

Promoting Elderly Care with a Community-based Cloud Platform under the Smart City Scheme in Hong Kong: Recommendations for Policy and Strategy

Group 8

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Executive Summary

Hong Kong is aging rapidly, the importance of elderly care service is increasingly prominent. At present, the threat of Hong Kong's imperfect elderly care system to social development is becoming increasingly urgent, to be specific, its capacity is insufficient to meet the soaring demand, the service lacks attention to addressing the mental needs of the elderly, insufficient supply, and it's vulnerability towards the contingency (e.g. amid Covid-19 outbreak). Hong Kong government's attempt in mitigating the fallacies tends to be inefficacious by approach under the Smart City Blueprint e.g. the exhibition of relevant R&D outputs under HKSTP Smart Elderly Campaign and subsidy scheme regarding the trial use of technology products among caretaker. But solely focusing on technology equipment is not a catholicon in fundamentally refine the elderly caring system, thus, the intervention of cloud technology is indispensable by relying on the Internet to integrate the networked hardware, software, and internet resources, so as to realize the data calculation, storage, processing, and sharing without direct active management of the users and administrators is an available approach to solve the current dilemma.

A community-based cloud platform should be introduced to optimize the resource's allocation regarding HK's elderly caring ecology, and improve HK's elderly caring services in-depth, and integrate fastness and adaptive capacity of the current elderly care system accordingly.

To test the eligibility of the Community-based Cloud Platform in Hongkong, both quantitative and qualitative analytical methods are adopted. Through cost-benefit analysis (CBA), a conclusion is reached that introducing a community-based cloud platform is a positive- benefit project, especially when covering all the elderly living alone at domestic household or with their spouses only , along with 50% of the elderly that are living with their child(ren). The SWOT analysis also indicates that the platform is of great strength that bears remarkable developing opportunities at present. But the weaknesses such as the tradeoff between in technology usage and privacy protection cannot be overlooked, and the system is threatening by lack of in-depth cooperation among multi-stakeholders. The Hong Kong SAR Government, Legislative Council, Judiciary, public opinion, private sectors, research institutes and universities, the elderly, etc., all playing as important interest groups. From stakeholder analysis, the barriers in

its development are the insufficient collaboration among stakeholders, substandard business environment, and skepticism among the public is further exposed.

In order to explore how to develop the community-based cloud platform in Hong Kong, we discussed what role should the government played in introducing the community-based-cloud platform. Two distinguished lessons are learned from experiences from the UK 's approach - government as a service provider and Zhejiang, China 's public-private partnership (PPP) model are illustrated through the case study. Based on the experiences, two alternatives-"Government as the service provider" and "Cooperation with enterprises (PPP mode)"- are proposed for HK government to address the elderly care in Hong Kong. Based on the previous study and Hong Kong's context, feasibility, effectiveness, equity, and sustainability are put forward as criteria for alternatives' evaluation. By analyzing the policy alternatives with criteria, we find that PPP mode performs well overall.

Furthermore, concrete recommendations are delivered for implementing the PPP mode to carry out the community-based cloud platform in Hongkong. On the one hand, an Internet+ Community-Based Elderly Caring System should be established, with strengthening the all-round cooperation of the government, caretakers, private sector, communities, and other relevant interest groups. On the other hand, initiating a pilot project in Kowloon East to examine the feasibility of developing an innovative elderly care system incorporated with the IoT and better manage the data to protect personal privacy meet the necessary data needs for smart elderly care analysis, and maximize its research value, can facilitate the realization of the project.

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Chapter 1

Improving Current Elderly Care in Hong Kong





In this chapter, population aging, and the current elderly caring services are introduced as the background of improving elderly care in Hong Kong. Based on the Hong Kong government's effort, practices, and plans on developing smart elderly care are discussed. To address the existing problems from the root, a community-based cloud platform is considered to be helpful in enhancing the resource allocation of the current system and strengthen its adaptability. Along with the mechanism of establishing a Community-based Cloud Platform, its significance for the development of smart elderly care in Hong Kong is further explored.



1 Introduction: Necessity of Developing Community-based Cloud Platform in Hong Kong

1.1 Population Aging and Elderly Caring Services in Hong Kong

Hong Kong's population continues to age rapidly, according to the population projection released by Census and Statistics Department of GovHK (Census and Statistics, 2015), from 2014 to 2064, the proportion of elderly person aged 65 and over at population is projected to rise from 15% in 2014 to 33% in 2064, and the elderly dependency ratio will climb to 716 from 198 accordingly.

Population By-census, Thematic Report: Older Persons published by Census and Statistics Department of GovHK (Census and Statistics Department, 2016) indicated that 91.9% of the elderly lived in family households, while the remaining 8.1% lived in non-family households (i.e., in elderly homes, hospitals and penal institutions). There are 152536 elders living alone, accounting for 13.1% of the total elderly population. In addition, 293308 elders (25.2%) only live with their spouses, 337623 elders (29.0%) live with their spouses and children, and 226801 elders (19.5%) only live with their children.

At this stage, Hong Kong's elderly caring services could be basically divided into two major parts: Residential Care Services (*Nursing Homes*) and Elderly in Places & Community-based Elderly Caring (*Community Care and Support Services*).

Currently, 544 out of 732(73.4%) of the nursing homes are privately owned and operated, and only 26.6% of which are funded or subsidized by the government (Legislative Council, 2017). Although the two-part elderly caring services system appears to have covered all the older persons that need assistance in all aspects, when put the schemes into practice, it is not as effective as designed.

Given that a great number of older persons are living with little or without the support from their household, it is demanding that the Government of Hong Kong SAR should pay more attention not only on the policies that could offset the aging problem but also on the policies that could ensure the older persons' rights and welfares. And there are several elderly caring services in Hong Kong are provided by the government and other institutions.

1.2 Defects in Current Elderly Caring Service Scheme

1.2.1 Undersupply: Insufficient Capability to Meet Soaring Demand

Currently, the biggest challenge of Residential Elderly Caring is the supply shortage. To be specific, 74,000 places are provided across the city, which means 6.3% of the 65 plus senior community can be accommodated.

The under-supplied public-funded or public-subsidized nursing homes cannot fulfill the increasing demand from the public. According to a report of the Legislative Council of Hong Kong, from 2017 to 2018, 38286 older people were put on the waitlist after they applied for public-funded or public -subsidized nursing homes, and the average waiting time for different nursing homes vary from 24 months to 36 months (Legislative Council, 2018). During the same year, 6611 older people had died while waiting, and 2191 older people withdrew their applications.

The place & community- based elderly care services are also bring criticized for the long waiting duration, for example in March 2019, over 12300 elders are on the waitlist of long-term care service provided by Social and Welfare Department, the waiting time of some schemes like day-care center exceeded 12 months (Legislative Council 2018). And in its initial design concept, a scientific and effective home-based elderly care plan should be a long-term and integrated service strategy, which needs the participation of medical staff, psychological consultants and other professionals, social workers, cleaners and other non-professionals under the guidance of a nursing plan formulated according to each person's different situations. But to practically operating like this, the cost of money, personnel and other resources would be unaffordable.

1.2.2 Quality Deficient: Absence of Addressing Senior Needs of the Elderly

Apart from the efficiency of resources allocation of home help and nursing home, there are growing concerns about the elderly's psychological needs and self-fulfillment.

Taken private nursing homes as an example, in order to meet the requirement of the Social Welfare Department (SWB) issued Enhanced Bought Place Scheme 1998 that stipulated the minimum place space per person and the staff-elderly ratio, some private nursing homes employ unqualified caretakers to minimize the cost. In addition, the huge and growing demand makes the owners of private nursing homes lack reinvesting to enhance the quality of their services. According to SWB, government supervision and monitoring of private elderly homes are comparatively feeble. By the end of 2015, the license management department of Social Welfare Department reported that there

were 2950 cases of misconduct or service quality below standard with advice letters issued, and 350 with warning letters issued, but only 44 of which are prosecuted.

In the previous research work, the analyses of elderly's care have revealed that there are more dimensional needs for the elderly except the basic need for survivorship and a vision of longevity. Once the lower level of needs is fulfilled, the willingness of the needs will go up to the next level. To specific, one will be willing to seek a higher level of needs only if the prior needs are fulfilled.

But the facts are indeed more complicated in Hong Kong. The short of public-funded nursing homes, the undergrad private nursing home services, long-waiting time to access services, and ineffectiveness of family care make it difficult to address the elderly's physiological needs and safety needs in an efficient way. Moreover, the concerns of the elderly's mental health and psychological need still exist.

According to the statistics from The Hong Kong Jockey Club Center for Suicide Research and Prevention, the trend of suicide death in Hong Kong remains stable in these years, around 12 to 13 per 100,000 people each year.

Nevertheless, the suicide rate of people aged over 65 has long been double or more that of any other age group in Hong Kong, shown in Figure 1, which indicates that the elderly in Hong Kong are more likely to kill themselves than any other age group. Thus, more attention should be paid to the psychological needs of the elderly.

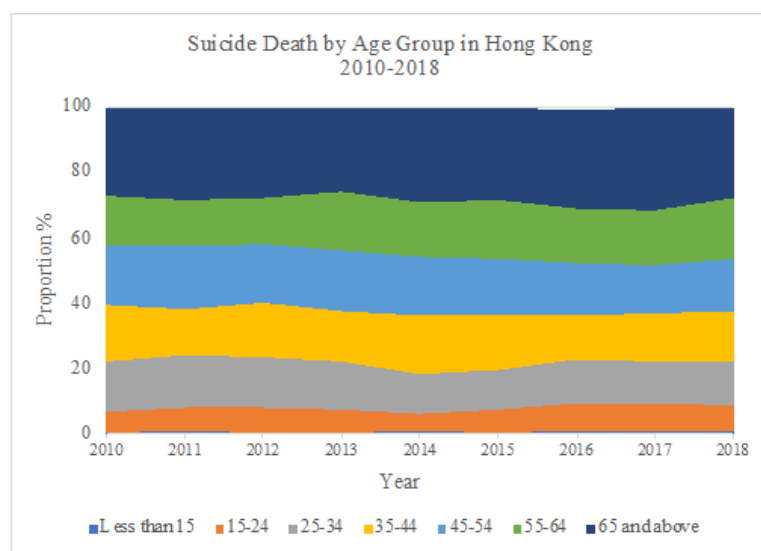


Figure 1. 2010-2018 Hong Kong Suicide Death by Age Group

Stated by a governmental researcher, among those who aged over 60 that committed suicide, there were about 56.6% of them suffering from depression when they were

alive. Professor Lum, Head of Department of Social Work and Social Administration from Hong Kong University, said that people always connect aging with negative images such as solitude, and mistakenly view elderly depression as normal phenomena (Leung, 2018). This makes it difficult to defend the elderly from suffering from psychological diseases such as phenomena. The lesson that we should learn from the past tragedy is to proactively come up with effective policies to facilitate the elderly care system in order to address elderly psychological needs at the source.

1.2.3 Vulnerability – Amid Covid-19 Pandemic

The two shortcomings mentioned above are based on the premise that Hong Kong's society can run smoothly. If we include the scenario of social unrest or public emergency into the discussion, the system's low adaptability defects would be exposed.

For example, after the Covid-19 pandemic swept the city in 2020, Hong Kong's elderly caring system has been jeopardized regarding its efficacy.

In this challenging time, the sudden attack of the pandemic has brought intangible pressure to the elderly, especially that they are believed to be the most susceptible cohort to be infected, the lack of understanding of the novel virus, and potential risks that may endanger their psychological conditions and evoke depression and anxiety.

The elderly living in nursing homes are forced to gather and interact with people who would raise their risk of infection. The 91.9% elderly living in the domestic household is suffering from social isolation, loneliness or alienation have a great impact on the elderly, according to Senior Citizen Home Safety Association (SCHSA) disclosed in April, from February to April 2020, there is a surge of the elderly's psychological assistance cases. The number of cases requiring social workers has increased by 72% compared with the same period last year, of which more than one third need further psychological assistances' intervention, and the number of cases has increased by about 41% compared with the same period last year.

The home-based elderly care services depend on the involvement of family member, neighbors, community centers, religious groups and social services (such as meal delivery services), they served as the important channel between the elderly and the outside world, or even the lifeline of their social contact. While amid pandemic, social distancing and lockdown disrupted their regular services, which means that the routine contact or community support of the elderly may tend to be reduced, and the health problems associated with living alone may increase. From other perspective, it may

bring additional loneliness to the elderly. The places where the elderly are accustomed to shopping, eating, and socializing may be affected by the change of service time or the suspension of business.

In addition, due to the lack of virus-prevention items, such as surgical masks or hand sanitizers, the elderly are also deterred from going out, which completely made their regular activities derailed and exasperated their physical and mental conditions.

1.3 Problem Statement: A Gloomy Outlook of Hong Kong’s Elderly Services

- *Increasingly Aging Population & Demand Soaring*

Fundamentally, an aging population is the most significant origin of the pressure on the elderly caring system.

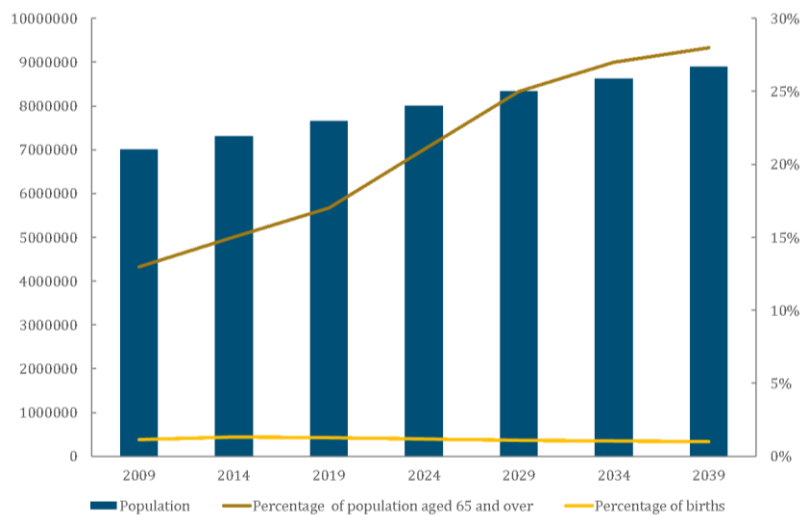


Figure 2. Trends of Elderly and Newborn Population in HK

Result from a decreasing fertility rate and increasing longevity. As shown in Figure 2, the 65-plus senior community are projected to increase in a more rapid scope and will hold a higher proportion in the coming decades - from 1.12 million (15.3% of the total population) in 2015 to 2.51 million (30.6%) in 2043, and further to 2.58 million (35.9%) in 2064.

The continuous growth of the elderly population spells that the demand for elderly care services will continuously grow. Additionally, the growth rate of the 85-plus senior community in Hong Kong is projected to be higher, the population of this cohort is predicted to be 1.6 times of 2014 by 2030, and 4.7 times of 2014 by 2064. The "older elderly" community will lead to higher demand towards more inventive and long-term caring services in the coming decades (Elderly Commission of HK, 2017), based on

official statistics and population projections, the total demand for public-funded long-term care services' places are expected to increase from 60000 in 2016 to 78000 in 2030, and then hit the peak of 125000 in 2051.(Census and Statistics Department of HK, 2017)

- *Undersupply of Elderly Care Services*

The undersupply problem could be reflected in the population projection either.

The traditional elderly caring at this stage requires myriad caretakers to provide services through on-site operation, which reveals the current system needs a large quantity of manpower. But Hong Kong's working age (15-64) population are predicted to decrease, from 5.04 million (73.0%) in 2014 to 3.92 million (54.6%) in 2064. In 2014, one older person was supported by about 5 working-age persons; the number will decrease to 1.8 in 2064 (Census and Statistics Department of HKGov, 2017). It can also be predicted that the shrink in the size of Hong Kong's households, with an average household size of 3.9 to 1.8 from 1981 to 2024 (Elderly Commission of Hong Kong, 2017).

