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Stakeholder analysis within the innovation ecosystem: A gerontechnology case in Hong Kong

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Abstract

Background: Hong Kong is experiencing rapid demographic ageing, similar to or ahead of many countries in Asia. In response to the many issues accompanying an ageing population, the Hong Kong Special Administrative Region Government (HKSARG) has prioritized gerontechnology, a field merging support services and technological advancements for elder care. A critical element for the future of this sector is the development of stakeholder collaboration within the gerontechnology ecosystem. This study aims to thoroughly examine the ecosystem's evolution by applying the innovation ecosystem concept and analyzing stakeholder engagement across the ecosystem.
Objective: This study seeks to explore the development of gerontechnology in Hong Kong through the lens of the innovation ecosystem concept. It aims to dissect stakeholder engagement by evaluating their positions, interests, motivations, and power within the ecosystem.
Method: Utilizing qualitative research methods, this study analyzed and discussed the viewpoints of 30 interviewees on stakeholder engagement through in-depth interviews and sketching techniques. The objective was to map out the gerontechnology ecosystem comprehensively.
Results: The study provides insights into the specific characteristics of the gerontechnology ecosystem, including its interconnectivity, common objectives, value chain, and micro-level insights. It highlights the pivotal roles of stakeholders in advancing gerontechnology in Hong Kong and outlines their potential contributions to the ecosystem.
Conclusion: The study provides a new perspective via its use of the innovation ecosystem to explain gerontechnology development, highlights the interconnected nature of stakeholder ecosystem development, and provides valuable insights into the stakeholders' roles. It suggests practical strategies for the government to collaborate with various stakeholders to foster social good through collective action, thereby promoting gerontechnology within the Hong Kong context.

Keywords: Gerontechnology, ecosystem, innovation ecosystem, stakeholder analysis, Hong Kong

Background

Hong Kong is navigating through a period of rapid demographic ageing, a phenomenon paralleling or surpassing trends observed in many countries in Asia. In response to the complex challenges brought about by an ageing population, the Hong Kong Special Administrative Region Government (HKSARG) has placed strategic emphasis on Gerontechnology. Since 2018, the HKSARG has dedicated billions from the innovation and technology fund towards applications in elderly and rehabilitation care. This move aims to facilitate the adaptation and adoption of gerontechnology within the eldercare sectors. Yet, one of the primary hurdles in this domain is the lack of sufficient collaboration among various stakeholders. It is suggested that creating a conducive gerontechnology ecosystem, which empowers stakeholders to actively participate in gerontechnology, is essential for enabling Hong Kong to effectively address the challenges of an ageing population (OHKF, 2021). The gerontechnology ecosystem, characterized by its interdisciplinary collaboration and cross-sector engagement, calls for stakeholders from various sectors to come together to advance the development and application of technology for an ageing society. This approach is poised to create significant social impact and provide holistic solutions to issues related to ageing. However, the current discussions on the development of gerontechnology in Hong Kong are predominantly focused on traditional value creation models, focusing on the dynamics between supply and demand. In the advocacy for promoting healthy ageing, the World Health Organization (WHO, 2019) emphasizes the need for stakeholders from all levels and sectors of society to possess the necessary skills, competencies, and knowledge. This is crucial for fostering healthy ageing and transforming the 'ecosystem' through cross-sectoral collaboration and coordination. Therefore, there is an urgent need for more dialogues aimed at stimulating ecosystem development and enhanc-

ing capacity building. Such efforts could lead to more effective ecosystem management, offering both economic and social benefits to society.

There is a clear necessity for further recommendations to lay the groundwork for sustainable development of the future ecosystem. This study aims to explain the concepts and framework of the ecosystem and to draw connections between the development of stakeholder engagement and the gerontechnology ecosystem, guided by the following research questions: What is the current state of gerontechnology development and stakeholder engagement in Hong Kong? How does this engagement facilitate changes and innovative benefits within the innovation ecosystem? Through this investigation, the study aims to provide academic insights into ecosystem management both within Hong Kong and the broader region.

Key concept: Ecosystem

The ecosystem concept has evolved to review how both individual and collective actions are being evaluated toward the sequences of resource management (Cortner & Moote, 1999). The term 'ecosystem' has become pervasive in strategic discourse, reflecting a variety of approaches to conceptualizing the structures of ecosystems and the strategies for their development (Adner, 2017). Valkokari (2015) delineates three primary types of ecosystems: business, innovation, and knowledge, each widely recognized within the scholarly community. Innovation ecosystems, in particular, are dedicated to tackling broad conceptual issues or grand challenges through a solution-oriented approach. Within these ecosystems, every stakeholder plays a crucial role in the co-creation of innovation, transforming novel ideas into opportunities for enhancing services, especially in environments with limited resources (Mitra et al., 2020). This strategic advancement in stakeholder engagement not only opens new business avenues for service providers within the collaborative ecosystem but also provides valuable perspectives on fostering active ageing and societal well-being (Camarinha-Matos & Afsarmanesh, 2011).

Key concept: Stakeholder

Stakeholder theory focuses on identifying who contributes to decision-making processes and who benefits from the outcomes of these decisions (Phillips et al., 2003). This theoretical framework is instrumental in examining the relevant constituencies and the rationale behind prioritizing and incorporating their interests into decision-making processes (Mitchell et al., 1997). Understanding stakeholder analysis is vital in the contexts of policy development, strategic changes, and organizational development initiatives, and in comprehending the social and natural phenomena influenced by stakeholders' decisions or actions (Reed et al., 2009). This analysis extends to individuals, groups, and organizations that may be impacted by or have the potential to impact these phenomena and the decision-making landscape. Furthermore, the interdependent nature of stakeholder relationships plays a significant role in determining their influence within the organizational network and their positioning within this network. Stakeholder analysis can also shed light on public sector management practices in the face of increasing societal complexity.

Research aim

The term 'innovation ecosystem' has emerged as a focal point of scholarly interest, attracting considerable attention from academics and researchers across various disciplines (Granstrand & Holgersson, 2020). The concept has not only seen a rapid growing in the body of literature but has also underscored its interdisciplinary nature, with studies spanning fields such as business management, healthcare, and sustainability, among others.

To provide a comprehensive understanding of the concept and identify literature trends, a thorough literature review was conducted. This review aims to provide a comprehensive understanding of the concept and to trace the evolution of literature trends within this domain. The innovation ecosystem has increasingly captured significant academic focus, demonstrating a broadening scope of discussion across various cross-disciplinary studies, including but not limited to business, enterprise management, global health, biotechnology, information technology, environmental protection, and psychology. Despite its widespread application across different countries and regions, there remains a gap in the literature regarding the growth experiences of innovation ecosystems in East Asia.

The importance of collaboration and the construction of ecosystems, particularly in the context of eldercare, has been underscored as a means to enhance the management of services and resources and to tackle the challenges and complexities presented by an ageing society (Chen, 2020). By examining the gerontechnology ecosystem in Hong Kong, this study aims to contribute valuable suggestions for fostering more sustainable development of future ecosystems. Furthermore, it seeks to provide academic insights into ecosystem management within Hong Kong and to propel forward the research on innovation ecosystems in the region.

Review of received definitions of innovation ecosystem

The innovation ecosystem comprises multiple actors, activities, artifacts, and institutions within

complex systems and relationships (Feng et al., 2021). Stakeholders have specific objectives, such as health services improvement (Sibuyi et al., 2022), technology-led innovations (Dixit et al., 2018), or economic and social benefits (Zou et al., 2021). The ecosystem is oriented towards sustainability and solution-driven approaches to grand challenges (Jütting, 2020). Collaboration and value co-creation bring together actors from different sectors to develop new services or technology and speed up innovation (Ferguson & Langer, 2021). Key attributes and features of the innovation ecosystem include openness, value co-creation, sustainability, and interconnectivity.

Attributes – (I) Openness

Openness is a crucial characteristic that enables interested participants to engage in the innovation ecosystem (Tsujimoto et al., 2018). The ecosystem encourages integration with other services and platforms, fostering interactions and relationships that expand and transfer knowledge, driving innovation forward (Silva et al., 2018; Nouman et al., 2022). Unlike a closed ecosystem, an open innovation ecosystem acquires knowledge and technology from external sectors. Such external support stimulates innovation, and businesses value external inventions and partners as an 'outside option' (Arora et al., 2019). Customers play a vital role in generating relevant and practical knowledge, making their involvement and that of the community of users a meaningful component for knowledge and value co-creation (Klimas & Czakon, 2022). The innovation ecosystem's emphasis on openness means that stakeholders from diversified backgrounds and sectors have the opportunity to join and participate, leading to the ecosystem's evolution (Chesbrough et al., 2014).

