to the other Party if the other Party commits a material breach of the terms of the Agreement which cannot be remedied or, if such breach can be remedied, fails to remedy such breach within 45 days of being given written notice to do so.
- 11.2 Termination of this Agreement, howsoever caused, shall not affect:
- (a) any subsisting rights of any third party under any licence or sub-licence validly granted by the Publisher prior to termination and the Publisher shall be entitled to retain its share of any sum payable by any third party under any such licence or sub-licence;
 - (b) except where stated otherwise in this Agreement, any claim which either Party may have against the other for damages or otherwise in respect of any rights or liabilities arising prior to the date of termination;
 - (c) the Publisher's right to continue to sell any copies of the Work which are in its power, possession or control as at the date of expiry or termination of this Agreement for a period of six months on a non-exclusive basis.

12. General Provisions

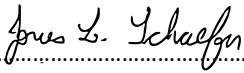
- 12.1 This Agreement, and the documents referred to within it, constitute the entire agreement between the Parties with respect to the subject matter hereof and supersede any previous agreements, warranties, representations, undertakings or understandings. Each Party acknowledges that it is not relying on, and shall have no remedies in respect of, any undertakings, representations, warranties, promises or assurances that are not set forth in this Agreement. Nothing in this Agreement shall exclude any liability for or remedy in respect of fraud, including fraudulent misrepresentation. This Agreement may be modified or amended only by agreement of the Parties in writing. For the purposes of modifying or amending this Agreement, "in writing" requires either a written document signed by both the Parties or an electronic confirmation by both the Parties with DocuSign or a similar e-signature solution. Any notice of termination and/or reversion and, where applicable, any preceding notices (including any requesting remediable action under the Clause "**Termination**") must be provided in writing and delivered by post, courier or personal delivery addressed to the physical address of the relevant Party as set out at the beginning of this Agreement or any replacement address notified to the other Party for this purpose. All such notices shall become effective upon receipt by the other Party. Receipt is deemed to have taken place five working days after the respective notice was sent by post or left at the address by courier or personal delivery. If the Publisher is the terminating Party the notice need only be provided to the address of the Corresponding Author. If the Author is the terminating Party a copy of the notice must also be sent to the Publisher's Legal Department located at Heidelberger Platz 3, 14197 Berlin, Germany.
- 12.2 Nothing contained in this Agreement shall constitute or shall be construed as constituting a partnership, joint venture or contract of employment between the Publisher and the Author. No Party may assign this Agreement to third parties but the Publisher may assign this Agreement or the rights received hereunder to its affiliated companies. In this Agreement, any words following the terms "include", "including", "in particular", "for example", "e.g." or any similar expression shall be construed as illustrative and shall not limit the sense of the words preceding those terms.
- 12.3 If any difference shall arise between the Author and the Publisher concerning the meaning of this Agreement or the rights and liabilities of the Parties, the Parties shall engage in good faith discussions to attempt to seek a mutually satisfactory resolution of the dispute. This Agreement shall be governed

by, and shall be construed in accordance with, the laws of Switzerland. The courts of Cham, Switzerland shall have the exclusive jurisdiction.

- 12.4 A person who is not a party to this Agreement (other than an affiliate of the Publisher) has no right to enforce any terms or conditions of this Agreement. This Agreement shall be binding upon and inure to the benefit of the successors and assigns of the Publisher. If one or more provisions of this Agreement are held to be unenforceable (in whole or in part) under applicable law, each such provision shall be deemed excluded from this Agreement and the balance of the Agreement shall remain valid and enforceable but shall be interpreted as if that provision were so excluded. If one or more provisions are so excluded under this Clause then the Parties shall negotiate in good faith to agree an enforceable replacement provision that, to the greatest extent possible under applicable law, achieves the Parties' original commercial intention.

The Corresponding Author signs this Agreement on behalf of any and all co-authors.

Signature of Corresponding Author:


.....
Jones Luís Schaefer
[Name of Author]

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Appendix “Author’s Self-Archiving Rights”

The Publisher acknowledges that the Author retains rights to archive the Contribution but only subject to and in accordance with the following provisions:

1. **Preprint:**

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