The dwindling of working-age population and household signifies that the undersupply of manpower is inevitable.

The undersupply issue also resides in another perspective. At present, 95% of the elderly who need long-term care choose to apply for residential care services (Elderly Commission, 2017), but with the burgeon in the elderly population and the elderly who need long-term care, if we assume their behavior habit remain unchanged, a surge in the demand of places is foreseeable. However, under the context of Hong Kong's land issues, it is practically unfeasible to build a large number of new nursing homes to meet the new needs.

- *Inefficiency in Resource Allocation*

As indicated above, Hong Kong's elderly are largely dependent on home-based elderly caring services, but its mechanism is suffering from an inefficient issue.

A suitable elderly caring system should be not only able to take up stability, but also be able to adapt to social changes and emergencies to maintain effective operation.

At present, Hong Kong's elderly caring system has not reached a high degree of informatization and intellectualization, therewith incapable of achieving a real-time monitoring and response mechanism.

In the case of contingency amid social disruption, such as the shortage of necessities, lockdown, traffic paralysis, or failure to conduct communication, the current system

cannot effectively responses in a timely manner to the social situation change. Amid the Covid-19 pandemic, more manpower and resources have been deployed in order to provide services to the utmost extent. Given that undersupply of the system is significant at this stage, such handling style is unsustainable that may lead to a reduction in the service's accessibility, responsiveness, efficiency, and quality.

2 Hong Kong Government's Approach –Smart Elderly Care

2.1 Hong Kong's Smart Elderly Care Initiative

To reach the mission of providing safe, efficient, and convenient services to the growing number of elders with independence, participation, care, self-fulfillment, and dignity (UNHR, 1991). In terms of current elderly caring in Hong Kong, public and cost-effectiveness private nursing homes are not satisfied enough to meet the increasing demand of elderly caring, not to mention the quality of the service they provide. In the meantime, although the traditional values had laid the foundation that people support and care for their parents when they were getting older, the high burden and high cost of elders caring, as well as insufficient professional information and training, limits the caring they can offer (Ng, 2015; HKPRI, 2017).

- *Hong Kong Smart City Blueprint*

As pointed out in Hong Kong Smart Blueprint released by Innovation and Technology Bureau (ITB), the vision of the planning is to "embrace I&T to build a world-famed Smart Hong Kong characterized by a strong economy and high quality of living" (Innovation & Technology Bureau, 2017). Focus on the development in "smart mobility", "smart living", "smart environment", "smart people", "smart government" and "smart economy", Hong Kong has been desperately seeking ways to address emerging urban challenges and to improve people's living standards. We believe that the development of Smart City Scheme is now an opportunity for Hong Kong government to improve the elderly care system, with the help of technology and innovation to better facilitate the current problems with high efficiency as well as to allocate resources in a smarter way.

- *HKSTP Smart Elderly Campaign*

In 2017, in associated with Hong Kong Housing Society, Hong Kong Science and Technology Park (HKSTP) hosted *Aging in Place Experience Tour* that invited 28 local and overseas technology companies to showcase more than 30 smart elderly care or

smart housing equipment and gears e.g., intelligent wheelchair, smart watch that could monitor blood pressure and heart rate.

- *Innovation and Technology Fund for Application in Elderly and Rehabilitation Care*

Kicked off in December 2018 and operated by Social Welfare Department, \$1 billion HKD were issued to support the elderly caring and rehabilitation service providers to purchase, lease, and their trial use of technology products to improve the quality of their service.

Hong Kong government claimed that by using the smart gears and gadgets, the burdens on nursing staff and caregivers could be alleviated and the older persons' livelihood could be enhanced.

2.2 Flaws in Hong Kong Government's Practices.

At present, the Hong Kong government's rationale is to offer support on supply side through incubator (e.g., HKSTP) to encourage the private sector to produce more R&D achievement transformation. For demand side, the government issued full subsidies to the elderly caring institutions to guarantee the application of related products.

One of the defects in the demand side is notable. The application of the fund is totally voluntary, and the incentives of the elderly caring providers are insufficient, as of January 2020, the first round of applications has only granted \$HK 37 million, covering 210 service institutions (Hong Kong Government, 2020). The usage of the smart gadgets provided could relieve the pressure on the personnel and enhance the quality of their services to some extent, but what restricting the elderly caring institutions is the vacuum phase during the diffusion process of the innovation's effects that lead to the concern of an uncertain foreground. Although the government would cover all the expenditure in the procurement and adoption, the institutions would still fret about the implicit costs and even sunk costs, such as making appropriate procurement plans, staff training and running-in period. Thus, in short term, the scheme could not settle the current issue in an efficient aspect.

Another defect also roots in the demand side, according to the scheme, only elderly caring agencies or institutions could become legit applicants. Those who do not or are difficult to connect with the institutions are excluded from the scheme; its coverage is not wide-reaching enough. As the undersupply issue of current caring institutions deteriorating, the number of neglected older persons will increase thereupon. Finally,

the overarching goal to meet the growing demand for elderly care services would not be accomplished in the long term.

As for the equipment provided, it is limited to behavioral disability aid, rehabilitation training, short-range communication (Social Welfare Department of HK,2019), on the one hand, it still depends on human hands to conduct on-site treatment, with more professional technical support personnel need to be employed to conduct emergency handling. On the other hand, it has not harnessed the adaptability requirements of real-time response. Therefore, the scheme neither fundamentally solves the undersupply issue nor improves the ecology's adaptability.

Therefore, simply focusing on technology and equipment is not a panacea. Hong Kong government needs to adopt other technologies to mitigate the risks embedded in the current elderly caring system and smart elderly caring scheme.

To address the existing problems from the root, Hong Kong must rely on technologies that can break the time and space constraints and possess the ability to conduct automatic analysis or learning. Thus, turning to Internet, big data, and cloud-based technology have become feasible directions. Under the context of Hong Kong and smart elderly caring, the introduction of a community-based cloud platform could serve as an expedient.

2.3 Exploitation of Community-based Cloud Platform: Mechanism

The underlying logic of the cloud platform is to rely on the Internet to integrate the networked hardware, software and internet resources, so as to realize the data calculation, storage, processing and sharing without direct active management of the users and administrators.

Cloud computing makes the resources to be distributed over multiple locations from central server attainable, and then to meet diversified needs of different users concurrently.

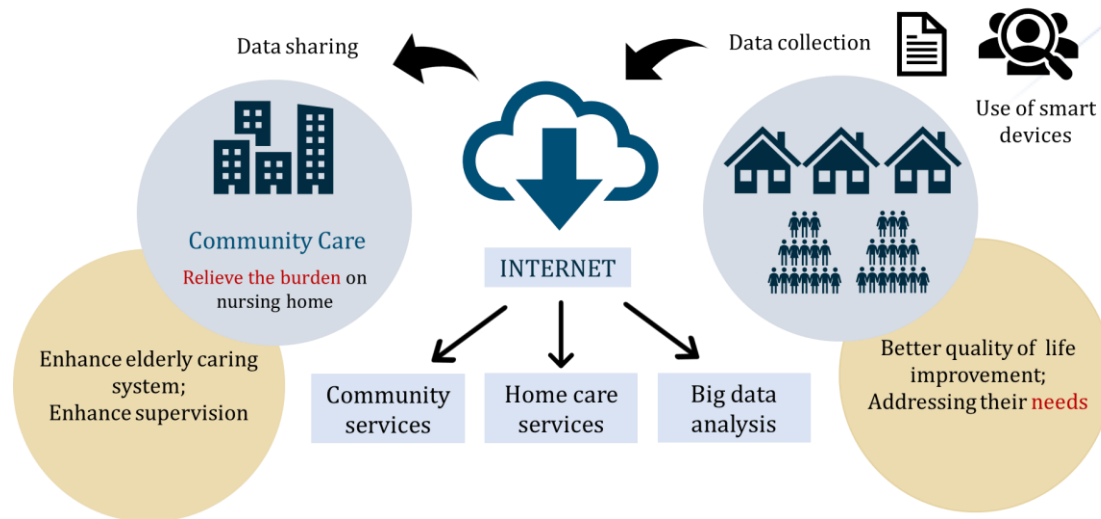


Figure 3. Flow Diagram of Community-based Platform

Source: Hitachi Inspire the Next

By collecting the data regarding the older person’s body, health status and behavioral habits from the smart devices (e.g. sensor gadgets, tele-com devices), the cloud platform would share the possessed data to the caretakers in real-time.

The platform would contribute to the refinement in community-based care services, residential care services and big data analysis. The utilization of big data makes it possible to precisely target the assorted demands of the elderly and their habits that goes up with the adaptive solution to meet their accurate need.

2.4 Significance of Establishing Community-based Cloud Platform in Hong Kong

(1) Optimization of the resource’s allocation regarding HK’s elderly caring ecology

As mentioned in the previous analysis, the undersupply and resources shortage issues pertaining to Hong Kong’s elderly care services are deteriorating. The introduction of the cloud platform, from the demand side, breaks the spatial and time constraints, so that the elderly in need can connect to the elderly care services originally provided by specific institutions at any place. Thus, the deadlock of over- dependence on elderly care institutions will be broken. At the same time, more on-site caretakers could be liberated, thereby the shortage in manpower can be mitigated. At the supply side, benefiting from the natures of cloud technology, a caretaker can provide services to more elderly people in a more efficient way at the same time.

(2) In-depth Improvement of HK's elderly caring services

With the intervention of the cloud-based platform, the government, medical institutions, service providers, individuals and families are integrated to meet the diversified and multi-level needs of the elderly. Undoubtedly, compared with elderly care services in Hong Kong at this stage, the community-based cloud platform could greatly expand the supply scope for ripe growing demand with the help of information technology, and enriches the service breadth and depth (As shown in Figure 4).

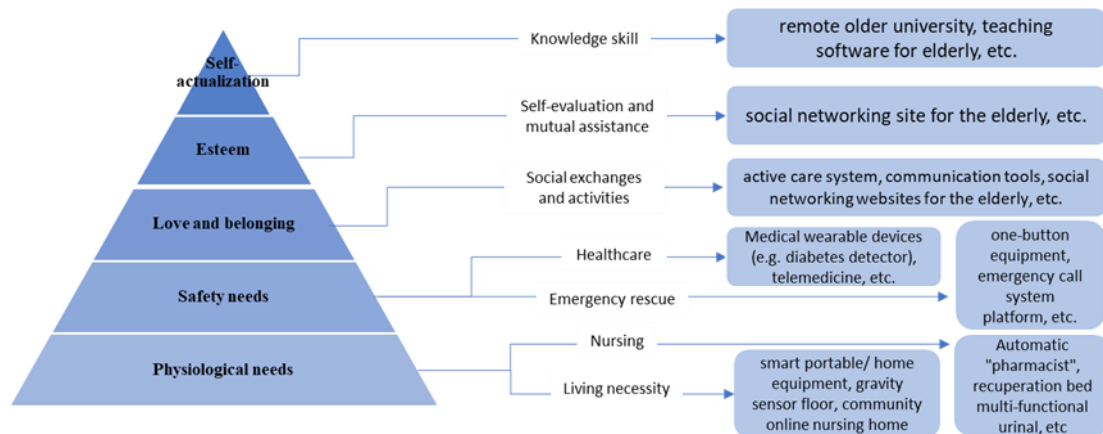


Figure 4. Smart products accordant with Maslow's hierarchy of needs for elderly

(3) Integration of fastness & adaptive capacity

The operation of cloud platform has realized a high degree of automation, the human intervention will be greatly reduced. Therefore, the threats towards the stability regarding Hong Kong's elderly care system and the caring treatments are predicted to be minimized.

On the other hand, cloud technology also bears a high timeliness, which can make real-time response and update in correlate to the change of data. The real-time response ability, in most cases, would not be affected by external factors (such as blockade, traffic congestion, social unrest). Through this platform, the services provided could pick up adaptive capacity cope with the complexity lodged in the demands' vicissitude.

Promoting Elderly Care with a Community-based Cloud Platform under the Smart City Scheme in Hong Kong: Recommendations for Policy and Strategy

Chapter 2

Feasibility of Developing Smart Elderly Care with a Community-based Cloud Platform





In this chapter, both quantitative and qualitative analytical methods are adopted to test the eligibility of the Community-based Cloud Platform in Hongkong. Cost-benefit analysis (CBA) is introduced to examine the economic feasibility pertaining to the practical use of the platform under various scenarios. Following by a general overview of strength, weakness, opportunities and threats (SWOT) under the context of developing a smart city in Hong Kong. And by analyzing how the stakeholders are involved in its development, a straightforward map of sources that can be mobilized during the process could be put forward.



3 Cost-Benefit Analysis & Cost-Effectiveness Analysis

A more comprehensive understanding of the role of this platform in elderly care is needed. The costs associated with care of the elderly are both financial and psychosocial. The psychosocial costs associated with care may result in increased financial burden – an area of major concern to government. The total costs may vary when considering upon age, level of disability, mental and physical health conditions, and subsequent deterioration. Based on existing studies, the cost and benefit factors can be divided into five major categories as shown in the Table 1.

Table 1. Costs can benefits factors for introducing a community-based could platform

Categories	Cost and benefit factors
Wellbeing	Morbidity <ul style="list-style-type: none"> • Preventable injury Mortality (life years)
Care	<ul style="list-style-type: none"> • Personal care • Home care • Meals • Transport • Community Service
Medical	<ul style="list-style-type: none"> • Doctor • Nursing • Dentist • Allied health • Pharmaceuticals
Income	<ul style="list-style-type: none"> • Superannuation • Saving • Carers Pension • Old Age Pension • Rental
Building and operation	<ul style="list-style-type: none"> • Cloud platform and community center building cost • Platform and center operational cost • Purchase of smart device • Home Modification • Home Maintenance
Accommodation	Residential <ul style="list-style-type: none"> • High care (NH) • Low care (Hostel) Community <ul style="list-style-type: none"> • Owner/purchaser • Private renter • Public renter

Source: Bridge, C. E., Phibbs, P., Kendig, H. L., Mathews, M. R., & Cooper, B., 2008.

The factors that influence a comprehensive cost-benefit analysis of using a community-based cloud platform as the base for caring elderly people in home are far reaching, encompassing not only the cost of direct care (such as medical and affiliated health care treatments), but also the costs of enabling an older person to function independently at their own places. For example, a community-based cloud platform can better manage home care, which can available reduced nursing home and hospital admissions and length of stay.

When we focus on the impact of the platform on the person, smart elderly care tend to be cost-effective, even if we only assume effects on relatives and no reduction in (nursing or health care activities) time costs with on-site caretakers or medical personnel (Aanesen, Lotherington & Olsen, 2011). As we discussed, smart elderly home care has different effects on the elderly with a different physical condition, including their age, disability, etc. It illustrates that the cloud platform is more efficient for people who are living at domestic household or with mild disability conditions.

Given that over 90% of the elderly are living at their domestic household, we can reach to two conclusions. First, it proves that this project can work virtuously in Hong Kong, as with the assistance cloud platform, smart elderly care at places are predicted to be more efficient. Second, elderly living alone, living in residential homes or with mild disability that need more intensive care services would become the entry point.