Attributes – (II) Value Co-creation

Value co-creation is one of the commonly identified features of the innovation ecosystem. Cobben et al. (2022) identify several value-creation mechanisms in the innovation ecosystem, including collective uncertainty management, mutual learning, shared vision development, and stakeholder engagement through a review of the ecosystem literature. The value chain of networks (Sibuyi et al., 2022) or ecosystem, with the alignment of value integration, progressively creates, delivers, and captures a broad range of capabilities (Kolagar et al., 2022). New values are co-created and delivered through co-innovation processes within the ecosystem (Klimas & Czakon, 2022). The process strengthens actors' capabilities, resulting in a commonly created output based on the ecosystem's value proposition with more promising services and values for society (Kolagar et al., 2022; Cobben et al., 2022).

Attributes – (III) Sustainability

The ecosystem's mission is to meet social needs that lead to better results for the entire society and tackle social challenges at a system level (Jütting, 2020). Sustainability is critical when illustrating the ecosystem's conceptual roots in terms of community engagement, resource allocation, and human investment (Mitra et al., 2020). Stakeholders within the innovation ecosystem cooperate towards achieving sustainable development synergy (Zou et al., 2021). The joint effort can lead to dynamic service capabilities with advanced relational capabilities, creating a sustainable competitive advantage for the industry (Kolagar et al., 2022). From a broader perspective, the innovation ecosystem supports innovative solutions to tackle economic and societal challenges. The form of an innovation ecosystem also leads to reviewing societal challenges that can be sought at the immediate solution level and answer social needs (Jütting, 2020; Mitra et al., 2020). Collaborative actions are required within the innovation ecosystem to deliver aspirations to address the grand challenges and achieve a better and more sustainable future for all.

Attributes – (IV) Interconnectivity

The innovation ecosystem is a complex system with multiple relatively independent parts, high interconnectivity, and interactivity (Mäntymäki et al., 2019). This complexity allows stakeholders to be highly interconnected, with the keystone typically being one stakeholder capable of supporting and orchestrating activities within the ecosystem. Interconnectivity refers to the fact that an actor's success or failure in the ecosystem affects the other members (Mäntymäki et al., 2019). Different platforms are created to allow a multitude of stakeholders to join, exchange ideas, and engage in transactions (Dedehayir et al., 2018). Innovation ecosystem definitions often emphasize collaboration, complements, and actors, and less commonly, competition, substitutes, and artifacts (Granstrand & Holgersson, 2020). The innovation ecosystem provides a cooperative environment in which co-evolving stakeholders organize across co-innovation processes, resulting in the co-creation of new value delivered through innovation through different innovation activities (Klimas & Czakon, 2022). The established interconnected and interdependent relationships in the ecosystem can help lead to more rapid innovation progress and achieve value creation and capture (Zou et al., 2021).

The literature review work has highlighted the importance of reviewing the stakeholder engagement in the ecosystem, which creates crucial information for the development of the innovation ecosystem. The more in-depth analysis helps to highlight the interaction relationship,

which constitutes a structure that can examine the patterns that elaborate and characterize the stakeholder relationships in the targeted ecosystem (Ramalingam, 2006; Wu et al., 2020) and facilitate the productive processes of knowledge sharing among the stakeholders (Ramalingam, 2006). The stakeholder analysis of this study is conducted based on the following assumptions: (i) The ecosystem operates out of mutual interest. (ii) The set of individuals or organizations that can produce something of greater value for the mutual benefit of the ecosystem as a whole (Davidson et al., 2015).

This study aims to employ the stakeholder categorization framework developed by Dedehayir et al. (2018), which strategically organizes the stakeholders pivotal to the innovation ecosystem's growth into four primary categories: 'Leadership', 'Direct Value Creation', 'Value Support', and 'Entrepreneur Ecosystem'. The approach goes beyond simple classification by delving deeper into stakeholder theory. It incorporates four additional dimensions to refine the analysis of stakeholders, potentially enriching our comprehension of the dynamics at play within stakeholder interactions.

To further understand stakeholder dynamics, the analysis introduces four critical elements that acknowledge the nuanced factors influencing stakeholders' decisions and actions. These elements are stakeholders' 'position' and 'power', which can have profound effects on the ecosystem's development. Additionally, the investigation considers stakeholders' 'motivation' and 'interests', which are essential for fostering ecosystem cohesion and offer a broader perspective on stakeholder relationships. This methodology aims to provide an exhaustive review of stakeholder engagement within the gerontechnology ecosystem, and the collaborative decision-making processes therein, and offer deeper insights into the complex interrelations among stakeholders. Ultimately, this enhances our understanding of the ecosystem's collaborative dynamics, contributing to a richer, more nuanced understanding of its operational mechanisms.

Position

Stakeholders are defined as individuals or groups with a vested interest, ownership, or rights in an organization's activities, whether in the past, present, or future (Clarkson, 1995). Understanding stakeholders' positions enables the identification of key actors within the ecosystem and the collection of insights regarding their perspectives, facilitating the quantification of stakeholder positions and the level of support or opposition they may offer (Varvasovszky & Brugha, 2000). This approach aids in mapping out the steps for analysis and further supports the examination of stakeholders' claims and interests in operations and decision-making processes.

Power

In stakeholder analysis, it is essential to identify those who wield significant influence over the principal decision-makers or who can exert influence within the decision-making process (Varvasovszky & Brugha, 2000). Evaluating the influence and resources that different stakeholders can leverage in decision-making or implementation is a critical component of stakeholder analysis (Varvasovszky & Brugha, 2000). Stakeholders may possess or potentially exert an active or passive influence on decision-making and implementation due to their positions, and some may have legitimate power impacting ecosystem development. The innovation ecosystem is characterized by both cooperation and competition, where the strategic management of stakeholders' power can yield strategic advantages (Klimas & Czakon, 2022).

Interest

Stakeholder interest is regarded as a pivotal element within innovation ecosystems (Autio & Thomas, 2014; Russell & Smorodinskaya, 2018; Klimas & Czakon, 2022). Following Freeman's (1984) perspective, stakeholder analysis should consider both the basis of power and stakeholders' interests. Innovation ecosystems must balance the distinct needs and demands of both public and private interests (Silva et al., 2018). Stakeholders' interest in and support for specific outcomes influence their capacity and willingness to mobilize resources toward achieving goals within the ecosystem (Varvasovszky & Brugha, 2000). Potential conflicts among stakeholders' interests in collaborative ecosystems may also arise and should be addressed in stakeholder analysis (Taratori et al., 2021).

Motivation

Motivations are the driving forces that influence behavior, propel actors to achieve specific objectives, and impact outcomes. Understanding the motivations behind stakeholders' engagement in ecosystem development is crucial (Kolagar et al., 2022). In discussions on stakeholder mapping in citizen science projects, examining both institutional and personal motivations of stakeholders is advised (Skarlatidou et al., 2019). It is suggested that organizations should account for stakeholders' motivations to promote collective value creation and performance (Bridoux et al., 2011). This information is valuable for strategic ecosystem management and for fostering sustainable stakeholder relationships, which are key to improving services and activities within the system.

Classifying stakeholders into four categories and analyzing four additional elements of stakeholders helps in understanding where and how decisions and actions are formulated within the ecosystem. Such insights provide a robust foundation for strategic ecosystem management and the cultivation of sustainable stakeholder relationships, essential for the ongoing enhancement of services and activities within the system.

Methods

Stakeholder identification

The initial and foremost step in understanding the gerontechnology ecosystem involves the identification of stakeholders. In this study, the process of identifying stakeholders was meticulously conducted through an examination of existing information available on websites related to the development of gerontechnology in Hong Kong. The analysis began with the identification of obvious stakeholders and continued until no new actors could be identified. The preliminary literature search was carried out between 13 and 23 June 2022, focusing on academic papers, articles in newsletters, and online publications. The search employed keywords such as 'Gerontechnology', 'Ecosystem', and 'Hong Kong', without imposing any restrictions on the publication year. The selection criteria included accessibility to open resources and articles published in English. Consequently, 14 distinct groups were pinpointed through this stakeholder analysis process and chosen as representatives for the study. Respondents from these diverse stakeholder groups were subsequently invited to participate in in-depth interviews, enriching the research with their insights and experiences.