Table 2. Costs for introducing smart elderly home care, and possible quantified effects, € per patient per year

	Disability	Light	Average	Heavy
living at home without SHT	Capital costs	529	529	529
	Operational costs	2187	2187	2187
	Total costs	2719	2716	2716
	Reduction in relatives' care	-2912	-2912	-2912
	Reduced hospitalization in time	-245	-245	-245
	Costs for homecare provider in the case of no other effects	-51%	-16.5%	-8%
living in a nursing home	Capital costs	529	529	
	Operational costs at home care provider	2187	2187	
	Total costs	2716	2716	
	Reduced nursing home cost	-75134	-75134	
	Increase in relatives' care	2912	7280	
	Increase in hospitalization costs	245	245	
	Break even time cost increase at home care provider	69261	64893	

Source: Aanesen, M., Lotherington, A. T., & Olsen, F., 2011

Focusing on the most obvious and easily measurable effects for the whole society, we calculate the costs and benefits to introduce a community – based cloud platform in five scenarios. These scenarios are also based on the current elderly care situation. In the previous introduction, we have introduced that about 90% of the elderly are living at home, where 50% of them living with at least a child, and 30% living alone. Our assumption is based on the principle of giving priority to the elderly who do not have a helper and live alone or with their spouse. Thus, the five scenarios are as follow:

- 90% of the elderly living at domestic household, i.e. all the elderly living at domestic household,
- 60% of the elderly living at domestic household, i.e. all the elderly living alone at their places or with their spouses and half of the elderly living with their child(ren),
- 30% of the elderly living at domestic household, i.e. all the elderly living alone at their places or with their spouses,
- 15% of the elderly living at domestic household, i.e. half of the elderly living alone at domestic household or with their spouses,
- 15% of the elderly living at home and 1% of the elderly living in nursing home, i.e. half of the elderly living alone at domestic household or with their spouses and half of the elderly living in the subsidized nursing homes.

The calculation process is shown in Appendix 1, and the result is shown in the Table 3.

Table 3. Costs for introducing community-based cloud platform in different scenarios, million HK\$

		90% of elderly, in home	60% of elderly, in home	30% of elderly, in home	15% of elderly, in home	15% of elderly, in home & 1% of elderly, in nursing home
Benefit	Wellbeing	2730.67	1820.45	910.22	455.11	455.11
	Care	6453.75	4302.5	2151.25	1075.62	3585.42
Cost	Building and operational	-3764.02	-2998.09	-2232.98	-1126.58	-1203.85
	Total	5420.4	3124.86	828.49	404.15	2836.68

From the result, we can conclude that it's a benefit positive project in all scenarios. Considering the fixed cost of building the cloud platform, the efficiency would be lower in scenarios that covers fewer old persons. On the other hand, although it seems of more virtuous to cover almost all the elderly in Hong Kong, the feasibility tends to be low¹. For elderly living with their children in a small house, the smart elder care can help little, since what they need is more than care. Thus, we suggest that the community-based cloud platform can be conducted under the scenario that 60% of the elderly living at domestic household, i.e. all of the elderly living alone at home or with their spouses and half of the elderly living with their child(ren).

¹ Social Census Department. (2016). Thematic Report Older Persons. Retrieve from https://www.byccensus2016.gov.hk/data/16BC_Older_persons_report.pdf

4 SWOT analysis

In this part, SWOT analysis was conducted to assess the scheme qualitatively by focusing on analyzing the strength, weakness, opportunities and threats embeds in promoting smart elderly care with a community-based cloud platform in Hong Kong based on the macro-environment.

Table 4. SWOT analysis of Smart elderly care in Hong Kong

	<i>Helpful to achieving the objective</i>	<i>Harmful to achieving the objective</i>
Internal <i>attributes of the organization</i>	Strengths <ul style="list-style-type: none"> Integrating information technology can improve both service quality and efficiency Big data can collect and analyze the supply and demand of elderly care services. Community smart elderly care can maximize the sharing of social resources. The series of smart home care products and technology have been launched and improved, providing support for the construction of smart care projects 	Weaknesses <ul style="list-style-type: none"> High economic cost High dependence on Internet Life privacy cannot be guaranteed. It is difficult to adapt in the old community
External <i>attributes of the organization</i>	Opportunities <ul style="list-style-type: none"> The rapid increasing demand on elderly care and their higher quality consumption willingness of the elderly is increasing year by year. Hong Kong Smart Blueprint put forward construct a smart living in Hong Kong Government established R&D center to conduct research and government-provided research funding scheme. A well-developed market helps development of new technology companies and inducing foreign companies Excellent research can be provided by universities and higher education institutions. 	Threats <ul style="list-style-type: none"> The elderly has low awareness and operation ability of the novel intelligent products. People's concern about privacy Lack of deep cooperation among government, social organization and enterprises

- **Strengths**

(1) Improve service quality and efficiency by integrating information technology. Smart old-age care can mitigate the traditional problems of self-care security risks, when the family member cannot step in and a paid caretaker is costly .

(2) Use big data to collect and analyze the supply and demand of elderly care services. Relying on the carrier of Internet technology platform, smart community provides diversified personalized services to facilitate self-service consumption of the elderly, and to solve the problem of few elderly customers due to the mismatch between supply and demand of the traditional model and uninformed information.

(3) Community smart endowment can maximize the sharing of social resources. Intelligence community endowment service network with large data to expand the scope and categories of demand response, embedding miniature virtual nursing home or community, sharing information resources, provide flexible services for the old man, with a third party attitude in "home" community endowment new patterns, such as through the remote medical services, solve the problem of empty nest elderly health care, ease the pension shortage of nursing staff on the quality and quantity.

(4) The series of smart home care products have been launched, providing technical support for the construction of smart care projects. In recent years, many enterprises have made use of the Internet and smart devices to enter the pension market and optimize the home care conditions for the elderly from the hardware. Several excellent medical and technology enterprises have sprung up, especially in or carrying out business in mainland China. For example, the New World Development Company introduced medical and technology, including VR instruments, advanced physical fitness and rehabilitation devices, such as the newly developed "HandyRehab", "smart gloves" to help stroke patients treat their hands, "automatic retinal image analysis system" using to assess the risk of serious diseases such as stroke, diabetes, heart disease and hypertension, and in 2018 initiate a new brand "Humansa" to provide elderly care service, including health services, homes for the elderly, home care, etc. (New World Development Company, 2018).

- **Opportunities**

(1) The rapid increasing demand on elderly care and their consumption willingness of the elderly is increasing year by year. Firstly, ageing population rapidly grow, and their life expectancy increases in Hong Kong. It is estimated that by 2040, the population of Hong

Kong aged 65 and above will account for about 30% of the total population, and the elderly dependency ratio will rise sharply from 198 in 2014 to 494 in 2040. The aging of the population stems from the declining fertility rate and the increase in life expectancy, which leads to a continuous increase in the average age of the population (United Nations, 2015). Secondly, generally speaking, future elders will accumulate more assets, because more women have entered the job market in the past, and the median income has also continued to grow. Therefore, the elders in the future will be expected to pursue a more autonomous and quality retirement life. The increasing and higher quality demands on elderly cares will expand the “silver hair” market, and also bring more business opportunities to new technology, such as smart elderly care.

(2) As pointed out in Hong Kong Smart Blueprint released by Innovation and Technology Bureau (ITB), the vision of the planning is to “embrace I&T to build a world-famed Smart Hong Kong characterized by strong economy and high quality of living” (Innovation & Technology Bureau, 2017). From several major areas of “smart mobility”, “smart living”, “smart environment”, “smart people”, “smart government” and “smart economy”, Hong Kong has desperately been seeking ways to address emerging urban challenges and to improve people’s living standards. The development of Smart City Scheme is also an opportunity for Hong Kong government to improve the elderly care system, with the help of technology and innovation to better solve the current problems with high efficiency as well as to allocate resources more wisely.

(3) The government established R&D center to conduct research and government-provided research funding scheme. The government plays an important role in monitoring the entire technology ecosystem, and through the formulation and implementation of policies and regulations. The influence of the government may be particularly important in the early stages. In the 2017-2018 budget, the government plans to set aside 10 billion HKD to support innovation and development, and proposes the establishment of a new 2 billion HKD Innovation and Technology Fund (ITVF) to encourage private investment in local start-ups, to entrepreneurial incubators and accelerator programs such as incubation programs focus on three key areas – Incu-App, Incu-Tech, and Incu-Bio that support the development of companies and other start-ups spun off from research institutions. Smart elderly, to some extent, combining medical technology, mobile devices, application, etc., is also one of the areas supported by the government.

(4) Hong Kong, as an international trading center, has its advantages on a well-developed market, which can be helpful on developing new local tech-companies as well as inducing

advanced foreign companies. In addition, angel investors and venture capital firms providing advice to start-ups. Angel investors and venture capital firms will nurture and guide early-stage start-ups. They separately implement entrepreneurship incubation plans to help companies improve early business ideas to develop their first prototype products, and entrepreneurship acceleration plans to help start-ups establish a viable business model and run-in at the later stages of existing prototype products. Also, business incubators and accelerators will provide financial assistance to enterprises, and help enterprises develop their businesses with support such as guidance or business consulting.

(5) Excellent research in universities and higher education institutions focuses on application areas. The academic level of universities in Hong Kong is very high. The computer science, mathematics and electronic engineering departments of several local universities are ranked in the top 30 in the world, Hong Kong universities attract the best students to study. Hong Kong assesses educational institutions with a performance system called Research Assessment Work (RAE). This system assesses the ability of higher education institutions in Hong Kong to conduct scientific research in order to allocate resources for universities to conduct scientific research. The research appraisal work used by the University Grants Committee (UGC) for research grants focuses on academic results. Hong Kong universities and higher education institutions will help promote scientific research dedicated to the elderly community and elderly technology.

- **Weakness**

(1) The community-based cloud platform is high economic cost. On one hand, the investment to the cloud platform construction is high at one time. According to our cost-benefit analysis, if the project can only cover a small scare of people, it would be high cost-benefit ratio. It also suggests that the project would be negative benefit in the early stages, when only a few elderly participating in. On the other hand, the full operation of the cloud platform needs to invest money to buy smart elderly care devices, which is also a lot of money. It would be burden to some families if they need to purchase it by themselves.

(2) High dependence on Internet. As the intelligent pension platform is highly dependent on the Internet, and the Internet service is easily affected by servers and managers, it needs to be maintained and updated regularly. If the elderly has a sudden disease and the intelligent pension platform is in the maintenance state, it is very likely to delay the treatment of the elderly and have a negative impact. At the same time, the community-based cloud platform also needs to be updated in real time according to big data and new

medical development, and the update may also result in unsupported accessories for the elderly, resulting in frequent replacement and additional cost.

(3) Life privacy cannot be guaranteed through smart elderly care with the cloud platform. The "smart" premise of the scheme is to collect the data and living habits of the elderly for daily safety monitoring and health monitoring, and connect with the service terminal platform, which makes the physical condition and living behavior of the elderly exposed on the network platform, causing the elderly and their children to worry about privacy, so they are not willing to accept smart pension.

(4) It is difficult to adapt in the old community of Hong Kong, the cost and resistance are not optimistic and cannot be enforced. As many elderly people in Hong Kong live in older communities and the housing types are diverse, it is difficult to renovate the unified housing so as to install smart facilities for the elderly. On the other hand, the per capita living space in Hong Kong is small, and the elderly often live with their children or even their grandchildren, so the facilities related to intelligent elderly care will also have a certain impact on their life.

- **Threat**

(1) The elderly has low awareness and operation ability of the novel intelligent products. According to the Thematic Report: Older Persons from Census and Statistic Development, HKSAR, the elderly in Hong Kong have a low level of education and a limited acceptance of new things, especially things like the Internet that require a lot of new knowledge. For the elderly living alone, without the help of their children, it is difficult to use this intelligent platform and master the required functions. Therefore, the role it can play for these elderlies is relatively low. They prefer to the traditional way such as seeking for a doctor.

(2) People's Concern about Privacy. In the era of big data, the old age field is facing new opportunities. The accumulation of big data for the elderly provides better data analysis support for smart elderly care. But whether these elderly data can be used correctly, many people still have a certain degree of worry. In July 2019, 50 smart light poles with functions such as Bluetooth traffic detectors, weather sensors, and AI panoramic cameras were put into service in Hong Kong. Unexpectedly, the move has raised concerns among some Hong Kong youths about privacy monitoring. During a parade on August 24, the smart lamppost became the target of some radical demonstrators to wreak havoc.

This incident also reflects the unacceptability of many people in Hong Kong to emerging technologies. This will lower the morale of a big quantity of local hi-tech companies and will also make people more questionable about the security of equipment, software, and programs.

(3) The Lack of Deep Cooperation among Government, Social Organization and Enterprises. Many people of insight have realized that the pension industry is becoming a rising industry. Throughout the world, many large real estate companies, insurance companies, and even technology and Internet companies have begun to race and start the practice of smart elderly caring services. Although the smart elderly caring industry has attractive prospects, the risks, long investment cycle, and the industry needs to be regulated are all issues facing the government, society, and enterprises.

In Hong Kong, although there are examples of cooperation, such as the Hong Kong Textile and Apparel R&D Center (HKRITA) and the Hong Kong Polytechnic University. But few cases of cooperation in smart elderly care among the Hong Kong government, companies and other universities in Hong Kong can be found.

There are also relevant financial aids provided by the Hong Kong government for technology companies, such as the Hong Kong government reserves 2 billion Hong Kong dollars to fund middle and downstream research. Another example is the I&T Venture Fund, which is also a Hong Kong dollar 2 billion to support the operation of startups and encourage more companies to co-invest with local governments in local startups. However, these enterprises are still struggling in the early stages of operation and cannot prosper the entire smart elderly caring industry ecology in Hong Kong. The last funding from the Hong Kong government is the Senior Age and Rehabilitation Innovation Application Fund. This fund provides subsidies to organizations that apply for the use of new research and development rehabilitation facilities. But no funding can be provided for longer use. In Hong Kong, there is no deep interaction between the government, society and private enterprises. The current cooperation is simply financial assistance.

In Conclusion, the SWOT analysis of Hong Kong's smart elderly caring implies that the government should play a bigger role to promote its practice in the domestic market.

5 Stakeholders analysis

Hong Kong's Smart Elderly Caring demands multi-stakeholder's participation, the policy making process and practices of which was affected by the interrelations and interactions among different stakeholders.

At present, the practice of smart elderly caring in Hong Kong is still at the stage of exploration and germination, thus the attitude of different stakeholders towards this emerging industry are complex and uncertain, in addition to the first-hand information that can be used for stakeholder analysis is quite limited, but according to the interaction among different stakeholders in other fields of Smart City development in Hong Kong and the disclosed information in hand, reasonable prediction and speculation of their reactions or attitudes could be made.

For instance, the development of smart transportation in Hong Kong is relatively fruitful, e.g. the heavy practices of Area Traffic Control System, Journey Time Indication System, Hong Kong eTransport, Hong Kong eRouting etc. Under this framework, the Transportation Department of Hong Kong SAR government serves as an executant with the endorsement and supervision of Legislative Council and Judiciary Authority. The government, research institutions, companies related have been working collaboratively on delivering solutions and innovation that correlates with the development of the city's smart transportation. And, the citizens public opinion and the users' experience also affect the decision-making process of the executive branch and the legislative (Transportation Department of HKSAR Government, 2020).

Although there are similarities among the stakeholders' interactions in the two distinguished fields, such as the games among the three branches of administration, legislation and judiciary, or the role of public opinion on the authorities, smart elderly caring, as an independent and cutting-edge field, the stakeholder analysis towards with has its own characteristics.

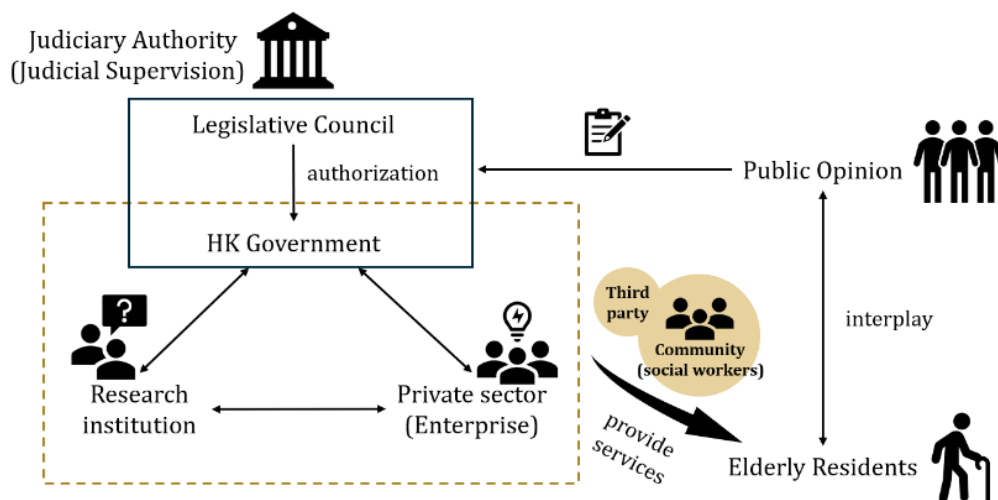


Figure 5. Stakeholders of Smart Elderly Caring in Hong Kong

Figure 5 shows the functional relationships among the stakeholders, their functions, roles, motivations, interests would be furtherly elaborated in the following analysis respectively.

- *Hong Kong SAR Government*

The Hong Kong government is not only responsible for providing public services for the elderly, but also an advocator and decision-maker of the local smart city development scheme. The relevant departments under which also hold the power of administrative supervision over the implementation of smart elderly caring in region, which is the key to the smooth and sound operation of smart elderly care.

To be specific, it is an inter-departmental scheme that demands the involvement of Innovation and Technology Bureau (ITB), the department that responsible for the improved use of innovation and technology and innovation, and Social Welfare Department, the department that provides services to elderly.

Hong Kong government has launched several schemes to promote the development of the region's smart elderly caring, in the 2014 Policy Address of Hong Kong SAR Government, Carrie Lam announced to support smart elderly caring in her policy agenda; in 2017, Elderly Commission announced the advocacy of smart elderly caring in *Elderly Service Program Plan*; In response of the Government's 2017 Policy Address, Social Welfare Department launched *Innovation and Technology Fund for Application in Elderly and Rehabilitation Care* to subsidize the department-funded elderly nursing homes and Neighborhood Elderly Centers (Social Welfare Department of HKSAR Government, 2017).

The vision of Hong Kong government is to embrace innovation and technology to build a world-famed Smart Hong Kong characterized by a strong economy and high quality of living (Innovation and Technology Bureau of HKSAR Government, 2017)

The government also have sound reasons to be a supporter. First, smart elderly caring is an indispensable part of the development of a smart city, which is in line with the needs of Hong Kong government. Secondly, Hong Kong is facing an escalating situation of aging and poverty over elderly, HKSAR government has invested a lot of resources to tackle relevant issues. The introduction of smart elderly caring system can effectively help the government ease the city's current problems and improve the livelihood of the elderly. It can not only save the cost of the government in the long term, but also improve the satisfaction of the government in Hong Kong and ease the social tense atmosphere.

And in the same way, the decision-making and administrative behavior of the Hong Kong government are subject to many restrictions, such as the supervision and restriction of the judicial authority and the legislative authority, as well as the response to the public opinion, etc. In the short term, the increased resources and human resources expenditure due to the construction of smart pension will also cause opposition from the outside and the inside.

- *Legislative Council of Hong Kong SAR*

As the legislature of Hong Kong, the Legislative Council has the power to decide whether to authorize and question the Hong Kong government. Its attitude determines whether the government's plan can be implemented. As a scheme that beneficial to the people's livelihood, the Council is a strong advocator of it, from 2017-2019, the Legislative Council discussed the promotion of smart elderly caring in Hong Kong 16 times (Legislative Council of Hong Kong, 2019). Many members of the Council have repeatedly questioned and supervised the government's plan to promote smart elderly caring, but the game between the legislature and the administrative authority in the region may be reflected in the details of the scheme, such as the scheme's effectiveness and put forward more specific suggestions on its specific contents and implementation methods .

Since the seats of the Legislative Council are elected by voters (mere residents), the public opinion of Hong Kong is significantly crucial to the Council. If the public opinion strongly opposes the scheme, a considerable number of members of the Council will cater to the public opinion for the ballots. Similarly, the tacit mutual understanding between the pan-democracy camp, who have just gained a complete victory in the 2019 District Council election and are likely to occupy a majority of the Legislative Council, and the current

government is not going smoothly. Therefore, it can be inferred that the Legislative Council will not oppose the launch of the smart elderly caring scheme.

- *Judiciary of Hong Kong*

The judiciary authority of Hong Kong has three main functions in the practice. The first is to exercise judicial supervision over the legality of private enterprises' business operation in the industry. The second is to determine whether the government's policies are legitimate. The third is to provide legal protection for the citizens that participating in the smart elderly caring scheme.

Hong Kong is the first jurisdiction in Asia to legislate to protect personal privacy and data information. Its Personal Data (Privacy) Ordinance (the "PDPO") is based on internationally recognized consensus, close to OECD and EU rules and can be reformed in a timely manner (Privacy Commissioner for Personal Data of Hong Kong, 2019). (The detail is discussed in Chapter 2, 4.2 Data Protection in Hong Kong)

At present, the judicial authorities in Hong Kong have not ruled the smart city related projects as illegal. Therefore, as long as the government's policies and the operation of relevant companies are in line with the framework of relevant laws in Hong Kong and do not violate the relevant laws in its operation process, it can be inferred that the judicial authorities in Hong Kong will not restrict the legitimate smart pension projects. However, smart elderly caring relies on new technology, new concepts and technologies emerge in endlessly. While it is a test to their judicial ability that whether the judicial authority can timely or reasonably interpret or adjudicate the novel smart elderly caring scheme and the civil or criminal disputes that come along with it.

- *Private Sector (Industry Players)*

As a private firm in the field of smart elderly caring, their activities are related to profit-making, so its fundamental business logic is to introduce competitive products suitable for local demand to occupy as much market share as possible to pursue profits.

Currently, only a limited number of related companies are active in the Hong Kong market, such as HOHOLIFE, which specializes in selling elderly caring products, DORO Hong Kong Limited, that develops mobile phones for the elderly, Human Washer limited, which operates intelligent elderly bathroom design, Rondish Co Ltd - Hong Kong, which develops monitoring and positioning products, etc.

The initial introduction of science and technology equipment to assist elderly caring in Hong Kong was earlier than 1996, but its development has been extremely slow in the past 24 years (Our Hong Kong Foundation, 2017). The reason is that for local smart elderly caring enterprises, Hong Kong government follows a free market economy policy, which means there is limited policy or financial support for R&D start-ups, so that local start-ups are difficult to start their business, and the cooperation between private enterprises with public institutions, universities, and incubators are seriously insufficient, resulting in the difficulties of which to build up enough competitiveness.

For overseas companies with mature and developed technology or products, such as Japanese, American and European R&D companies, there are visible and invisible barriers for them to enter the local market. First, import of radio transmitting apparatuses is controlled under the *Telecommunications Order*, only local companies in Hong Kong are qualified to apply for the import of relevant products, which means that they must set up local branches and go through approval process to successfully introduce products into Hong Kong, and they cannot guarantee that their products are adequate for the local needs of Hong Kong, this dilemma means that they have to risk investing before the market research and afford the sunk cost. Secondly, Hong Kong 's local market is too small, and the contexts of Hong Kong is very unique. For example, they have to redesign their equipment to cope with the unique housing structure in Hong Kong, or they need to develop voice interaction equipment based on Cantonese etc. The cost of localization may be higher than the sales revenue. Thus, their motivations towards localization is seriously insufficient.

Therefore, if private enterprises in the industry can get government subsidies, public-private cooperation or official procurement and other forms of support, their R&D capacity and business willingness will be greatly improved.

- *Elderly Residents of Hong Kong*

The population of the elderly aged 65 and above is 1,160,000 in 2016, accounts for 17% of the total population (Census and Statistics Department of HKSAR Government, 2017).

With the aging of the elderly, their physical function and cognitive ability will gradually decline. If they do not get proper care, their living standards and quality of life will seriously decline either, the life of the elderly with chronic diseases or disabilities will be more difficult, the someone will even be completely unable to take care of themselves.

The introduction of the smart elderly caring scheme will increase the convenience of their lives, which can not only offer them a dignified life to a certain extent, but also create the opportunity for them to live alone completely safely. Different types of smart elderly caring devices can also avoid their injuries or deaths caused by emergencies or help them communicate with the outside world to achieve a normal social life.

Therefore, in theory, the introduction of smart elderly caring scheme is good news for the elderly in Hong Kong, especially the elderly living alone, with poverty or illness. While in practice, firstly, there is lack of social awareness of smart elderly care in Hong Kong, and the local elderly are not highly receptive to the new things. Secondly, due to the lack of government subsidies and a sound technical ecology related, the price and user experience of smart elderly caring products may not be satisfactory.

Therefore, it can be predicted that a small number of the elderly in Hong Kong are willing to accept new things, and those with abundant economic conditions are willing to purchase and use smart elderly care services, while most of the elderly ignore or even resist the use of smart elderly care services because of economic problems, or simply lack of understanding, or distrust of new things

- *Hong Kong's Public Opinion*

The mainstream public opinion in Hong Kong is not only related to the government's governance activities, but also to the decision-making activities of the Legislative Council and the marketing activities of the private sector

In 2017, Dr. Angus Cheong, chief consultant of uMaxDATA—a local public opinion monitoring company, disclosed that they had used machine learning and other means to study the public's attitude towards Hong Kong's Smart City scheme, the data collected from news media showed 53.6% of which held a neutral attitude and 42% when comes to positive attitude, and a surge in negative attitude (35.4%) was observed in the data collected from social media. Of the two statistical methods, 58% and 64.6% are neutral & negative respectively. It can be concluded that the mainstream public opinion in Hong Kong has an indifferent or negative attitude towards the development of smart cities. In light of the accomplishments of smart cities by the Hong Kong government is not satisfactory, and the professional services in Hong Kong are relatively developed, some Hong Kong citizens believe that the development of smart cities has not had a great impact on their daily lives.

As for the technologies used by smart elderly caring such as personal data collection and transmission, location system and monitoring system, the mainstream public opinion shows a radical opposition trend due to the pursuit of personal privacy protection and the conflict with location monitoring technology, just like the East Kowloon smart road lamp belonging to the smart city plan is maliciously damaged due to its dubious use of face recognition technology. In addition, at present, due to the social unrest in Hong Kong, the public's trust among Hong Kong government, Carrie Lam and her team has declined significantly, a populist tendency has converged that tend to oppose all government decisions due to distrust. Therefore, if the government's smart elderly caring plan and the whole smart city blueprint cannot be trusted by the mainstream public, the difficulty of its promotion will be greatly increased.

- *Third Party (Research Institution & University)*

As an international metropolis and a developed economy, Hong Kong ranks 13th in *Global innovation index*, but its sub-ranking regarding the innovation output is lower (16th) when comparing to other developed economies like Singapore(1th) or even developing economies like China(5th), Israel (10th). (World Economic Forum, 2016).

By analyzing the relevant innovation indicators in Hong Kong, we can predict that the participation of the academic sector in is insufficient at present.

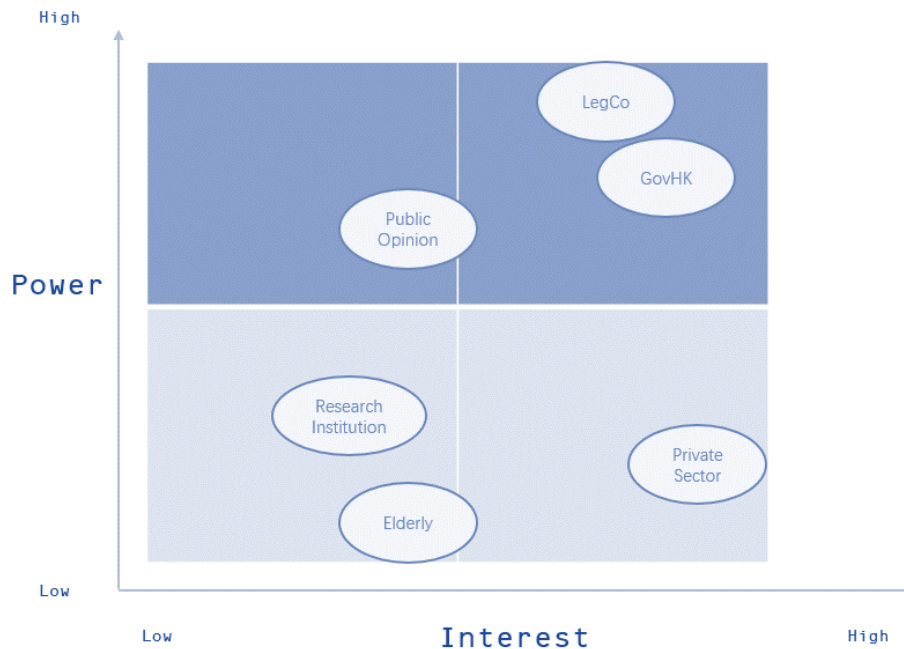
There are two main sources of R&D funding: 1) government and 2) business (Our Hong Kong Foundation, 2017). The total amount of research funding from Hong Kong government accounts for 0.4% of GDP in 2013; the total amount of research funding from Hong Kong enterprises and government accounts for 0.7% of GDP (Our Hong Kong Foundation, 2015). Compared with other developed economies such as Singapore (2.1%) and Japan (3.5%), Hong Kong's investment is relatively inadequate.

In addition to the low total amount of funding, the short duration of funding is another reason for the lack of motivation of the academic community. (Our Hong Kong Foundation, 2015).

The contribution of Hong Kong's industry and commerce community is also insufficient. Its R&D investment accounts for 45% of the region's total R&D investment(2013), which is far lower than that of other developed economies such as South Korea(79%), Japan(76%), Taiwan(76%), etc.

As an international metropolis and a developed economy, Hong Kong ranks low in "innovation capability", only 29th, while it ranks 43rd in "supply of scientific and technological personnel and engineers" (World Economic Forum, 2016).

A Brief Summary: Barriers in the Development of Elderly Caring in Hong Kong



Power – Interest Grid

Figure 6. Quadrant of Stakeholder

In summary, as showing in Figure 6, the quadrant of stakeholder indicates their efficacies in Hong Kong Smart Elderly Caring scheme, the Horizontal Axis (interest) represents the willingness of the stakeholder to participate in or promote the development of the scheme, the Vertical Axis (power) indicates the extent to which it can influence the decision-making and policy implementation in terms of our topic.

From the above analysis, a conclusion could be reached to that it is a dynamic and complex process to build a perfect smart elderly caring eco-system. But at this stage, several significant obstacles spanning in its development can be spotted.

(1) Scant collaboration among stakeholders

One of the institutional shortcomings is the insufficient collaboration among research institutions, private sector and universities. Hong Kong government’s effort in facilitating the collaboration is deficient that resulted in an underpowered R&D environment.

(2) Substandard business environment

From the supply side, currently the pilot scheme or trial regarding the technology products related are sparse. Private sectors' incentives to enter the market and innovation is restricted by the vague prospects of the market.

(3) Skepticism among public

From the demand side, Hong Kong's elderly community and the public opinion's acceptance of smart elderly caring is insufficient. Firstly, the acceptance of a new concept among the public, especially for older people takes time, both smart elderly care or cloud-based technology are novel and emerging concepts. Secondly, at present, the application and popularization of smart elderly related products in Hong Kong is not far-reaching enough, the public has limited opportunity to foster the intuitive understanding of its effect and utility. Third, smart elderly care services, especially the application of cloud technology, requires the collection of mass and myriad personal data, which triggers the privacy concerns among Hong Kong's residents.

To conclude, the commonness of the above three barriers is the underperformance of Hong Kong government in promoting the development of the region's smart elderly care ecology and the community-based cloud platform we mentioned. Therefore, we will furtherly discuss how the government could participate in its development more efficiently and furtherly elaborate how the government would step in.

Promoting Elderly Care with a Community-based Cloud Platform under the Smart City Scheme in Hong Kong: Recommendations for Policy and Strategy

Chapter 3

To develop the community-based cloud platform in Hong Kong: The Role of Government





In order to explore how to develop the community-based cloud platform in Hong Kong, the role that the government should play is investigated, in this chapter. Two kinds of experiences from the UK 's approach of government as a service provider and Zhejiang 'public-private partnership model are illustrated through the case study. Based on the experiences, two alternatives are proposed for the government to address the elderly care in Hong Kong. Given the existing studies, problem, and the current situation of the elderly care in Hong Kong, feasibility, effectiveness, equity, and sustainability are put forward as criteria for alternatives evaluation. By analyzing the policy alternatives with criteria, recommendations on the elderly care developing blueprint can be drawn.