In-depth interview for stakeholder analysis

This study is approached from a practitioner-researcher perspective, necessitating that researchers bring experience and roles to bear in their research endeavors with the aim of enhancing professional practices. This methodology underlines the importance of evidence-based practice, comprehensive evaluation, and the distinct insights derived from active professional engagement. The researcher's five years of experience in the field of gerontechnology have informed the adoption of this perspective, expected to offer substantial support and make a meaningful impact within the gerontechnology communities.

Employing a qualitative methodology, this research utilizes semi-structured interviews as the primary method for data collection. It engages stakeholders from 14 distinct groups, selected based on insights drawn from existing literature, materials, and reports. For each group, 2 to 3 representatives were invited to engage in the interviews. To ensure a thorough representation across all identified stakeholder groups, a combination of purposive and snowball sampling techniques was used. The in-depth interviews, lasting around 90 minutes and structured around a set of guiding questions, allowed the invited respondents to share their in-depth perspectives on the ecosystem and their interactions within the gerontechnology sector.

However, the researcher's positionality could potentially impact the closeness with interviewees adversely (Luintel, 2020). To mitigate concerns regarding bias and subjectivity, the researcher maintained a stance of neutrality, acting as an observer rather than a participant throughout the interviews. Prior to the main interviews, three pilot tests were conducted to evaluate the questionnaire design, anticipate and address potential biases or limitations, and confirm the feasibility and effectiveness of the research protocol.

Data collection was conducted through qualitative, semi-structured interviews with 2 to 3 interviewees from each stakeholder group, resulting in a total of 30 individuals invited for either face-to-face or Zoom interviews between 9 August and 12 December 2022. Essential terms, such as 'gerontechnology' and 'gerontechnology ecosystem', were clearly defined to ensure mutual understanding among participants. Participants were asked to visually map the current gerontechnology ecosystem in Hong Kong, using circles and lines to represent stakeholders and their relationships, and a red pen to denote missing stakeholders and their potential or envisioned relationships. By incorporating visual elements, this methodology not only enriched the data collected but also provided a valuable and rich theoretical foundation for analysis.

Qualitative data analytic and software used

The interviews were recorded using zoom or a recorder and transcribed into Word files. To generate ideas and identify patterns and themes for higher-level analysis, microanalysis was employed. The coding process, which involves creating different nodes, was used as the primary tool for organizing and classifying source data. A node hierarchy was developed and considered as the basis for developing visualizations in the analysis (Edhlund & McDougall, 2019) to better organize and classify the information. The Word files, as sources of materials, were uploaded onto NVivo12 for the coding process.

Demographic profile

To maintain ethical standards of confidentiality and anonymity, each interviewee was assigned a code during the data collection, analysis, and reporting processes, as detailed in *Table 1*. Additionally, the table lists the "Year of Understand-

Table 1. Demographic profile of interviewees

No.	Stakeholder Group (Code)	Code	Year of understanding Gerontech
Leadership role			
1	Government and governmental units (G)	G1	2018
		G2	2019
Direct value creation roles			
2	Older adults (OA)	OA1	2018
		OA2	2019
3	Caregivers (C)	C1	2018
		C2	2021
4	Service operators (N)	N1	2019
		N2	2017
5	Vendors (V)	V1	2021
		V2	2009
6	Business (B)	B1	2020
		B2	2019
Entrepreneur ecosystem roles			
7	Accelerators, Incubators & Groups (A)	A1	2019
		A2	2017
8	Gerontech startup, Innovative entrepreneurs (S)	S1	2016
		S2	2018
9	Charities & foundation (F)	F1	2019
		F2	2020
Value support roles			
10	Research and Development Institutions (R)	R1	2017
		R2	2020
		R3	2017
11	Healthcare professional (H)	H1	2019
		H2	2020
12	Academics (E)	E1	2020
		E2	2020
		E3	2017 – 2018
13	Young People (Y)	Y1	2019
		Y2	2019
14	Media (M)	M1	2017
		M2	2020

ing Gerontechnology" for each participant, indicating that all interviewees possess at least two years of experience or understanding in the gerontechnology field.

Results

Stakeholder analysis

In the interviews, participants were asked to identify and elaborate on all potential stakeholders within the gerontechnology ecosystem. They were prompted to describe each stakeholder's role, including their position, interests, motivations, and power, through a structured series of questions, such as:

- Who are the participants in the gerontechnology ecosystem, and how would you characterize their positions, interests, motivations, and power in interacting with other members?
- Could you describe the nature of the relationships among the stakeholders?
- How do you or your job interact with the other stakeholders? And how do the stakeholders interact with each other?
- Could you recount any specific activities, events, services, projects, or platforms you've participated in? How do stakeholders come into contact with each other?

Table 2 presents a summary of the stakeholders identified by the interviewees, specifically outlining their positions, interests, motivations, and power within the ecosystem. To deepen the stakeholder analysis, respondents were further inquired about their personal experiences, workflows, or daily interactions within the gerontechnology ecosystem. Questions aimed to explore these connections included:

During the interviews, respondents were able to easily identify more than five distinct stakeholder groups integral to the gerontechnology ecosystem in Hong Kong. Following the identification process, these stakeholders' roles were categorized into four main groups: leadership roles, direct value creation roles, value support roles, and entrepreneurial ecosystem roles, in alignment with the framework proposed by Dedehayir et al. (2018). The subsequent section provides an overview of these categorizations, including detailed descriptions of selected stakeholders to further clarify their roles and contributions within the ecosystem.

Leadership roles

The concept of 'leadership roles' within this study underscores the pivotal governance responsibilities stakeholders undertake to ensure the functionality of the ecosystem. This encompasses initiating and managing both internal and external interactions, as well as mobilizing diverse resources among partners. Leaders are instrumental in forming partnerships and managing platforms to foster collaboration. In the context of innovation ecosystems, leadership often entails defining the roles of other actors and orchestrating their interactions. The management of resource flows extends beyond platform-centric approaches, with leaders encouraged to cultivate relationships and establish inter-organizational trust. This approach to governance emphasizes a reduced dependence on formal, intricate contracts for inter-organizational exchanges.

In Hong Kong's context, the HKSARG is envisioned to embody leadership roles through specific, contextually relevant actions or 'directive roles.' These actions involve the creation of collaborative platforms and projects, equipped with the necessary resources, to facilitate stakeholder engagement within the gerontechnology ecosystem. Given its authoritative position, the government is equipped to allocate resources essential for the innovation process, playing a critical role in value management, the bundling of offerings and supplied components, and the stimulation of value appropriation for both producers and end-users (Dedehayir et al., 2018). The HKSARG actively encourages stakeholder collaboration and the societal adoption of gerontechnology, exemplified by the organization of the annual Gerontech Expo, showcasing the collective