6 Case study: Experience from other regions

In this section, United Kingdom Zhejiang province's smart elderly caring schemes were selected for lucubration. The key lessons and implementations of the three regions' policies and strategies were introduced, summarized and elaborated to guide Hong Kong's policy making process in the next stage.

6.1 United Kingdom: Government as service provider

6.1.1 Public Sector's Role in UK's Elderly Caring Services

Elderly caring in place (domestic household) is the main mean of supporting elderly in the UK, only 3.2% of elderly people chose to live their old-age life in elderly caring homes. (Office for National Statistics, 2011).

British public sector is actively participating in the elderly care service, and directly providing services to UK citizens. At the central government level, UK's publicly funded institution National Health Service (NHS) offers multiple forms of support for all elderly citizens to tackle their difficulties with activities daily-living and multi health conditions that need pertinent services, which includes providing trained career, food on wheels. House adaptation service or professional settings that more suitable to elderly people's living is also offered. For elderly people with illness or disability in need, targeted services are also available (NHS,2020). Most of these services require payment, but their prices are more reasonable than commercial services, and the cost of low-income families can be reduced or waived.

For local governments (local councils), according to NHS's affiche, the local councils also provide services like home adaption and recommendations as of elderly care. The councils would pay for the equipment that costs less than £1,000.

To conclude, United Kingdom has built a relatively complete elderly caring scheme, including multiple guarantees in terms of funds, facilities and personnel, which not only achieve comprehensive coverage, but also pay attention to the special needs of specific groups.

6.1.2 Cooperation among government and other parties

Although government serves as service provider itself, it still has extensive cooperation with different parties.

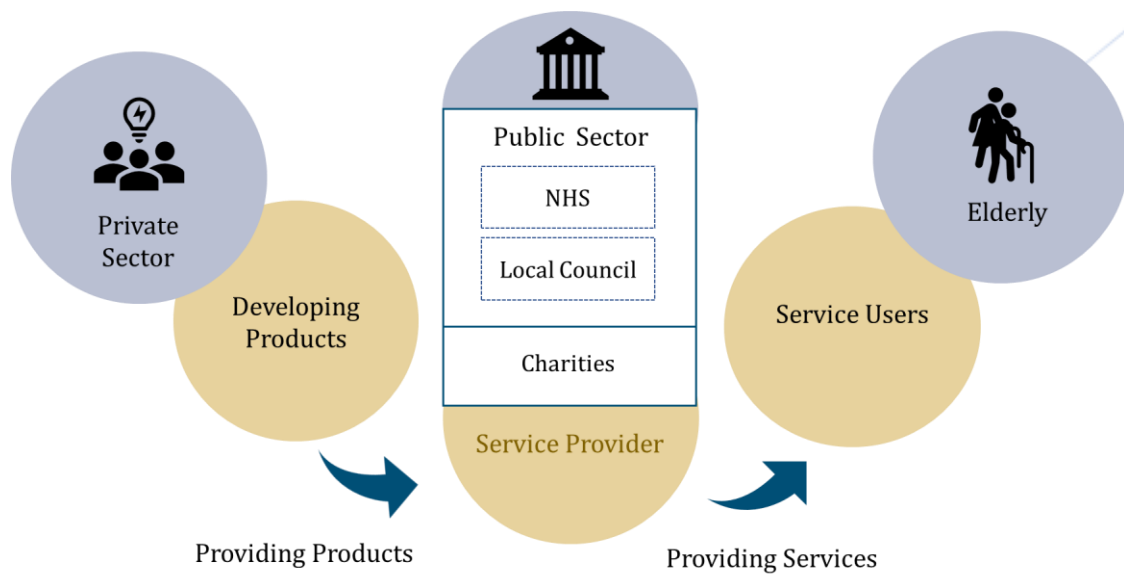


Figure 7. Public Sector's Participation in Elderly Care Services of UK

- *with charity sector*

Charity sector is another significant service provider regarding elderly care services in UK, these non-profit institutions also provide low-cost or free elderly care services to British citizens. The government cooperates with them in the form of assistance in promotion, i.e. NHS will guide and recommend citizens in need to select the right charity to get access to their services.

- *with private sector*

The private sector not only provides elderly care services directly to the public, but also produces related products. The British government's connections with private sector are in the form of government procurement or outsourcing, and then provide the services to the citizens at a more advantageous price or free of charge.

- *with public*

In addition to providing services directly, the UK government will recommend services provided by charities and private institutions to its citizens by providing official guidance and advice.

6.1.3 Lessons from UK and its adaptability in Hong Kong

As a former colony of UK, Hong Kong's legal system and social system have many similarities with Britain, but there are still significant differences in the economic, political and social contexts between the two places. Therefore, how to learn from the

advanced experience of the UK in the field of smart elderly caring and successfully localize in Hong Kong is very crucial.

The 3 key features of UK's smart elderly health caring:

- *Publicly-sector directly offers services*
- *Active participation of all-level official institutions*
- *Participation of third party (charity sector)*
- *Government directly procure from private sector or through outsourcing*

Hong Kong government pursues a laissez faire economic policy and seldom directly participates in economic activities. Therefore, the British model is a novel choice for Hong Kong.

Under the context of developing a cloud platform in Hong Kong, by introducing UK's experience: Hong Kong government would lead and fundraise the construction of cloud platform by purchasing private sector technology, equipment, or through outsourcing, and then the government will directly involve in and take the responsibility to operate the platform on its own.

6.2 Zhejiang province: Public-Private Cooperation Model

Wuzhen and Pinghu are typical cases of the cooperation model of community and home-based elderly care systems in Zhejiang Province, mainland China. We look deep into the case in Pinghu and Wuzhen Internet platforms respectively.

6.2.1 Wuzhen

After the first World Internet Conference was held in Wuzhen in 2015, the local government has launched the first smart elderly care scheme in China. While this first attempt did not come to a good outcome due to the lack of professional service providers and a basic level local government's resources are limited.

Later, in 2017, the local government cooperated with Chunxi Tang, a private company. After the cooperation, the regions' elderly caring starts a virtuous development. The big data system had received more than 700 times call and provided the elderly caring service more than 1800 times (Zuo, 2018).

Cooperation between the Wuzhen government and the service provider

The local government and service provider play different roles in smart elderly care. The government gives policy support and the enterprise has the responsibility of building, partly financing, and running the project.

- *Service provider's role*

Chunxi Tang is a professional service provider that offers online and on-site smart elderly caring service. In 2017, with the financial and infrastructure support of the Wuzhen government, it established two smart elderly caring platforms: one is the big data platform which records, monitors, and analyses the local elderly's information; the other one is the integrated management platform which offers the functions of monitoring, supervising, and dynamic feedback, run by the Wuzhen government². These two platforms' fund was financed by Chunxi Tang and the government.

Based on these two platforms, the smart elderly caring services operators can provide two types of services: one is the routine-service in the interactive system to achieve "grant whatever is asked". The other one is the customized service achieved by an array of smart living sensors, some of them deployed in furniture, some of them are electrical appliances themselves.

Based on the big data platform, Chunxi Tang mainly provides the elderly with home-based service.

Chunhui Tang timely records and updates each senior's health information by smart wearable kits on the elderly's body. The data could be used to analyze the elderly's health situation from multiple dimensions. Besides, Chunhui Tang provides security monitoring services around the clock. The system can respond to the call from the elderly and tackle the issues quickly. It forms an emergency rescue network for the elderly focused on by the government.

Based on the big data platform, Chunxi Tang mainly provides the elderly with home-based service. It sends carers to the elderly's home. All the employees provided by Chunxi Tang are trained very professionally before they go to the positions. They will help the elderly eat, bath, and clean the houses

- *Government's role*

The Wuzhen government is divided into 3 roles. The first role is a financial supporter. Investing a smart elderly caring platform is very costly. So, the government just partly financed the platform to relieve the fiscal pressure. Also, the government subsidizes the

² Source: http://www.360doc.com/content/16/0705/08/34279512_573188264.shtml

caring services for the elderly. It provides 1.5 million yuan to Chunhui Tang for the daily operation. 80% of the services and 5 kinds of smart devices are free now.

The second role is infrastructure supporter. Since 2015, when “Tongxiang Smart City Development Plan (2016-2020)” and “Tongxiang Wuzhen ‘Internet Town’ Building Implementation Scheme (2015-2017)” were listed in the Tongxiang government’s specialized planning (Wuzhen is in Tongxiang City), the Tongxiang government had generated fiber-to-the-home project, promoting broadband network capacity and speed, and Wi-Fi coverage in public place as the foundation of the "Internet+" elderly caring services. The Wuzhen government also had greatly supported infrastructure building projects such as electricity, gas, pipe and so on.

The third role is the supervisor. For example, the local government introduced a local elderly-caring standardization document in 2016. It standardizes the types, charging standards, and service workers’ behaviors. Also, the Wuzhen government has been receiving service feedback from the elderly based on the integrated management platform.

6.2.2 Pinghu City

With the improvements in people's living standards and longevity, China has been faced with population aging problem. As estimated, till 2020, the number of people aged over 60 would increase to 0.25 billion, accounting for 17.8% of the total population in China (General Office of the State Council, 2017). Thus, the aging population has become a social problem. In the meanwhile, the health care industry has been playing an important role in coping with the growing needs of the elderly.

In order to solve the problem of social needs, Hitachi *Inspire the Next* Center has carried out investigations on the market since 2014. Afterward, under the big context of improving the home care system raised by the central government, Hitachi Innovation Center has come up with the solution of “Internet + Smart Elderly Care Platform”, which aims at developing a home care system for the elderly.

Cooperation between the Pinghu government and the service provider

Hitachi helped establish two critical systems focusing on Internet & Technology (IT) services to realize the core concept of the smart elderly care system. They are: "Internet + Community Home-based Elderly Care Platform” used by community homed-based elderly care service centers, and “Smart Elderly Care Platform” used by Pinghu

Government.

- *Service provider's role*

As a globally leading technology innovation company, Hitachi mainly provided technical support. One technology used is the indoor positioning system (IPS). The information of each elder people like position and health condition can be collected by sensing elements and then be shared with their relatives, health care centers and so on. The technology underlines the new e-platform which provides elaborate care services the elderly need.

The platform can meet the needs of elderly care from different dimensions. First, it stimulates the community care center to provide daily care services for the elderly to satisfy their need for love and belonging, which contains bathing, catering, entertainment, mental soothing, family connections, law consulting and so on. Second, it meets the elderly's need for health care by providing health consultation and inquiry. Third, it meets the need for safety concerns with the use of varied smart devices.

- *Government's role*

The Pinghu government plays an important role in building the smart caring platform. Its role is the half funding provider, the Pinghu government and municipal department pay for social services from Hitachi. that purchases software and hardware devices. (Pinghu Civil Affair Department, 2018). Also, the Pinghu government subsidizes the disabled and semi disabled elderly for the basic caring services and Hitachi for purchasing software and hardware devices. (Pinghu Civil Affair Department, 2018).

6.2.3 Lessons from Zhejiang and the Inspiration for Hong Kong

Based on experiences of Wuzhen and Pinghu, Hong Kong can learn from the following five points to build its own smart elderly care service platform.

First, when the government cooperates with the enterprise, two platforms should be established. Whatever in Wuzhen or Pinghu, two platforms are making different positive effects on the elderly caring services. The big data platform has responsibility for recording, analyzing personal data. Based on the data analysis, the service provider can accurately match between services and the needing users. For the Hong Kong situation - lack of professional service workers, it is especially important. The monitoring platform is also important. Although compared with a government, enterprises can provide better services, as a profit-seeker, there are some risks of doing

some rule-ignored behaviors by enterprises. The elderly caring service is a foundation of social stability that needs the local government to monitor the operation of smart elderly care. It is a good opportunity for the government to save time and resources to use technical method for monitoring the services.

Second, government should use different policy instruments to fuel the development of a smart elderly caring platform. In the cases above, governments do not stand in the middle of the stage as before. However, retiring backstage does not mean doing nothing. the two governments adopt different policy instruments to give convenience to the establishment and operation of the smart elderly caring platform and to provide basic security for the elderly in need.

Third, government should select a leading enterprise as the partner. Whatever Chunxi Tang or Hitachi, they have extensive experience in smart elderly care. A government should be cautious about the partner. Although there is no evidence showing why two governments select both, selecting a leading enterprise is a way to save time and resources.

Fourth, establishing the online-platform should be with standardized offline-services. The elderly care cannot exclude physical services. The smart elderly care's subject is the human-being and technology like big data is only a tool to better serve the elderly.

Fifth, the home care project should be customized regarding the local features and cultural concerns. There is no "one-size-fits-all" model. Thus, incremental adjustments should be made in different phases. The pilot study and experimental project are strongly needed before the generalization of the policy.

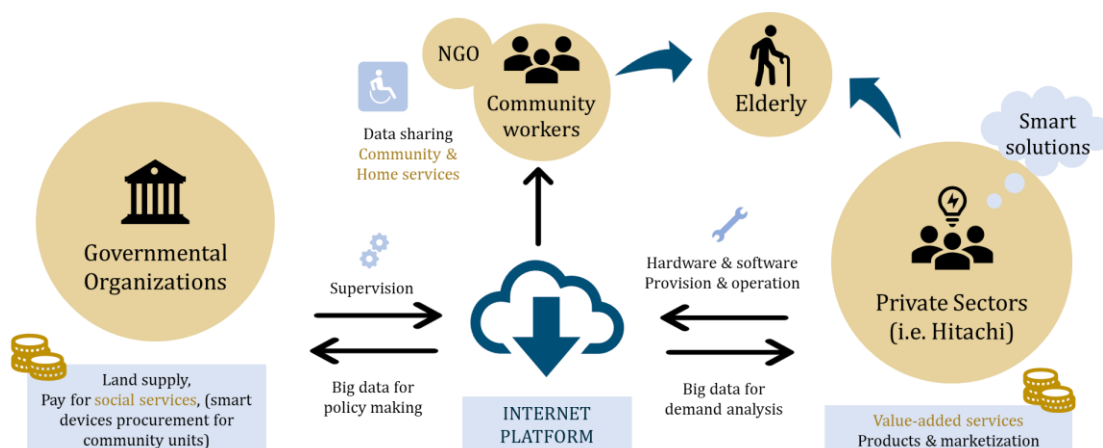


Figure 8. Cooperation Mode of Home-based Elderly Care System

7 Policy Alternatives and Evaluations

7.1 Alternatives and Policy Options

Based on the former case studies, in this section, we propose three policy alternatives and policy options of establishing the internet-based platform to enhance elderly caring in Hong Kong, which is summarized by Table 5.

Table 5. Policy Alternatives and Brief Descriptions

Policy Alternatives	Options	Brief Description
Maintain status quo	Stick to the current funding scheme under current Smart City scheme	Support to the trial use of new technology; adopt more technology applications
<i>Establish and Internet-based platform</i>	Government as service provider	Government fundraises to establish the platform and provide services, cooperates with charity sector
	Cooperation with enterprises (PPP mode)	Government fundraise for land supply and social services, private sectors responsible for platform establishment and operation.

(1) Maintain Status Quo

As pointed out in Smart City Blueprint, the government still sticks to increase the support to the trial use of new technology as well as to adopt more technology applications under current funding scheme.

(2) Establish an Internet-Based Platform

- By Government Operation

Alike the UK mode, the government would be responsible to establish the platform and operate it as well as build cooperation with charities. Services are bought from private sectors in the market.

- By Cooperation with Enterprises (Public-Private-Partnership (PPP) Mode)

Applied from the mode in Wuzhen and Pinghu City in Mainland China, it refers to build cooperation with the enterprises in the market by PPP mode. The government would

offer land needed and procurement of social services. And it is enterprises' responsibility to establish a cloud platform with expertise as well as maintain daily operation.

7.2 Evaluative and Practical Criteria

Before deciding on which alternative is the most appropriate in the context, criteria for justification should be clarified first. Based on previous studies, in this section, we select four criteria to be the determinant factor of choosing among policy alternatives, which are: *feasibility*, *effectiveness*, *equity* and *sustainability*.

- *Feasibility*

Feasibility criterion contains two aspect: political feasibility and administrative feasibility. For political feasibility, emphasis should be placed on the acceptability of the policy option among stakeholders. For example, whether it would be opposed by a certain group of people and how many supports can the government receive from different parties. It should be carefully considered during decision-making period. As for administrative feasibility, is specified as the potential difficulties and obstacles of implementing a policy. The resistance to change may impede the process when the government is trying to implement a radical policy alternative.

- *Effectiveness*

Effectiveness is about to what extent improvements can be made through one policy option. In this case, the effectiveness is among those policy options, which one can best alleviate the problems mentioned under the current scheme, including the concerns of inputs and outputs as well as the cost-effectiveness of the policy option.

- *Equity*

In terms of equity criterion, the major point is how the stakeholders involved would be influenced after the implementation of the policy alternative. The major stakeholders here are private sector (services provider), the elderly and public. If the implementation of the policy proposals could bring about impacts on the stakeholders fairly, the proposals could be viewed that they perform well in the equity criterion. However, it is hard to compare the specific value of the impacts caused by the alternatives for different participators in the whole society. Therefore, we just consider about the alternatives can impose positive effects or negative effects on the stakeholders.

- *Sustainability*

Literally, sustainability refers to whether the policy can sustain from a long-term perspective. Under the current scheme, it can be specified as the tolerance of policy in supporting the improvements of elderly caring system by using the resources existed. In other words, it is important to identify the factors that may influence the practicability of the policy in long run. Moreover, it can be considered from whether the policy can generate a long-term balance between demand and supply.

7.3 Analysis of Policy Alternatives

In order to compare these alternatives, we evaluate the three alternatives in a qualitative matrix with the four criteria (Seen **Error! Reference source not found.**). Overall, the PPP mode performs better in feasibility, effectiveness, and sustainability especially, then the government-operated approach. The status quo also has high feasibility and sustainability, but its effectiveness is low. Thus, we suggest the government cooperate with other stakeholders with PPP mode to carry out the community-based cloud platform, along with current policy.

Table 6. Alternative-Criterion Matrix of Four Alternatives

Alternatives	Feasibility	Effectiveness	Equity	Sustainability	Choice
1 Status Quo					√
2 Government-operated					
3 PPP					√

I. Maintain the Status Quo

The status quo, under the current scheme, is to stick to the \$1 billion funding scheme—*Innovation and Technology Fund*, of which the purpose is to support the trial use and procurement of technology products by elderly and rehabilitation service units. According to statistics released by Hong Kong Government (2020), the first round of applications has only granted about \$HK 37 million, covering 210 institutions. In the next stage, government will adopt more technology applications from institutions and

eligible nursing homes.

Feasibility. This existing policy performs well in terms of feasibility criterion and ranks the highest among all policy options. Politically, since not too many stakeholders are involved, there is less opposition to the policy. As for administrative feasibility, all the government needs to do is to adopt more technology applications and send more approvals in the following stage.

Effectiveness. As mentioned before, the usage of the fund is to relieve the burden on personnel and enhance their service quality by introducing more smart products. However, that doesn't necessarily address the several problems of elderly caring system in Hong Kong. First, the fund only focuses on the use of equipment rather than mobilizes possible resources especially in terms of the goal of smart living. Current scheme is limited to behavioral disability aid, rehabilitation training, short-range communication (Social Welfare Department of HK, 2019). With the smart devices granted by the government, the personnel still have to conduct face to face field treatment. Thus, perhaps more and more technical personnel have to be employed, which is contradictory to the purpose of smart living. Also, it has not harnessed the adaptability requirements of real-time response. Therefore, the scheme neither fundamentally solves the undersupply issue nor improves the ecology's adaptability. Second, it is considered to be less cost-effective. The policy may generate implicit costs such as time, overrun of the budget and human power while it is also hard to evaluate the actual utility improved by trial use of technology products. On one hand, the returns are so uncertain that government may be faced with the risks of sunk costs in the long run. On the other hand, only by using the fund cannot settle the issue in an aspect of efficient ecology under smart city scheme.

Equity. The application of the fund is not compulsory. The coverage is far from wide-reaching. In terms of demand side, only elderly caring agencies and institutions are eligible for applying the fund. Those elder people who do not or are difficult to connect with the institutions can no longer be beneficiaries of the funding scheme. Moreover, there exist restrictions to the applicants and the use of fund is conditional, which would make it even harder to realize the equity. As the number of the elderly is drastically increasing, the undersupply would be exacerbated.

Sustainability. In terms of the tolerance of the policy, there are few factors that may leave potential impacts on the implementation in the long run. However, it is unlikely that the policy will address the balance between demand and supply because of the

uncertain returns and the undersupply of the efficient services.

II. Establish a Cloud-based Platform

(a) By Government Provision

Feasibility. The threats to its feasibility are evident.

Compared with Britain, the institutional disadvantage of Hong Kong government lies in the missing of lower-level district governments and grass-roots administrative organs, the communication cost between mere residents and senior government units tend to be exorbitant, and as the sole practitioner of the scheme, the consequent administrative costs will escalating, such as personnel input or marketing etc.

It is also unpractical to turn to charity sector to relieve the pressure. At present, the development of charities that specialized in elderly affairs in Hong Kong is at a premium. According to the statistics of the Hong Kong Social Welfare Department, only *Chung Shak Hei (Cheung Chau) Home for the Aged Limited* and *The Hong Kong Society for the Aged* focused on providing elderly's welfare exclusively out of 160 registered charities (1.3%) that focus on social welfare provision.

Effectiveness. Endorsed by the government credibility, the public trust regarding the platform would be relatively high when comparing with a private-owned scheme. As for its effect on demand side, the initial stage will be limited to the internal of public-funded institutions due to the time-consuming diffusion process as for its implications, the velocity of its popularization may depend on well-designed trial uses and pilot schemes.

Equity. The alternative is designed to be a scheme that covers the whole society and all residents in need, especially those in poverty or low-income cohorts. Along with that the goal of the government is to utilize the alternative to harness the city's elderly caring issues, rather than profit oriented. Thus, the alternative is predicted equitable.

Sustainability. This alternative needs scads of financial and resource input from the government to undertake. As a well-endowed government, the practices of which in the short-medium term tend to be not affect its finances. However, the threat of the sustainability implanted beyond the business activities, that is, the government's involvement in the market may lead to a innovation failure. To be specific, the partnership among government and private sector would diminish the innovation incentives among the firms already contracted in the out-source activity due to the

competitive advantage formed by stable government orders. On the contrary, the neglected players in private sector may fall into “Valley of Death”. Therefore, the hinge is how the government defines and reviews the scope, object and quantity of the out-source strategy.

(b) By Cooperation with Enterprises (PPP Mode)

The significant difference in PPP mode from a public-only solution is that private sectors are introduced and thus become active actors in the roleplay of promoting elderly caring. In this sense, government plays a facilitator and supervisor in the process of establishing a cloud-based platform. The government takes on the responsibility of partial fundraising and purchasing social services for those who are extremely in need, similar to the cases in Zhejiang province. The private sectors are expected to help with designing the platform according to the investigations and research as well as to maintain the daily operation. Through big data analysis, they can provide the elderly with services accurately. Moreover, they generate profits by providing value-added services and smart services in the market.

Feasibility. PPP mode has a long history in Hong Kong. With experienced learned from the past, for Hong Kong Government, there are possibilities and room for PPP once a compromised decision is accepted by private sectors. Once well elaborated, the policy can receive fewer political opposition. From administration perspective, the risks are shared among public and private sectors, which attracts the private sectors to focus more on practicability of the solutions and the platform. PPP is widely used in infrastructure development and management. Establishing a cloud-based platform is a kind of smart infrastructure investments in the context of smart city scheme. However, PPP under the smart city scheme is a comparatively new idea. Thus, how the government can stimulate the motivations and build shared partnership with private sectors is the key success factor. Unlike traditional PPP mode, greater flexibility is needed under the smart city scheme.

Effectiveness. The introduction of the private sectors will just activate the market by stimulating their innovation capacity for smart solutions to relieve the burden on current elderly caring system since there exists financial attractiveness. According to the current evidence, it is believed that shifting towards a system based on private-sector service providers can effectively help releasing the burden on public institutions, and the service delivery by private sectors can satisfy a diversity of needs. In China, after introducing the private-sector service providers, associated with other policies aiming

at raising service level, there is a 50% reduction of government-run beds (cited in Miyazaki et al., 2016). After introducing a “Internet + Community Home-based Elderly Care Platform” in Pinghu city, there is an estimation of about 50,000 beneficiaries based on periodical success, which is nearly a half of the aged population in the city (Hitachi Inspire the Next, 2018). Getting involved in more stakeholders can activate the vigor in the realm of technology. By sharing the risks, resources can be allocated wisely. Thus, the mechanism is able to enhance the effectiveness of satisfying the needs of the elderly. This is how the involvement of the private sectors can realize a more cost-effective ecosystem.

Equity. It is justifiable to say that the PPP mode can to some extent address the equity by diversified service provision. However, because of the nature profit chasing, private sectors may set a higher price for value-added services or smart devices. Those who cannot afford the price may be excluded. Yet, by shifting some of the responsibility to the private sectors, it becomes more feasible for the government to allocate more resources on supervision and caring for those who are in special needs.

Sustainability. Once the contracts are signed, the policy is unlikely to be affected by other factors. As for long-term development, the PPP mode allows risk sharing among public and private sectors, which is critical when it comes to technology innovation especially under smart city scheme. The partnership built among private and public sectors is beneficial to the development of ecology.

Promoting Elderly Care with a Community-based Cloud Platform under the Smart City Scheme in Hong Kong: Recommendations for Policy and Strategy

Chapter 4 Policy Recommendations





The concrete recommendations for policy implementation are delivered in this chapter. Following the PPP mode in the previous chapter, this chapter discusses how to carry out the community-based cloud platform, and promote smart elderly care by strengthening the all-round cooperation of the government, elderly care workers, science and technology enterprises, communities, and other relevant interest groups. In addition, recommendations, covering pilot project and data management, to facilitate the realization of introducing a community-based cloud platform are put forward based on previous analysis.



8 The realization path of developing community-based cloud platform with PPP mode

Since there is no “one-size-fit-all” solution and PPP mode under the smart city scheme is a novel concept, it is necessary to analyze it within Hong Kong’s context.

8.1 PPP mode in Hong Kong

Public-private partnership (PPP) is thought to be the most popular way when launching public projects in Hong Kong. Hong Kong has a long history of launching public-private partnership (PPP) projects. As cited in Cheung, Chan & Kajewski (2010), the first and most famous one is the Cross-Harbor Tunnel, which was delivered by a build-operate-transfer model in the late 1960s (Chan et al., 2007). The results were found that the top attractive factors for Hong Kong were efficiency-related, which were “Provide an integrated solution (for public infrastructure /services)”, “Facilitate creative and innovative approaches” and “Solve the problem of public sector budget restraint” (Cheung, Chan, & Kajewski, 2010).

Previous literatures explore the success factors of PPP schemes. So as to attain “triple win” scenario among public sector, private consortium and general community, questionnaire surveys and expert interviews were carried out by Ng, Wong, & Wong (2012). And the results found that, the critical factor for examine the feasibility to the general community is whether there is an acceptable tariff. Cost-effectiveness is highly valued by public sector. As for the private consortium, financial attractiveness is ranked as the most important evaluation factors. Moreover, an existence of long-term demand for the proposed service, strong availability of private consortium, alignment with government’s strategic objectives as well as reliable service delivery are highly important to the PPP schemes (ibid).

A practice of framework for PPP in Hong Kong has also been developed through the previous study. The process of eight key steps has to be clarified for implementation of PPP in Hong Kong (Cheung, 2009): (1) Mobilization and development of a business case; (2) Funding; (3) Technical assessments consultation and land requirements; (4) Expression of interest exercise; (5) Policy and funding approvals; (6) Procurement and selection; (7) Service commencement; and (8) Payment and contract management.

8.2 PPP for Smart City Enlightenment

Under the smart city scheme, the importance of big data in PPP mode cannot be overemphasized. Fu (2018) has depicted the urgency of establishing PPP mode and taking the advantage of big data under a smart city scheme. Information acquired in the perception layer is processed intelligently through big data, which is the biggest difference from the previous digital city. Big data can provide powerful decision support for every field of PPP smart city in city planning, transportation management, public opinion monitoring and security and disaster prevention (ibid).

In terms of smart city scheme, latest research reveals the factors influencing the concerns of PPP for smart city projects. An objective approach of Multi-Attribute Analysis (MAUA) is introduced by Lam & Yang (2020), where 8 types of common smart city projects in Hong Kong are studied. Results show that among three procurement options—public-only; PPP; private-only, not all projects are best suited for PPP. An appropriate representation of stakeholders is essential and the criteria assessment needs refinement according to specific smart city projects. There are possibilities and room for PPP once a compromised decision is accepted by both public and private sectors. What's more, the authors point out the potential necessity of involving citizens in the focus group as a part of decision-making body.

PPP modes are widely used in infrastructure development and management. Yet smart infrastructure calls for restructuring in terms of existing PPP modes—greater flexibility will be needed, and truly shared partnership will be acquired to attract the private sector towards smart infrastructure investments (Cruz & Sarmiento, 2017).

8.3 Developing Hong Kong's Community-based Cloud Platform with PPP mode

The idea of establishing a cloud-based platform can better satisfy a diversity of needs among the elderly as well as improve the effectiveness of elderly caring system by the shifting towards home-based and community-based system through big data and IoT. And the adoption of PPP mode can potentially bring foreseeable benefits. Thus, based on the rich literature and former analyses, recommendations on the establishment and how to mobilize actors involved are provided as follows:

(1) Establish an Internet + Community-Based Elderly Caring System

- *Construction of basis database system*

The core idea of the cloud-based system is to build connections between the Social Welfare Department (SWD) and communities in Hong Kong. The basis of the platform is big data and information collection, which provide evidence and rationales of service provision and evaluation. Thus, the SWD should take the lead and invite private sectors to develop relevant system software. The collection of basic information to build a database system can be accomplished through visiting, statistical activities and social communications. Data can be divided into four typologies, which is shown as Table 7: personal information, service need, health portfolio and social service resources, all of which should be updated timely.

Table 7. Community-based elderly care basic database system

Typologies of basis database system	Descriptions
Personal information	Age, education level, capabilities, economic conditions etc.
Service need	Daycare need, activity need, emotional need etc.
Health portfolio	Common diseases, chronic diseases, special care needs, etc.
Social service resources	Institution information, volunteer information, etc.

- *Construction of service subsystems*

Service subsystems contains community management subsystem, medical service subsystem and livelihood service system.

The main function of community management subsystem is to allocate resources by matching demand and supply. As for medical service subsystem, it aims to connect community system with public hospital system. Livelihood service subsystem provides daily care services and entertaining services such as food delivery and housework service. In the meanwhile, incorporated with IoT and smart devices, it can provide emergency service and home-care service, aiming to avoid accidents and promote the elderly's mental health.

- *Construction of operation application subsystem*

After the former two systems are completed, there are two more operation systems to be developed. One is for service operation management, and the other is for personal operation. Service operation management system is designed for service providers such as community centers, household service institutions and medical institutions. Services can be directly provided by these institutions to the elderly through the information exchange between the two systems.

(2) Roleplay of different actors

- *Leading role–Social Welfare Department (SWD) and Innovation and Technology Commission (ITC)*

As the facilitator, the SWD should develop a plan of the platform development and make sure that the service provision meets the demands of the elderly. From administration perspective, ITC should make sure the establishment of the platform is on the right track as well as raise fund. Furthermore, it is both SWD and ITC's responsibility to cultivate specialists for service arrangement and mobilize other social organizations to guarantee the service delivery.