Table 2. Stakeholder analysis of the gerontechnology ecosystem in Hong Kong

Type of stakeholders	Identified by (N=Total No. of respondents)	Position	Interest	Motivation	Power
Government and governmental units	N=29 (A1, A2, V1, V2, B1, B2, C1, C2, E1, E2, E3, F1, F2, G1, G2, M1, M2, N1, N2, OA1, OA2, R1, R3, R2, S1, S2, Y1, Y2, H2)	Leading, supportive, active, driving.	Responding to governmental initiatives and ageing challenges, promoting economic and industrial development, seeking collaboration for social innovation	Gaining support from citizens, addressing ageing population challenges, creating a favorable business environment, building reputation, reducing social costs	The most significant power in terms of governance, regulations, and decision-making
Service operators	N=26 (A1, A2, V1,V2, B1, B2, C1, E1, E2, E3, F1, F2, G1, G2, H1, M1, N1, N2, R1, R3, R2, S1, S2, Y1, OA2, OA1)	Supportive, important role as demand-side, beneficiaries from government policy, hold a neutral position as users.	Interested in exploring new technology functions from local and overseas, enhancing service operations' efficiency and effectiveness, and exploring social collaborations with different stakeholders.	Enhancing service quality, reducing workload and stress, and reducing the risk when caring for service recipients.	Possessing usage and buying powers, decision-making authority through assessments, executive power to enhance usage rates, influencing power to promote products to service users and reach potential users, and subject to resource availability.
Older adults	N=26 (A2, V1, B1, B2, C2, E1, E2, E3, F1, F2, G2, H1, H2, M1, M2, N1, OA1, OA2, R2, S2, Y1, Y2, A1, C1, S1, N2)	Some hold positive attitudes and act as end-users on a need-basis, while others are supportive on the demand side.	Exploring ways to age in place, gain new knowledge, investigating products that can support their lives, and following trends based on personal interest.	Believing that products can enhance their quality of life, provide self-help, autonomy, and allow them to age gracefully and live with dignity.	Having buying and consumption power, autonomy, and influence through word of mouth. Relatively passive, and dependent on their resources to buy.
Caregivers	N=21 (A2, B2, C1, C2, E1, E2, E3, F1, G2, H1, M2, N1, OA1, R2, S1, S2, Y2, A1, OA2, Y1, N2)	End-users on the demand side of the ecosystem, welcoming and supportive on a need-basis.	Exploring solutions to reduce their burden, providing better care work, finding affordable products, improving their quality of life, and finding time for themselves.	Solving problems, reduce their burden, save resources, improve the care experience, and keep care recipients happy and satisfied.	Having buying power, feedback power, word-of-mouth influence, and consumption power.
Academics	N=28 (A1, A2, V1, B1, B2, C1, C2, E1, E2, E3, F1, F2, G1, G2, M1, M2, N1, N2, OA1, OA2, R1, R2, S1, S2, Y1, Y2, H1, H2)	Favorable, impartial, emphasizing education, promoting research and development, facilitating and participating in roles.	Providing education for training new generations, considering academic values, transferring knowledge, conducting research with societal impact, encourageing exploration of relevant topics among students, promoting diversity.	Supporting sustainable development, promoting talent development, enhancing the gerontechnology ecosystem, creating new areas and businesses, achieving research impact, gaining government support, enhancing reputation and ranking.	Acquiring research and development capabilities, cultivating talents, establishing credibility, assessing influence, academic authority, administrative power within the academic community.
Gerontech startup, innovative entrepreneurs	N=21 (A1, A2, C1, C2, E1, E2, E3, F1, F2, G1, G2, M1, N1, OA1, OA2, R3, R2, S2, B2, S1, R1)	Serving as suppliers, manufacturers, supporters, and leading the technological development.	Focusing on profits, reputation, creating quality products and services, responding to user needs, enhancing competitiveness, fulfilling a sense of mission, conducting research and development.	Helping older adults by providing new technologies, developing businesses, generating revenue.	Possessing the power of product development and formulation, intellectual property, being passive, and having the power of diversity in gerontech development.
Business	N=14 (A2, V1, B1, B2, E2, E3, F2, G1, H1, M1, M2, C2, E1, R1)	Driven by business goals, being supportive, integrating marketing, and supporting social responsibility.	Focusing on profits and reputation, exploring opportunities, and seeking working partners.	Economic incentives, reputation and branding, and profits.	Possessing the power of sales and service promotion and formulation, being passive, dependent on business priorities, and having financial power.

Table 2. Stakeholder analysis of the gerontechnology ecosystem in Hong Kong (cont.)

Type of stakeholders	Identified by (N=Total No. of respondents)	Position	Interest	Motivation	Power
Charities & Foundation	N=10 (B1, C1, E3, F1, F2, G1, N1, N2, S1, A2)	Neutral, considering charities, serving the people, sponsoring philanthropy.	Promoting the vision, helping others, allocating resources to the needy.	Filling the service gap, goodwill, branding, and contributing to society.	Possessing varying but significant funding and resource power, being one of the stakeholders with the largest resources, but their power is limited as they rely on temporary funding and resources.
Healthcare professional	N=10 (A2, V1, V2, C1, F2, G1, H1, H2, B1, E3)	Service providers, catering to specific patient needs.	Reducing workload, improving the quality of nursing care by adopting gerontechnology.	Enhancing the well-being of older adults, developing a better healthcare system in Hong Kong.	Possessing buying power and providing professional endorsement.
Accelerators, incubators & Groups	N=6 (A1, A2, B2, N2, R3, V2)	Focusing on technology innovation, being supportive of start-ups, and serving as incubators.	Considering the development of start-ups and seeking collaboration opportunities.	Supporting economic development, creating job opportunities, promoting smart living, and sustaining businesses.	Possessing certain influential power in the ecosystem.
Vendors	N=10 (C2, E1, E3, N1, N2, R1, OA2, V1, R2, H2)	Being considered as the supply-side, providing products, and making profits, while being supportive.	Serving customers with professional services, exploring new technologies overseas.	Focusing on market share, making profits, fulfilling business mission and vision, and seeking financial rewards.	Possessing a large influential power (which also depends on business size) and controlling product quality.
Young people	N=7 (C1, E1, E3, F2, S1, Y2, A2)	Being supportive, future users, and future decision-makers.	Focusing on career development, innovative products, and industry knowledge.	Seeking a sustainable industry for their careers, generating income from their jobs, and being involved in subject-related work.	Possessing a large population but currently having low influential power, and being relatively passive in the ecosystem.
Research and development institutions	N=8 (A2, V2, E2, M2, R1, G2, R2, E3)	Advocating for research and development, serving as think-tanks and being supportive.	Focusing on policy design, determining research topics, and developing new solutions.	Solving societal problems and encourageing collaboration through research work.	Possessing influencing power and guiding collaboration, but having limited power in execution as the role is expected only to provide opinions.
Investors	N=9 (A2, E1, R1, Y1, N1, F2, OA1, H2, E3)	Serving as sponsors and investors, adopting a supportive to neutral role.	Providing support to those in need, exploring new investment opportunities, entering new markets, and seeking new collaborations.	Contributing to social welfare, exploring new investment opportunities and markets, and supporting new trends.	Possessing high influential power and obtaining significant resource power.
Media	N=4 (G1, G2, M1, M2)	Serving as connectors and promoters but may have varying standpoints, providing a broader view to the public.	Accessing the latest information and news.	Reaching more audiences, engageing readers, and expanding their reach.	Possessing significant influential power, especially among the community, and embracing the power of criticism.

efforts to address ageing challenges.

In addition to formulating policies and providing government funds and incentives, the government fosters an environment conducive to public and private collaboration. It establishes R&D initiatives to enhance capacities and plays a crucial role in identifying strategic technology areas, promoting research, and spurring innovation in targeted fields. Transitioning beyond its traditional regulatory functions, the government actively engages in creating and orchestrating ecosystems, aligning with international trends of promoting ageing in place (Elderly Commission, 2017). The exchange of best practices and innovative ideas within the ecosystem is poised to yield viable solutions to both local and global ageing challenges (Mitra et al., 2020). Through its support for research and innovation, the government and regulatory authorities contribute to the development of an innovation ecosystem and the co-creation of value through collaborative efforts (Nouman et al., 2022).

Based on the sketching contributions from various respondents (*Figures 1-4*), it becomes clear that the HKSARG is perceived to hold a pivotal and leading role (illustrated within a circle) within the gerontechnology ecosystem. There is a consensus among respondents that the HKSARG is deeply

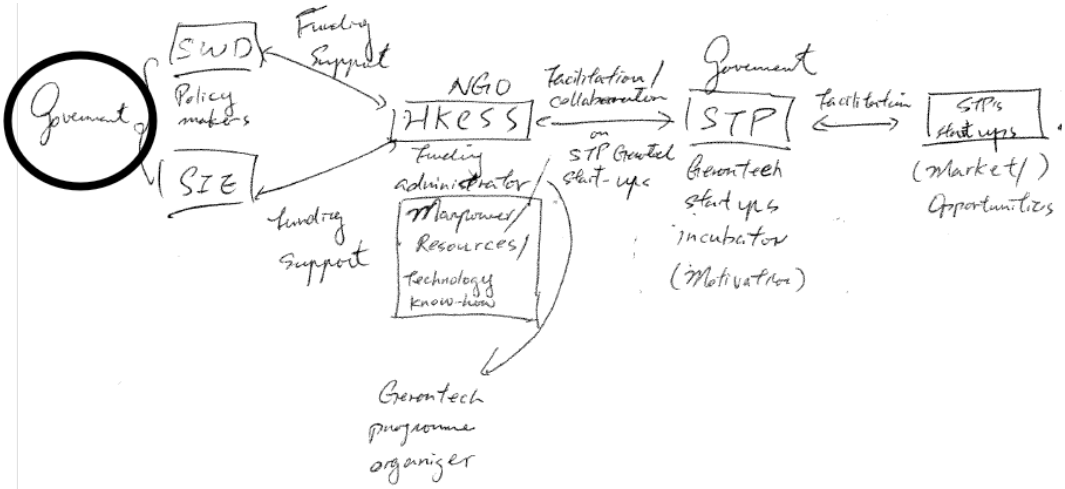

Figure 1. Sketched by R3 from an R&D institution, depicts the gerontechnology ecosystem and emphasizes the significance of governmental funding for its development

committed to advancing the development of gerontechnology in Hong Kong. As the entity with the highest governance authority, the government is instrumental in championing gerontechnology, managing vital social and economic resources, and driving policy changes to address the challenges posed by an ageing population. Respondents highlighted the government's key motivations, which include addressing societal needs, promoting ageing in place to tackle the challenges of an ageing society, enhancing public satisfaction, bolstering its reputation, garnering citizen support, reducing healthcare and social costs, and fostering economic and industrial development through gerontechnology. Furthermore, the HKSARG's powers and position, as outlined in administrative procedures, play a significant role in the gerontechnology ecosystem. These include setting priorities and strategic directions, policy development, stakeholder mobilization, and the legitimate utilization of resources. Such actions are deemed essential for