- *Enterprises*

As mentioned before, enterprises play another crucial role in developing a smart community and home-based elderly caring system. Incentives such as subsidizing enterprises which participate the development of software can be offered.

- *Social mobilization*

Charity sectors and volunteers can also be mobilized and included in realizing a smart elderly care system. Relevant governmental departments should enhance public communications to encourage the voluntary activities with the help of IoT.

9 Policy Implementations

In terms of policy implementation process, two critical suggestions are offered:

9.1 Pilot Project

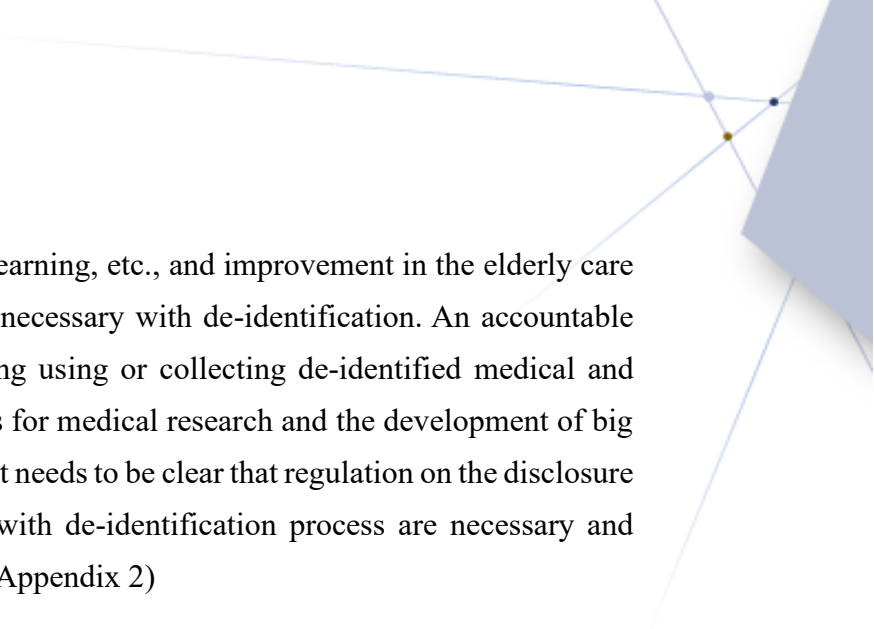
A pilot project is highly recommended to explore the feasibility of developing an innovative elderly home care system incorporated with the IoT. With the vision of developing smart city scheme in Hong Kong, the government has a good opportunity to initiate the project in Kowloon East to fill the current gap of health care system for elderly in Hong Kong. However, except the engagement of private sectors, social workers and governmental departments, it is critical to conduct policy communications of the core concept of smart elderly caring among the public. Incremental adjustments are needed in the process of establishing a cooperation network with the consideration of regional features, as shown in the case study. Moreover, experiences and lessons that can be learnt from the pilot work would benefit the development of smart city scheme.

9.2 Data management

Data management and protection are the perennial concerns to users and the public, which should also be taken into consideration when developing smart elderly care.

On the one hand, it needs to guarantee users' privacy while ensuring that there is sufficient data available for analysis to improve elderly care. Thus, firstly, the rule for data protection can be changed from regulating the data to ruling the organization. Regulating qualified elderly care companies and organizations with measures ensuring users' privacy, such administration, and technology approach, strictly regulating organizations on users' privacy protection can ensure that organization is accountable to its users and their privacy, and meanwhile, moderately open the organization's rights to data collection. Secondly, as an international port and trading market, Hong Kong can absorb resource from the world's leading smart elderly care technology. Technology companies, coming from different countries comply with different privacy rules. The condition and restriction, at this stage, need to be clarify. Thus, it needs a unified and feasible privacy protection regulation, which is not only designed for firms that setup business site in Hong Kong, but also for companies with business location or data processing in Hong Kong.

On the other hand, as the health record and other data are valued regarding further



research, such as medical, machine learning, etc., and improvement in the elderly care system, appropriate data opening is necessary with de-identification. An accountable and transparent process for approving using or collecting de-identified medical and health data can give huge advantages for medical research and the development of big data and smart healthcare. However, it needs to be clear that regulation on the disclosure by specifies methods, inquiry, and with de-identification process are necessary and important. (the detail is discussed in Appendix 2)

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Appendix 1: Cost-benefit analysis for community-based cloud platform

To analyze the impact of introducing the community-based cloud platform (CBCP) to the elderly care system on the whole society, we project the cost and benefit in the five scenarios. The goal is to research whereas the resulting benefits justify all the operational costs and investments that are needed for adopting the CBCP to improve the elderly care in Hong Kong. Thus, after quantifying the expected effects, the business as usual scenario (BAU), i.e. no cloud platform will be introduced, is compared with the new “Integrated scenario.” Therefore, the costs in integrated scenario are also modeled.

Evaluation period and population

For the benefit of introducing CBCP, First, we need to determine the evaluation period, which refers to the time horizon of measuring the costs and benefits of introducing CBCP. Take the cost-benefit analysis of Smart Care Platforms (SCP), a similar project, as an example. It suggests that integrating an SCP would have a payback time which is less than 1 year, whereas within a period of 8 years after the investment, a total cost reduction of 38% can be expected (Vannieuwenborg, et al., 2016)³. Most data centers take between 10 and 15 years to put into operation, and it takes 5-8 years for core equipment to be replaced with new products⁴. Due to the existence of uncertainty and the rapid development of technology and big data, the impact of the project should be measured less than ten years. It is hard to assume that maintenance costs involving maintenance expenses, employees' salaries and financial expenses, remain the same over such a long period because employees may require to raise their wage, etc. As the current inflation rate in Hong Kong in 2019 is about 2.9%, we assume that the discount rate is 3%.

According to the statistics, there are 1.3 million people aged 65 and over (excluding foreign domestic helpers), accounting for around 17.6% of the population in 2019⁵. As

³ Vannieuwenborg, F., Van der Auwermeulen, T., Van Ooteghem, J., Jacobs, A., Verbrugge, S., & Colle, D. (2016). Evaluating the economic impact of smart care platforms: qualitative and quantitative results of a case study. *JMIR medical informatics*, 4(4), e33.

⁴ China Electronics Standardization Institute. (2019). *Green data center white paper 2019*.

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<https://www.statistics.gov.hk/pub/B10100062020AN20B0100.pdf>

the aging of population intensifies, it would increase to 25% in 2026.⁶ Since we assume that the calculation period is from 2021 to 2030, we take the estimation of 1.8 million people aged 65 and above in 2026 into our analysis. Besides, according to the Social Welfare Department, there are 33,555 places supported by subsidies or provided by no-profit-organizations for the elderly, and 42788 places provided by the private elderly homes, at March 2020. Meanwhile, there are 39,655 applicants in the waiting list for subsidized elderly care⁷. Based on above information, we detailed the scenarios into following beneficiaries.

- Scenarios 1: 1.62 million elderly people living at home,
- Scenarios 2: 1.08 million elderly people living at home,
- Scenarios 3: 0.54 million elderly people living at home,
- Scenarios 4: 0.27 million elderly people living at home,
- Scenarios 5: 0.27 million elderly people living at home and 0.018 million elderly people living in nursing home.

Estimation of costs and benefits

In our analysis, we mainly focus on the direct cost and benefit relevant to introducing CBCP to the elderly care system in Hong Kong. They can be roughly divided into three major categories: 1) building and operational cost, 2) benefit to the wellbeing, i.e. the elderly, and 3) the care system. The details are as shown in the Table 8.

Table 8. Categories of the costs and benefits relevant to introducing Community-based cloud platform

categories	Cost and Benefit
<i>Building & operational cost</i>	Building the platform and community center
	Operational cost
	Purchase of smart device
<i>Wellbeing</i>	Home modification and maintenance
	Preventable injury
<i>Care</i>	Reduced nursing home care
	Reduced/increased Home care (Domestic Workers /Relatives)
	Community cares

⁶ CDS. (2017). Hong Kong Population Projections for 2017 to 2066

<https://www.statistics.gov.hk/pub/B71710FA2017XXXXB0100.pdf>

⁷ Social Welfare Department. (2020). Overview of Residential Care Services for the Elderly

https://www.swd.gov.hk/en/index/site_pubsvc/page_elderly/sub_residentia/id_overviewon/

Building and operation cost

In the data center building costs, the highest one is power equipment cost, the proportion of 55.6%. The operating cost is mainly depreciation and electricity, it accounted for 26%, 28% respectively.⁸ Servers account for the majority of data center building costs, with server purchase and maintenance accounting for 78%.⁹ Generally, the building cost of a rack is usually around HK\$100,000 to HK\$150,000 and the data centers at big Internet companies cost about HK\$80-100 per watt to build.¹⁰ According to the tariff of China Light & Power Company Syndicate, for the large power consumption customers, it charges HK\$120.3 for each of the first 5,000 kilovoltamperes(kVA), HK\$115.3 for each kVA over 5,000 on peak period, and HK\$33.9 each off peak kVA in excess of the on-peak billing demand. Besides, a big data platform needs about 10-30 people. Based on the average wage and land value, we have following estimation for each scenario.

Table 9. Estimation of building and operational cost for data center

	Building Cost (million HK\$)	Operational Cost – power consumption (million HK\$ / year)	Operational Cost – labor (million HK\$ / year)	Total (million HK\$)
Scenario 1	51.10	7.08	7.2	176.57
Scenario 2	34.00	4.70	4.8	117.47
Scenario 3	17.20	2.38	2.4	59.20
Scenario 4	8.40	1.16	2.4	39.68
Scenario 5	9.20	1.27	2.4	41.45

According to Aanesen and others' studies, purchasing basic smart devices including installing has a total cost of € 1,920 (equaling to HK\$ 16076.00)¹¹, which didn't include the PCs and mobile phones, and the period can be 5 years. As for the cost of

⁸ Zhiyan Consulting. (2019). Analysis of the development trend of UPS industry and IDC driven by the construction of China's Internet data center <https://www.chyxx.com/industry/201905/740211.html>

⁹ Yanguantianxia. (2018). Global data center costs in 2018: server investment accounts for the largest proportion <http://free.chinabaogao.com/it/201809/09253D4042018.html>

¹⁰ Yanguantianxia. (2018). Global data center costs in 2018: server investment accounts for the largest proportion <http://free.chinabaogao.com/it/201809/09253D4042018.html>

¹¹ Aanesen, M., Lotherington, A. T., & Olsen, F. (2011). Smarter elder care? A cost-effectiveness analysis of implementing technology in elder care. *Health Informatics Journal*, 17(3), 161-172.

home modification and maintenance, it highly depends on the dwelling type. Based on the elderly's living arrangement and type of housing in 2016 (as shown in the Table 10)¹², we estimate the home modification and maintenance for each scenarios according to Bridge and others' (2008) research on the costs and benefits of using private housing as the 'home base' for care for older people. The result is as shown in the Table 11.

Table 10. Older persons living in domestic households by living arrangement and type of housing, 2016

居住情況 Living arrangement	居於家庭住戶的長者 Older persons living in domestic households					總計 Total
	房屋類型 ⁽¹⁾ Type of housing ⁽¹⁾					
	公營租住房屋 Public rental housing	資助自置居所房屋 Subsidised home ownership housing	私人永久性房屋 Private permanent housing	其他 Others		
	數目 (百分比) ⁽²⁾ Number (percentage) ⁽²⁾					
獨居 Living alone	76 915 (50.4)	16 758 (11.0)	54 646 (35.8)	4 180 (2.7)	152 499 (100.0)	
與配偶同住 ⁽³⁾ Living with spouse ⁽³⁾						
並與子女同住 And with child(ren)	122 631 (36.3)	78 554 (23.3)	134 049 (39.7)	2 380 (0.7)	337 614 (100.0)	
並不與子女同住 And not with child(ren)	93 395 (31.8)	53 333 (18.2)	142 255 (48.5)	4 254 (1.5)	293 237 (100.0)	
小計 Sub-total	216 026 (34.2)	131 887 (20.9)	276 304 (43.8)	6 634 (1.1)	630 851 (100.0)	
只與子女同住 ⁽³⁾ Living with child(ren) only ⁽³⁾	85 239 (37.6)	48 448 (21.4)	90 964 (40.1)	2 146 (0.9)	226 797 (100.0)	
其他 Others	14 395 (24.6)	7 892 (13.5)	35 302 (60.2)	1 022 (1.7)	58 611 (100.0)	
總計 ⁽⁴⁾ Total ⁽⁴⁾	392 575 (36.7)	204 985 (19.2)	457 216 (42.8)	13 982 (1.3)	1 068 758 (100.0)	

註釋：(1) 所包括的房屋類型詳情請參閱「詞彙釋義」。

Notes: (1) Please see "Definition of Terms" for the detailed coverage of the type of housing.

(2) 括號內的數字顯示在總計中所佔的百分比。

(2) Figures in brackets represent the percentages in respect of the total.

(3) 數字包括與配偶及子女以外人士同住的人士。

(3) Figures include persons living with person(s) other than spouse and child(ren).

(4) 數字不包括住在船艇上的人士。

(4) Figures exclude persons living on board vessels.

Source: Census and Statistics Department. (2016). *Thematic Report Older Persons*

Table 11. Estimation of cost of home mortification and maintenance

	Total Cost (million HK\$)
Scenario 1	3587.45
Scenario 2	2880.62
Scenario 3	2173.78
Scenario 4	1086.90
Scenario 5	1162.40

¹² Social Census Department. (2016). *Thematic Report Older Persons*. Retrieve from https://www.byensus2016.gov.hk/data/16BC_Older_persons_report.pdf

Wellbeing

One of the advantages of applying smart elderly home care with CBCP is that it can reduce preventable injury by timely attention and treatment. We assume that the elderly who lives in nursing home have had this kind of service. Thus, it would not make effort. For the elderly who lives in the home without foreign domestic helper, we assume that the project can prevent the injure once within the ten years per person.¹³ Costs for hospital beds and treatment cost less money in public hospital, but it has high time cost, whereas in private clinics, it need less time but higher fee. Here, we focused on the benefit for the whole society, so we use HK\$1,960 per attendance of the geriatric day hospital for non-eligible persons' public charges to estimate the monetary value of preventable injury.

Table 12. Estimation of benefit from preventable injury

	Total Benefit (million HK\$)
Scenario 1	2730.67
Scenario 2	1820.45
Scenario 3	910.22
Scenario 4	455.11
Scenario 5	455.11

Care

According to statistics, 47.6% of the elderly people who needed assistance from others in their daily living had caregiver, where 17.7% were cared by their children, 12.2% were care by domestic helpers or nurses, and 5.2% were cared by relatives, friends for neighbors¹⁴. In scenario 1 to 5, the project can reduce the home cares for the elderly who live at home. We assume that an elderly whose life lightly and moderate depends on assistance from others will reduce their need from their children and relatives about 30 hours per month, who do not live with a domestic worker. But for the elderly, who

¹³ Note: As the purpose of the project is to protect and take care of the elderly in their daily time, it can surely prevent some little risk and injury. Thus, we assumed a relatively low price with a relatively high benefit cover rate for the elderly on the preventable injury, which should give us an estimate n accordance with actual practice

¹⁴ Social Census Department. (2009). Thematic Household Survey Report - Report No.40 Socio-demographic Profile, Health Status and Self-care Capability of Older Persons
<https://www.statistics.gov.hk/pub/B11302402009XXXXB0100.pdf>

was lived in the nursing house will need 30 more hours per month. Based on the average wage in Hong Kong, we have the estimation as follow.

Table 13. Estimation of benefit from reduced home care

	Total Benefit (million HK\$)
Scenario 1	6453.75
Scenario 2	4302.50
Scenario 3	2151.25
Scenario 4	1075.63
Scenario 5	1003.92

For the elderly who was living at nursing home, the resource can be saved, thus, we get the estimated reduced nursing home care equal to 2581.50 million HKD.