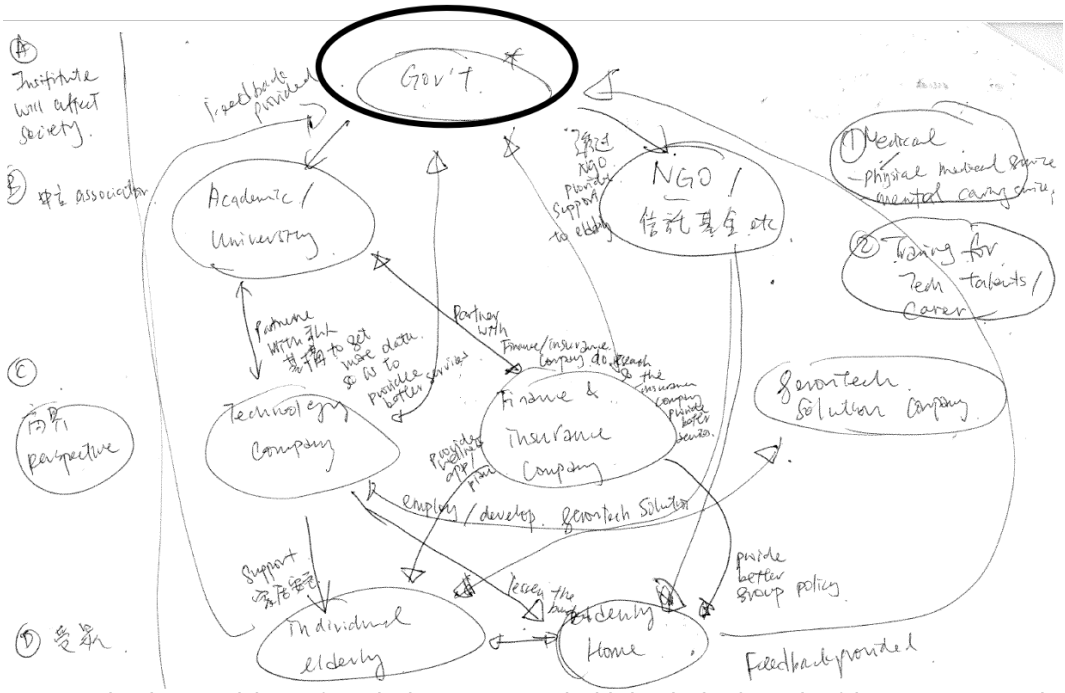

Figure 2. Sketching work by B1 from the business sector, highlights the leading role of the government in the ecosystem

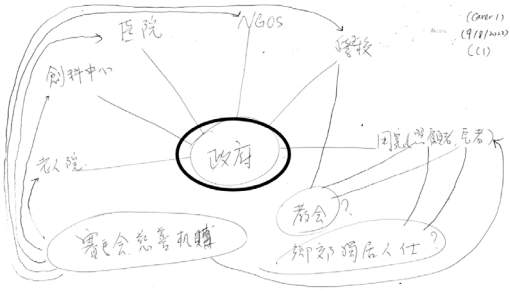

Figure 3. Illustrated by a caregiver (C1), depicts the central role of the government in the ecosystem

guiding and shaping the trajectory of gerontechnology development in Hong Kong, underscoring the government's central role in fostering an environment conducive to addressing the multifaceted challenges of an ageing population.

B1, a representative from the business sector, emphasizes the significant influence of the HKSARG within the gerontechnology ecosystem at various levels: *"The government plays the most crucial role in connecting different stakeholders, ranging from the top, middle, to the bottom tiers, including those receiving services."*
E2, from the academic sector, notes the government's vital position in the gerontechnology landscape: *"At this stage, I believe the government takes on a leading role to a notable degree. It is arguably the most keen on promoting the growth of gerontechnology, maintaining interactions and forging connections with a variety of organizations."*

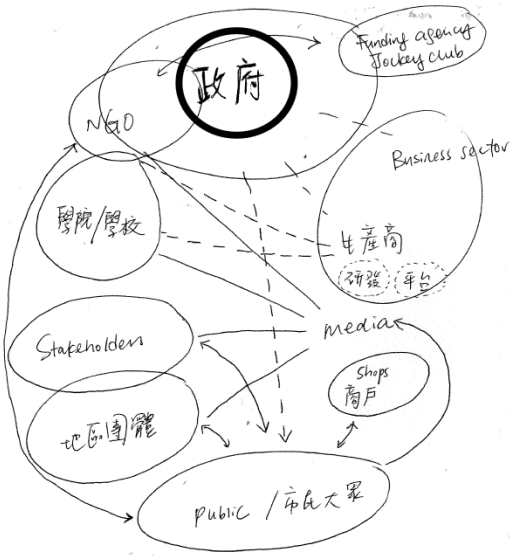

Figure 4. Sketching work by G1 from a governmental unit, further emphasizes that the government plays the most significant role in supporting the ecosystem

Direct value creation roles

The category known as 'direct value creation roles' plays a pivotal part in the gerontechnology ecosystem, comprising stakeholders who are actively involved in generating value. These stakeholders are instrumental in assembling and complementing services and materials, ensuring compatibility and cohesiveness within the ecosystem. Occupying various positions along the extended value chain, they engage in a wide range of activities as both suppliers and users of technology, materials, and services integral to the ecosystem.

Stakeholders identified within this direct value creation role are crucial for pinpointing societal needs and issues, thereby influencing the ecosystem's structure through their insights into user demands (Maracine & Scalart, 2008). This insight is invaluable for tailoring the design and development of products and services. On the supply side, vendors and gerontechnology startups play a significant role by delivering innovative services and products to the market. Communication and technology firms, too, are keen on harnessing technology design and Wi-Fi connectivity to offer enhanced gerontech solutions, thereby meeting the ageing population's needs, driving economic growth, and facilitating the accessibility of external technologies in the market.

On the other hand, NGOs, older adults, and caregivers within Hong Kong's gerontechnology ecosystem are recognized as users within this direct value-creation framework. As suggested by Dedehayir et al. (2018), users can be a fountain of innovative ideas, with the innovation ecosystem model highlighting the crucial role of end-users (Autio & Thomas, 2014). Their involvement is key to identifying societal needs and challenges, participating in transactions, and adopting gerontechnology products and services. As proactive contributors to the open innovation process, users and customers play a vital role in fostering the development of new products and services. Their active participation has the potential to significantly influence sectoral innovation, encompassing economic, social, and political dimensions of society. Furthermore, the respondents underlined the critical importance of older adults as essential stakeholders within the gerontechnology ecosystem. Their insights into the unique needs and preferences of the ageing population are invaluable for the creation of tailored products and services, ensuring that the offerings meet their specific requirements and enhance their quality of life.

Older adults

Within the gerontechnology ecosystem, older adults and caregivers are recognized as both us-

ers and customers. The literature and resources reviewed for this study underscore older adults as the primary end-users of gerontechnology, positioning them as key stakeholders with a significant impact on its development. Given that gerontechnology aims to address the needs of older individuals and their caregivers, their role within the ecosystem is indispensable. During the interviews, the necessity of gerontechnology for older adults, especially due to physical limitations, was highlighted by two participants:
OA2 remarked: *"I have observed two categories of gerontechnology. One caters to those of us who are in good health, offering essential daily use products like blood pressure monitors, heart rate trackers, and oxygen level detectors. The other category serves those requiring caregiving, acting as auxiliary support. Essentially, there are gerontechnologies for mild and severe cases. If gerontechnology development succeeds, we, the elderly, stand as the primary beneficiaries."* Similarly, OA1 shared: *"When older adults are unable to perform tasks independently, they must seek assistance from someone or utilize a tool to aid their daily lives…"*.

In this study, participants classified older adults into categories such as the youngest-old, middle-old, and old-old, recognizing that variables like educational background and economic status significantly shape their technological experiences. Insights from the respondents illuminated the diverse capabilities and interests of older adults in navigating and comprehending technology. It was noted that the younger cohorts within this demographic demonstrated a greater willingness to adopt new technologies.

The involvement of older adults in the gerontechnology ecosystem represents a deliberate move towards enhancing both the supply and demand sides by integrating end-user feedback directly into the development process. Some organizations have taken innovative steps by training older adults as gerontechnology ambassadors. This initiative not only enhances the ambassadors' familiarity with gerontechnology but also plays a pivotal role in the ecosystem's growth by capturing essential user insights. Respondents across various sectors acknowledged the significance of such ambassador programmes, emphasizing their contribution to refining gerontechnology offerings through firsthand user experiences.

Moreover, advancements in technology, coupled with effective strategies for information dissemination, have empowered older adults to make informed decisions regarding the technologies and information that best meet their needs. Respondents highlighted the untapped potential of the Key Opinion Leader (KOL) market, wherein elderly KOLs could share their experiences with gerontechnology on different platforms. Given the high level of trust attributed to word-of-mouth recommendations—particularly those emanating from family and friends, which serve as a crucial filter for information and experiences (Silverman, 2001; Gildin, 2003)—this strategy has the potential to significantly alter the dynamics of the gerontechnology market. By leveraging the credibility and relatability of elderly KOLs, there exists a unique opportunity to influence perceptions and adoption rates of gerontechnology, further enriching the ecosystem with diverse, user-generated content and insights.

Respondents across different stakeholder groups acknowledged the influential role of older adults within the gerontechnology ecosystem. E3, from the educational sector, noted, *"Older adults possess tangible rights. They can engage in gerontechnology projects, contributing feedback to product research and development, thereby benefiting future generations of older adults. Their ability to communicate their needs early in the product development process is a powerful tool."* M1, a radio host, further recognized the influential voice of older adults, stating, *"Older adults have a significant say, and their opinions carry weight, impacting stakeholders and shaping the future of gerontechnology, including new initiatives, products, and services. They have a significant influence."*

Value creation support roles
Stakeholders within this category play a critical role in providing essential support for value creation within the ecosystem (Dedehayir et al., 2018). These experts contribute to the ecosystem by engaging in research and development, offering consultation, advice, and specialized expertise. They are instrumental in promoting the commercialization of technology and in facilitating the transition of products and services to end-users. Dedehayir et al. (2018, p. 24) observed that stakeholders in this role can "serve and extend beyond the organizational boundaries" to foster the ecosystem's growth. This role is aptly termed 'value contribution', as it involves various stakeholders lending their expertise and resources towards collaborative value creation, thereby nurturing the ecosystem's development.

Universities and research institutions are recognized for their pivotal role in this context, as they are sources of knowledge, inventions, and discoveries (Clarysse et al., 2014; Dedehayir et al., 2018) that can be used in product and service development and benefit innovation co-creation. Evidence from the interviews and scholarly articles reviewed underscores the significant presence of universities and academics within the

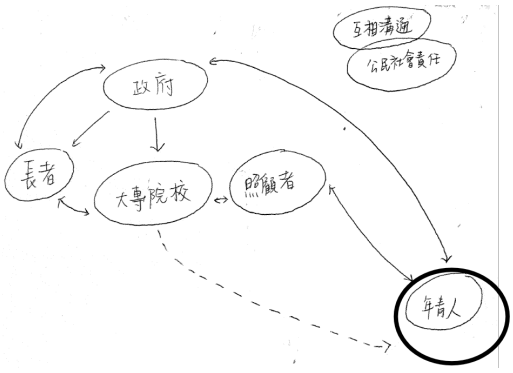

Figure 5. Sketching work from Y2 showed that the young people group is isolated from the ecosystem

innovation ecosystem. Universities excel due to their openness, convening power, and dedication to supporting regional economic development (Budden & Murray, 2019). Academic institutions, especially those rich in resources, can form alliances with resource-scarce stakeholders to cultivate local innovation ecosystems. They are capable of organizing activities and events that align with the ecosystem's social, cultural, and health-driven goals (Mitra et al., 2020). Collaborations between universities and industry can amplify the impact of knowledge transfer and foster entrepreneurial momentum (Gu et al., 2021). The co-creation of knowledge within the innovation ecosystem is a theme extensively discussed in the literature (Nouman et al., 2022). Gerontechnology providers and startups are encouraged to tap into external knowledge sources to boost their innovative capacity and value proposition. These sources may include public-funded activities and open-access knowledge (Nouman et al., 2022). Research institutions and universities can serve as conduits for such external knowledge, enhancing R&D efforts. Given the burgeoning interest in gerontechnology and smart ageing, academia also offers various courses aimed at cultivating a skilled workforce across different qualification levels.

This expert group encompasses healthcare professionals, such as physicians and medical specialists, known for their expertise in developing healthcare ecosystems (Maracine & Scarlat, 2008; Kapoor & Lee, 2013). There is an increasing agreement among healthcare practitioners on the adoption of innovative technologies, like AI applications (Chen, 2018), to address the needs of older adults and their caregivers. Gerontechnology is crucial for tackling major concerns about the health and social isolation of older adults, particularly during the pandemic. Its applications range from telemedicine and home health monitoring to safety surveillance and emergency response systems.

Interdisciplinary collaboration among healthcare professionals, scholars, and engineers is vital in advancing gerontechnology. Hospital representatives are encouraged to participate in gerontechnology initiatives to synergize the efforts of professionals in the field. Emphasis is also placed on community-based systems and primary health services to reduce the strain on public hospitals and foster 'medical-social collaboration'. In the post-COVID-19 landscape, there is a call for further development of telehealth products and services to improve eldercare and meet their evolving needs. Besides academic and healthcare professionals, it is imperative to consider and integrate the perspectives of other key stakeholders, including:

Young people

The changing dynamics of family structures, with an increase in multigenerational households, highlight the emerging role of young people as informal caregivers for elderly relatives. This development accentuates the need for gerontechnology education among the youth, not just to spark their interest in eldercare but to equip them with the necessary skills to support older family members effectively. Mok (2021) underscores the importance of such education, noting that young family members are instrumental in helping older adults to engage with and utilize home-based gerontechnology products, offering hands-on guidance that makes technology more accessible to senior users. Chen and Chan (2014) further highlight that gerontechnology serves as a conduit for enhancing understanding across generations, thereby promoting intergenerational harmony. However, the integration and visibility of the younger generation within the gerontechnology ecosystem pose challenges. During the ecosystem sketching, respondent Y2 from the youth group observed that the role of young people in the ecosystem is currently underrepresented. Y2 remarked, *"As a teenager, I feel somewhat distant from gerontechnology, which led me to position the young people group in a peripheral spot, with their role appearing unclear. Thus, I used a dotted line to denote the relationship"* (*Figure 5*). This feedback underscores the need for more explicit integration and recognition of young individuals' potential contributions to the gerontechnology ecosystem.

Other stakeholders share the view that young people should be aware of their capacity to impact the sustainability and evolution of gerontechnology. F2, a staff member from a foundation, stressed the importance of a forward-looking perspective for the youth, stating, *"The next generation needs to be well-acquainted with gerontechnology, considering they will age too. It's imperative they grasp the concept, as they*

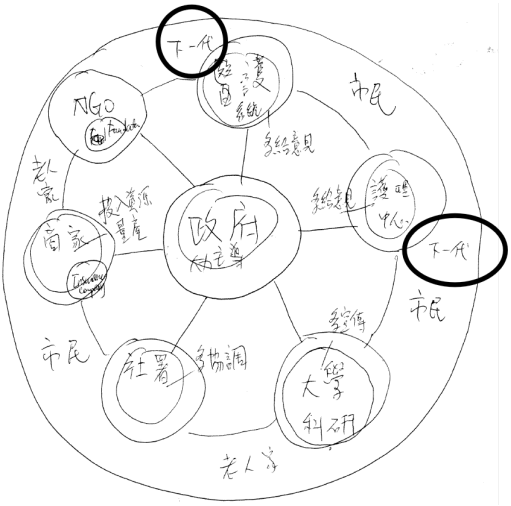

Figure 6. Sketching of gerontechnology ecosystem by F2, a respondent from a foundation

will become the future decision-makers." He also noted the active support of young people in nurturing the gerontechnology ecosystem, a sentiment visually shown in *Figure 6*.