Currently, elderly persons aged 60 or above living in the community not receiving institutional service, and assessed to be in state of either moderate or severe level of impairment by the Standardized Care Need Assessment Mechanism for Elderly Services can apply for community care. We assume that this project can benefit the community cares to the elderly more who are no, light disability, but also can benefit a little on the moderate situation.

According to above calculation, we get the cost and benefit for each scenario as shown in the Table 14.

Table 14. Costs for introducing community-based cloud platform in different scenarios, million HK\$

		90% of elderly, in home	60% of elderly, in home	30% of elderly, in home	15% of elderly, in home	15% of elderly, in home & 1% of elderly, in nursing home
Benefit	Wellbeing	2730.67	1820.45	910.22	455.11	455.11
	Care	6453.75	4302.5	2151.25	1075.62	3585.42
Cost	Building and operational	-3764.02	-2998.09	-2232.98	-1126.58	-1203.85
	Total	5420.4	3124.86	828.49	404.15	2836.68

Appendix 2 Comparative Case study: Data protection in Smart Elderly care

Privacy is always one of the major problems, as far as we talk about smart development. Similarly, smart elderly caring systems operate optimally by using information about the user, assisting him according to his preferences. The data gathered for such events is highly personal and sensitive. This can cause a loss of privacy and affect personal data. Thus, concerns regarding to smart elderly caring also have been voiced. What kind of data will be used? Who can access to the data? How will the data be used? How long can the company hold the customers' data? More and more people raise their doubt, which not limited to above question. Considering this, we should also think about the personal data protection, when we try to improve the elderly caring by smart development. Only if we can balance privacy and convenience, regular the access and usage of data, and guarantee people's right on protect themselves, can we ensure the elderly can accept smart elderly caring and get benefit.

In this part we will analyze the data protection policy, especially regarding to healthcare, in the world and in Hong Kong. Through comparison, we will summarize the lessons that Hong Kong can learn and improve itself.

1 Global Data Protection

Personal data means any information relating to an identified or identifiable natural person ('data subject') (European Parliament and Council of the European Union, 2016). Moreover, personal data regarding to smart elderly caring is more than normal personal data. It also involves in health data and medical data, which is more private for data subjects and more valuable for data processors and third parties. Therefore, it even needs more strict regulation for elderly caring.

Table 15. The development of personal information security globally and in Hong Kong

Year	Organization	
1973	Sweden	Data Act (Sw. Datalagen)
1980	OECD	Guidelines on the Protection of Privacy and Transborder Flows of Personal Data (common name: OECD Privacy Guidelines 1980)
1981	Council of Europe	Convention 108
1995	EU	Data Protection Directive
1995	Hong Kong	The Personal Data (Privacy) Ordinance
2005	APEC	APEC Privacy Framework
2013	OECD	OECD Privacy Guidelines, update revision
2016	EU	General Data Protection Regulation (GDPR)

Source: Privacy Commissioner for Personal Data, Hong Kong, 2017

In retrospect, personal data protection developed since 1973, when Sweden enacted the world's first national personal data protection law, Data Act. It aims to address problems such as the store and process of personal data as result of the dramatic increase in computer usage. Later, several data protection acts have been enacted by different countries and organizations. Until 2017, data privacy laws have been in force in at least 120 countries around the world, and 30 or more additional countries are planning to enact such laws.(Greenleaf, 2017)

In general, the legislative protection of personal health information privacy can be divided into three frameworks. The first one is to separate the personal health information from the personal privacy information under the basic privacy protection legal framework and to formulate the enforcement standards to protect the personal health information, such as the *Health Insurance Portability and Accountability Act* (HIPAA) in the U.S., *Health Records and Information Privacy Act* in Australia, and *Medical Privacy Act* in France. The second framework is to integrate personal health privacy information into personal information and sensitive information for comprehensive protection. Such data privacy regulations are often based on human rights principles. For example, the *General Data Protection Regulation* (GDPR) came into force on May 25, 2018 in the European Union (EU); China's *Information security technology — Personal information security specification* (GB/T 35273—2017) were officially implemented on May 1, 2018; South Korea and Japan also enacted their own personal information protection laws in 2001 and 2003, respectively. The third does not have the force of law but can have serious consequences when rules are breached, such as professional codes of conduct or policy guidelines. The Organization for Economic Co-operation and Development published *OECD Guidelines on the Protection of Privacy and Transborder Flows of Personal Data* (OECD Privacy Guidelines) in 1980 and updated it in 2013. OECD Privacy Guidelines set out some principles, but it is non-binding and non-mandatory.

- ***The General Data Protection Regulation***

One of the most important personal data protection guidance is *the General Data Protection Regulation* (GDPR) conducted by the European Parliament and Council of the European Union (EU). It superseded the Data protection Directive enacted in 1995 by EU and enacted in most of the European countries. it focusses on the handling of

personal data, including any activity that records, saves, downloads, organizes, changes, or shares personal data.

GDPR apply directly to EU members, while in the original directive countries have the discretion to implement data protection laws. Besides, GDPR not only take the dependency factor into account, but also the human. It can even be called the most stringent data protection rules in history. In addition to stipulating Transparency, Data Minimization, GDPR entitles Data subjects the Right to Withdraw Consent, Right to Erasure and Right to Portability at any time. Furthermore, the imminent GDPR is considerably more comprehensive. Horizontally, it applies to all sectors of the economy, all broadly defined “personal data” and all who control or process data. Vertically, it applies protective standards throughout the lifespan of data. (Carey, 2018) As a result, in addition to strict data and privacy protections, the implementation of the regulations will simplify the regulatory framework by harmonizing data and privacy regulations across the EU.

Specifically, the actors to the GDPR include: data controller or data processor 1) who has a place of business in the EU, whether the data processing takes place in the EU or outside the territory; 2) who does not set up a business site in the EU, but provides goods or services to the data subject of the EU, or the tracked network behavior takes place in the EU. 3) who does not set up a business site in the EU, but, according to public international law, should apply EU law. The protection of personal data only refers to "personal data" and does not involve any data other than personal data, anonymous information, or personal data that has been anonymized so that it is no longer identifiable. In addition, anonymity must be irreversible.

In the GDPR, it the strength a bigger administrative punishment. Based on the circumstance, violation can be fined 20 million euro at most, or the 4% of company annual turnover. Besides, each member state must set up a Data Protection authority (DPAs) to enforce the rules with the courts.

In nutshell, under GDPR, personal information must be 1) processed lawfully, fairly, and transparently; 2) collected for specified, explicit and legitimate purposes; 3) adequate, relevant, and limited to what’s necessary for the purposes of why it was collected; 4) accurate and up to date; 5) not be kept for longer than is necessary; 6) processed in a manner with appropriate security, including protection against accidental loss. The data protection principles include lawfulness, fairness and

transparency, purpose limitation, data minimization, accuracy, storage limitation, integrity and confidentiality, accountability, which cover the entire life cycle of personal information from generation to destruction.

- ***Health Insurance Portability and Accountability Act***

Legislation on privacy security in the United States was earlier. The *Privacy Act* was passed in 1974 to protect the privacy of citizens' personal information. In 1996, the United States passed the *Health Insurance Portability and Accountability Act* (HIPAA)¹⁵, and the HIPAA's *Privacy Rule* and *Security Rule* in 2003 took effect. In the following years, HIPAA related supplementary bills were further issued, until then, a set of privacy and security legal protection systems for personal health information were formed. HIPAA addresses medical data and specifies methods, requirements, and processes for de-identification, which is distinctive from other laws. This gives the HIPAA Act a huge advantage over other laws in the health data protection. There are five sections to the acts, covering healthcare access, portability, and renewability, preventing healthcare fraud and abuse, administrative simplification, medical liability reform, et al. Moreover, HIPAA is extremely relevant to Big Data. It covers most of data with high analysis value in healthcare.

Specifically, the HIPAA regulates the “covered entities”, such as health care providers, health plans, health care clearing house, and "business associates", which including covered entities and their associate contract, such as cloud services. According to HIPAA, if a third-party would like to use health data, they need to fulfill permissions, including: 1) research participants with written authorization; 2) privacy manager/board waiving authorization requirements; 3) de-identified personal health information; 4) “limited data sets” and “data usage protocols;” 5) legal permission to disclose personal health information, which is in progress or initiated before HIPAA becomes effective (e.g. in the case of an informed consent or an IRB waiver of an informed consent); 6) researchers with the required documentation, and HIPAA transition rules allow for the study of information. Meanwhile, HIPAA currently covers the identified data and has not yet covered unidentified data, like GDPR. It even points out three way—safe harbor, limited dataset and expert determination, to de-identify data and allow them to

¹⁵ See details: Summary of the HIPAA Privacy Rule.

<https://www.hhs.gov/hipaa/for-professionals/privacy/laws-regulations/index.html>

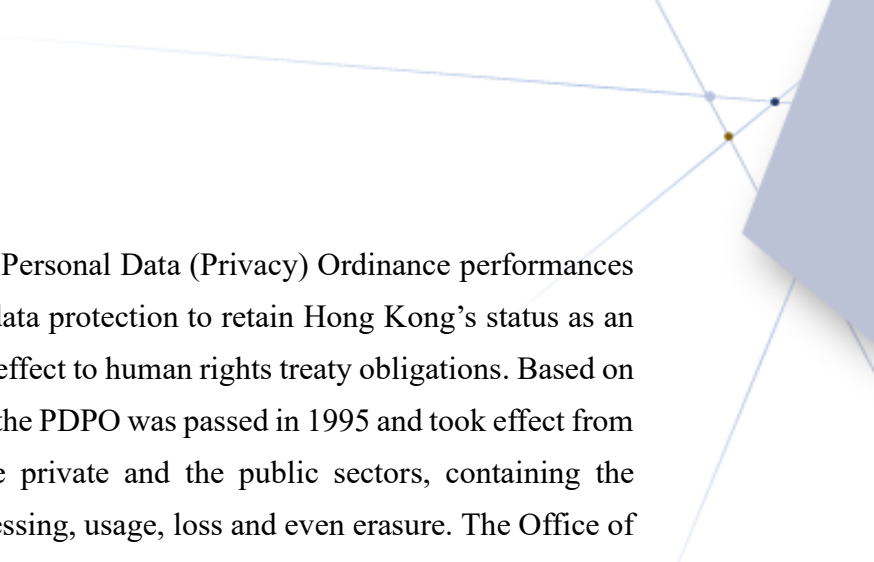
be used in public. Besides the HIPAA Privacy Rule regulates the use and disclosure of protected health information by "covered entities," the Security Rule lays out 3 types of security safeguards: administrative, physical, and technical, for electronic protected health information.

HIPAA Privacy and Security Acts require all medical centers and medical practices to get into and stay in compliance. The costs for the subject are high because they need to develop and revamp systems, practices and increase paperwork and education staff. Meanwhile, the cost of violating is also substantial. HIPAA explicit the different types of violation between civil and criminal penalties. A fine of up to \$250,000 with imprisonment up to 10 years would be prescribed for the worst criminal situation, and a max fine of \$50,000 per violation with an annual maximum of \$1.5 million would be prescribed for civil penalty.

Overall, the major purpose of HIPAA is to define and limit the circumstances in which an individual's protected health information may be used or disclosed by covered entities. A covered entity must maintain reasonable and appropriate administrative, technical, and physical safeguards to prevent intentional or unintentional use or disclosure of protected health information in violation of the Privacy Rule and to limit its incidental use and disclosure pursuant to otherwise permitted or required use or disclosure. It may not use or disclose protected health information, except either: (1) as the Privacy Rule permits or requires; or (2) as the individual who is the subject of the information (or the individual's personal representative) authorizes in writing.

2 Data Protection in Hong Kong

Generally speaking, Hong Kong do well in data protection. Hong Kong has been a leader in the Asia-Pacific regions, with one of the oldest privacy frameworks, the Personal Data (Privacy) Ordinance (the "PDPO"), in the region. According to the cloud readiness index, Hong Kong along with Singapore performed top in Asia Pacific (APAC) and even globally. Especially, Hong Kong ranked first in privacy in both 2016 and 2018. However, it ranked fifth in the aggregated cloud regulation and governance segment as its cloud regulation ranked fifth and the government regulatory environment ranked eighth, with even 0.2 scores out less than the average of the 14 regions in APAC (ACCA, 2019). In addition to the privacy law, the public in Hong Kong are sensitive to privacy problem. Studies show that privacy is in the top five concerns of citizens in this region (Chan, 2000).



From the perspective of privacy, the Personal Data (Privacy) Ordinance performances well to ensure an adequate level of data protection to retain Hong Kong's status as an international trading center and give effect to human rights treaty obligations. Based on the OECD Privacy Guidelines 1980, the PDPO was passed in 1995 and took effect from Dec. 1996. It has covered both the private and the public sectors, containing the processes of collection, access, processing, usage, loss and even erasure. The Office of the Privacy Commissioner for Personal Data was established specially under PDPO as the dedicated data privacy regulator. The data protection principle is "to ensure that personal data is collected on a fully informed basis and in a fair manner, with due consideration towards minimizing the amount of personal data collected."(PCPD,2020) In 2012, the PDPO underwent amendments, which mainly introduce the data protection in direct marketing provisions (PCPD, 2012). We can see that the PDPO covers almost every aspect for individual to ensure human right, especially in commercial activities.

With such privacy protection law, it can obviously protect users and their personal data well, but it's also no doubt a challenge for technology companies to collect data and reveal their shining points in smart elderly care. Smart elderly care is based on a mass of data, including the elderly's vital signs and even actions, to detect, give feedback or precaution. On the one hand, the larger the amount of data is, the higher the value. Accordingly, the higher the probability and risk of being attacked will be, and simultaneously, the damage to users will increase. It's hard to define the necessary and adequate but not excessive data boundary. On the other hand, these data indeed have extremely value not only for elderly care itself, but also for research and development.

Currently, the PDPO can be an excellent and essential foundation for conducting smart elderly care, protecting human right from infringed. However, different from previous economic development and trading, technology is the core of smart cities to improve people's lives, and data is the key now. Moderate change and open data might be needed for making the most usage of data.

3 Inspirations

Privacy and personal data protection have always been key challenges during the development of big data and smart development. From these two cases, Hong Kong can learn some lessons.

First, besides regulating the personal data, organizations should be put into the frame in the case of healthcare and elderly care. Identifying the medical data and data for healthcare can clarify the data that necessary for elderly care and make sure that data collection is not excessive, however, it's difficult to define the boundary. In the HIPAA, what they regulate are the "covered entities", such as health care providers, health plans, health care cleaning house, and "business associates", which including covered entities and their associate contract, such as cloud services. Changing the way of managing data to managing the organizations can clarify its responsibility and accountability and further better protect the privacy as well as make sure data is necessary and enough.¹⁶

Second, it's important to identify the actors to the privacy protection law in the context of globalization. Adoption of data privacy standards will be key to stamping out breaches, but the lack of uniform security standards across the Internet of things industry and different healthcare enterprises is a major hurdle. As actors to GDPR include data controllers or data processors, whether the business location, setup site, or data processing location in the EU, a comprehensive regulation for companies in global market is necessary. GDPR, clearly identifying the companies and the privacy rule, can ensure the human right in any circumstance.

Third, as the health record and other data are valued for further research such as medical and even improvement on elderly care system, appropriate data opening is necessary with de-identification. An accountable and transparent process for approving the use or collection of medical and health data would ensure that local companies, entrepreneurs, researchers, and civic organizations can use the data legally and faithfully observed the law. The HIPPA clearly identify the third-party who can use health data and regulate the use and disclosure of protected health information, including the specifies methods, requirements, and processes for de-identification. This gives huge advantages for the development of big data and smart healthcare.

¹⁶ It says that "the minimum necessary requirement is not imposed in any of the following circumstances: (a) disclosure to or a request by a health care provider for treatment; ..." See details: Summary of the HIPAA privacy rule. <https://www.hhs.gov/sites/default/files/privacysummary.pdf>