These perspectives collectively underscore a significant opportunity to better integrate and harness the potential of young caregivers within the gerontechnology ecosystem. Young people are envisioned as a skilled workforce for the eldercare sector, receiving training through various educational platforms to utilize gerontechnology products in assisting patients and caregivers in their daily lives. Gerontechnology education serves as a pivotal platform to engage youth, preparing them for the future workforce, thus fostering a sustainable workforce for an ageing society and talent development in Hong Kong. Respondents noted that young individuals, as integral components of the ecosystem, represent not only future users but also future decision-makers, with a considerable impact on the development of gerontechnology in Hong Kong. The young people can express interest in careers and innovative product exposure, joining the gerontechnology ecosystem to acquire skills and knowledge for future societal and career development. Engaging the younger generation in the ecosystem can further foster intergenerational harmony.

Organizations in Hong Kong are recognizing the potential to engage secondary school students with gerontechnology, providing them with life-wide experiential learning experiences and training them as community leaders equipped with gerontechnology knowledge and practice. Moreover, numerous projects and campaigns target young individuals to understand the needs of older people in society, promote ageing-in-place, and support the construction of an inclusive community with intergenerational harmony. These initiatives offer a comprehensive range of experiential learning opportunities, preparing young individuals for a deeper understanding of Hong Kong's ageing challenge and exploring career opportunities in the eldercare sector.

Media

The role of media in enhancing social connections, particularly emphasized during the COVID-19 pandemic, has been well documented in scholarly literature. The pandemic underscored how media facilitates quicker interactions between communities and healthcare professionals, thereby making medical and health information more accessible and transparent (Smailhodzic et al., 2016; Fung & Lau, 2020). Moreover, the crisis highlighted the potential of technology and social media in forging new pathways for development, with local governments leveraging social media to disseminate health information, campaigns, and policies (Fung & Lau, 2020).

In this context, representatives from the government expressed a keen interest in the media assuming a more proactive role in advocating for gerontechnology. G1, a government official remarked, *"I believe the media could intensify their efforts. Their contribution could significantly enhance the widespread acceptance of gerontechnology. I have encountered movies that illustrate how gerontechnology can assist in eldercare and aid recovery post-stroke. It would be advantageous if the media could highlight such instances."*

The media serves as a bridge, creating accessible channels for the public and linking various stakeholders within the ecosystem. Interviews with stakeholders, including those from government and media sectors, underscored the media's pivotal role in the gerontechnology ecosystem. Although adopting a neutral stance, the media can introduce a wider perspective to the community. The respondents observed that the media could effectively broaden the reach of gerontechnology services and products, possessing considerable influence. Media representatives also expressed a willingness to engage more deeply in the ecosystem by accessing the latest developments and offering constructive feedback on the efficacy of gerontechnology products, thereby contributing to their improvement.

In the era of the digital age, traditional media outlets, such as television and radio, have broadened their outreach by incorporating social media platforms. These online and digital platforms have become instrumental in facilitating community communication and information sharing, enabling

public access to information and discussion across various social media channels. Social media has empowered stakeholders to enhance their marketing and communication strategies, promote citizen involvement and transparency, and advance technological skills that foster innovation and knowledge management within the gerontechnology ecosystem (De Bem Machado et al., 2022) while promoting engagement and transparency.

Entrepreneurial ecosystem roles

Entrepreneurs, encompassing both individuals and start-up firms, are pivotal to the gerontechnology ecosystem. Their role extends beyond merely launching new ventures and businesses aligned with their vision; entrepreneurs are instrumental in orchestrating collaborations with other stakeholders to unearth innovative ideas for goods, services, and businesses. This 'entrepreneurial ecosystem role' is particularly pertinent to the evolution of the gerontechnology ecosystem in Hong Kong, a city renowned for its vibrant tech startup community. These roles have been recognized as essential within the gerontechnology context. As highlighted by Holloway et al. (2021), while the startup community may not be the leading actor, it has participated in numerous initiatives and is integral to ecosystem studies. It is imperative that products and services are developed in harmony with other ecosystem stakeholders and tailored to this collaborative environment. The gerontechnology ecosystem is witnessing a surge in entrepreneurial activity, serving as a critical component of the innovation ecosystem that delivers long-term economic gains for regions (Dedehayir et al., 2018).

Incubators, accelerators, and support groups play a crucial role in nurturing start-up growth by providing access to essential resources and networks, and by facilitating schemes conducive to scalable start-up creation and expansion. Most respondents emphasized the importance of the rise of start-ups or social enterprises for the development of the gerontechnology ecosystem. These entities are key to devising innovative solutions to social challenges, enabling efficient product launches in the local market, which is vital for fostering innovation and scaling the gerontechnology ecosystem. Additionally, some charities, foundations, and investors act as 'sponsors', offering crucial support to new ventures and initiatives within the gerontechnology ecosystem. This support is significant, as it enables entrepreneurs' novel initiatives and ideas to secure the necessary funding and resources for product development. The involvement of various charities and foundations enhances the ecosystem by fostering collaboration and co-innovation, as well as generating a positive societal impact.

Gerontech start-ups and innovative entrepreneurs

In recent times, Hong Kong has witnessed a surge of entrepreneurial activities, with local entrepreneurs collaborating with universities and NGOs to foster the adoption of technology among users, especially within the gerontechnology sector. These start-ups have engaged with diverse stakeholders through various programs and platforms, aiming to facilitate the widespread adoption of gerontechnology. Respondents noted that start-ups focus on meeting users' needs, producing high-quality products, and considering factors such as profits and reputation.

Representatives from start-ups, identified as S1 and S2, shared their motivations for entering the gerontechnology ecosystem, highlighting a shared desire to address social issues. S1 expressed, *"Start-up companies aim to tackle social problems by offering services and generating profits. More than that, we seek to address these social issues through our capabilities, which brings a sense of satisfaction."* Similarly, S2 emphasized the interest of start-ups in meeting social needs and creating a social impact, while also acknowledging the importance of profit.

Other stakeholders within the ecosystem also recognized the altruistic motivations of start-ups geared towards societal benefits. N1, a representative from the eldercare sector, observed that many start-ups in the ecosystem are dedicated to assisting older adults by introducing new technologies, with the social impact being a significant motivation alongside profit: *"As I mentioned initially, there are those who are motivated by financial gain, while some of them, I believe, are genuinely inspired by the lives of older adults. They see their work as a mission, a calling."*

Furthermore, start-ups within the ecosystem are keen on boosting their competitiveness, embracing a mission-driven approach, and advancing technology through research and development. Respondents from start-ups disclosed that they collaborate with other gerontechnology firms to innovate and develop leading-edge technology. As creators of products, start-ups, and technology companies hold exclusive rights and power over intellectual property. This authority enables them to capitalize on market opportunities and technological advancements, translating them into commercially successful products and achieving economic prosperity.

Discussion

Interconnectivity

It becomes apparent that the gerontechnology ecosystem in Hong Kong shares many similarities with the broader innovation ecosystem, characterized by a dynamic 'interconnectivity' network.

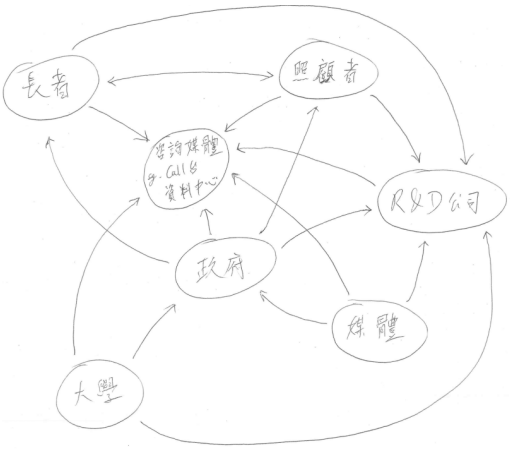

Figure 7. Sketching by the G2, a respondent from the governmental unit

This term frequently emerged to describe the operating model of the ecosystem, highlighting its intricate and intertwined nature. Despite the abstract concept, interviewees were able to elucidate the 'causal loop' and 'interactive communication' present within the ecosystem, shedding light on the complex behaviors and consequential effects of stakeholder actions. The ability of respondents to visually articulate these connections and relationships through sketching is particularly noteworthy. By employing arrows and labels, they effectively mapped out the influences, and causes-and-effects, thereby unraveling the complexity and interconnectivity that define the interactions between stakeholders in the gerontechnology ecosystem. This visualization underscores the paramount level of interconnection among actors, fostered within a collaborative environment dedicated to innovation. The sketches vividly depict the various relationships, whether through visible or invisible resource flows, contracts, trust, or a shared vision, all of which contribute to the ecosystem's development (*Figures 7-9*). In the sketching work, each stakeholder's decision and behavior significantly impact others, manifesting in a myriad of ways. This phenomenon of 'inter-influencing' and being 'mutually affected' aptly captures the essence of the stakeholders' connections within Hong Kong's gerontechnology ecosystem.

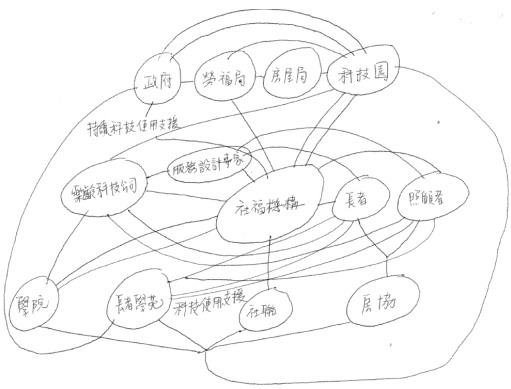

Figure 8. Sketching by the A1, a respondent from the accelerator group

The common objectives

The perceptions of the gerontechnology ecosystem shared by respondents closely align with the definitions of innovation ecosystems found within the literature reviewed. Fundamentally, innovation ecosystems are designed to address broad conceptual challenges or grand problems with a definitive focus on solutions, often oriented toward fulfilling a sustainability agenda. These ecosystems aim for collaboration that addresses societal needs, thereby yielding enhanced outcomes for the community at large. Such ecosystems prioritize sustainable, systemic solutions, fostering diverse engagement (Jütting, 2020) and promoting varied methodologies in addressing the issues at hand (Arora et al., 2019). In this study, respondents, who also serve as stakeholders within the ecosystem, recognized their participation in the gerontechnology ecosystem as driven by a unified goal: to improve the quality of life for the ageing population.

The gerontechnology ecosystem in Hong Kong is characterized by its acknowledgment of collaborative endeavors between public and private entities, leveraging their collective expertise to solve public issues (Dixit et al., 2018). The varied engagement and involvement of stakeholders allow for access to more extensive resources and the amalgamation of diverse knowledge bases and capabilities to address multidisciplinary challenges (Arora et al., 2019). Respondents highlighted the critical nature of a multidisciplinary approach in gerontechnology, emphasizing

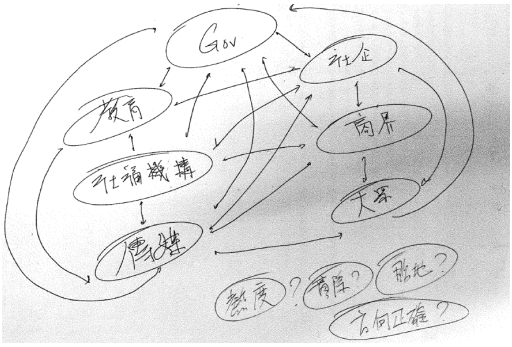

Figure 9. Sketching by the M1, a respondent from the media (For Figures 7-9, The sketch reveals that approximately 7-12 stakeholders are closely intertwined, maintaining robust linkages with one another. This level of interaction not only highlights the ecosystem's complexity but also its potential for fostering innovation through collaboration and mutual influence.)

the importance of diverse perspectives and the empowerment of collaborative efforts in addressing the challenges faced by an ageing society through sustainable solutions.

From supply chain to value chain

The concept of the innovation ecosystem also sheds light on the ecosystem's openness, incorporating stakeholders from both supply and demand sides, as well as broader societal engagement. It fosters the amalgamation of knowledge resources and the cultivation of close relationships, transforming the traditional supply chain into a more extensive network of stakeholders. The diversity and openness of the gerontechnology ecosystem have facilitated an interdependent collaboration model. The evolution from a supply chain to a value chain involves a shared vision among stakeholders, driving the market towards the co-development of sustainable innovations through innovative partnerships. This collaboration underscores the importance of knowledge co-creation and the sharing of resources, contributing to the gerontechnology industry's maturity. Strong collaboration not only has the potential to significantly influence technological innovation but also creates opportunities for cross-sector stakeholders to unite and address the challenges associated with ageing.

A micro-level perspective

Empirical studies often adopt a general perspective to explore the development of innovation ecosystems. However, this research has uncovered several micro-level insights within the gerontechnology ecosystem that were previously overlooked. The findings from the interviews have introduced novel viewpoints for examining the evolution of the innovation system and its implications for ecosystem sustainability:

Multiple identities of a stakeholder in the ecosystem

It is widely acknowledged that stakeholders play pivotal roles in the development and collective advancement of an innovation ecosystem. During the interviews, participants were able to further delineate their roles and identities within the ecosystem. It was fascinating to observe how individuals perceive and are attributed roles based on their engagement in the ecosystem. Perceptions vary regarding the central role of stakeholder groups in collaborative networks. Patterns of behavior, underscored by 'self-reflection' within and among individuals, reveal varying levels of analysis (Stryker, 1980). This concept of 'self-reflection' is grounded in James' (1890) theory that individuals in society adopt various 'selves' corresponding to different positions, shaping one's identity within the broader self. This comprehensive self is subdivided into multiple identities, each linked to facets of the social structure. Each person possesses an 'internalized positional designation' (Stryker, 1980) for every role relationship they maintain within society (Stets & Burke, 2003). Actors blur traditional boundaries, foster innovative collaborations (Cooper, 2018) within the innovation ecosystem. Recognizing that a single actor may embody multiple identities while participating in the ecosystem, it is important to enhance stakeholders' awareness and encourage them to stimulate improvements and advocate for change within the ecosystem.

The future role of a stakeholder

The transition from present to future roles involves a self-aware process, enabling individuals to attain consciousness regarding their existence. Humans, as processual beings, continuously engage in reflection and envisioning, thereby shaping and communicating future experiences (Stets & Burke, 2003). This dynamic may also contribute to the increased complexity of innovation ecosystem development and enhance the stability of the gerontechnology ecosystem. Some respondents envisioned themselves as future users of gerontechnology products, highlighting the necessity for an ecosystem to foster 'collective action'. Stakeholders must collaborate to champion valuable and innovative futures. Members of a thriving ecosystem are motivated to co-create their future (Spaniol & Rowland, 2022). Engaging future or potential users and stakeholders is crucial for the ongoing development of the ecosystem, as their insights can foresee interactions and self-engagement, offering a broad vision for the ecosystem's future development (Spaniol & Rowland, 2022).

Conclusion

This research study delves into the development of a gerontechnology ecosystem in Hong Kong, aiming to elucidate the innovation ecosystem and the array of stakeholders it encompasses. Drawing upon the framework proposed by Dedehayir et al. (2018), the study organizes stakeholders into four distinct categories: leadership roles, direct value creation roles, value creation support roles, and entrepreneurial ecosystem roles. A particular emphasis is placed on the pivotal role of government entities in nurturing innovation ecosystems. With their considerable resources and authority, these entities can significantly impact the ecosystem by providing vision, fostering cultural shifts, and supplying the necessary tools to support, enhance, and maintain collective innovation efforts. Furthermore, the study underscores the necessity of integrating micro-level perspectives to gain insights into innovation ecosystem development.

Every research endeavor faces limitations. In this case, the absence of a formal empirical analysis of the gerontechnology ecosystem within the current ecological context poses a constraint.

Evaluations and operational assessments are mainly reliant on reference materials. Serving as a pilot study, this research establishes a methodological framework for ecosystem evaluation, which may be refined and adjusted for future application. This initial phase of research offers a foundational blueprint and guidance for assessing Hong Kong's gerontechnology ecosystem and its relevant topics. Examining various successful case studies within the gerontechnology ecosystem will facilitate further analysis and improvement in stakeholder classification methods. The study hopes to have identified and included all or most relevant stakeholders, yet it remains cognizant of the possibility that certain important, but less obvious stakeholders may have been overlooked. Future developments in technology and research studies are essential to bring new actors who create positive contributions through different phases of development within the ecosystem.

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