Technology options for aged care in Japan

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Chapter 1

Introduction and overview

1.1 Motivation for the research

During my childhood years, in the 1950s and 1960s, it was very common to be part of a multi-generational household in Japan where care of the elderly was taken for granted as a family duty. As children we were taught to show the highest respect for the elderly in our communities. It seemed to me that the older a person became the more respect was commanded. Since leaving Japan in 1968, I have made trips home at least every second year and during these years social changes regarding elderly people have especially stood out in my observation, looking in as an outsider. With parents who have now retired, my interest in the welfare of the elderly in Japan has grown out of personal concerns. Interaction with my parents and their friends added significance to Japanese newspaper articles I began reading about the consequences for the economy and society of the dramatic demographic transition in the country.

There is much for the Japanese to celebrate in achieving the world’s highest average life expectancy. However, with rising longevity, aged care has become a focus of concern and interest in recent years. This is not merely
because the elderly population continues to rise in absolute numbers but because it is becoming a much higher proportion of Japan’s total population.

The transformation from high birthrate and high death rate to low birthrate and low death rate has created sets of issues including families with elderly members being challenged in the provision of aged care, particularly when it becomes a long term commitment.

Over the last decade, I became increasingly aware of different ideas and suggestions in the management of aged care in Japan. There have been numerous changes to the old age pension system and health care plans. New products to assist the elderly maintain independence and to assist care-givers have continued to enter the market. Robotics, an area of developing high-level technology, to assist aged care, caught my attention during one of my visits to Japan in the latter half of 1990s. It appeared that the development and diffusion of technology had become imperative as a means of addressing some of Japan’s aged care issues. My research began as a task of looking at some of the consequences for my parents and their elderly friends when technology became increasingly implemented for aged care. The interest grew as I met with some researchers developing robotics for aged care in Japan and then met people involved in organisations promoting ‘barrier-free’ technology, also for aged care.

Different views regarding the role of technology for aged care and different approaches in addressing similar issues created further curiosity, and fuelled my desire to research technology utilisation in aged care in Japan. Interestingly, there seemed to be two distinct directions in developing
technology to address aged care issues. One was to seek solutions is by developing high-level technology, such as robotics, and the other was to develop smaller-scale technology, such as barrier-free technology including kyoyo-hin and universal design. I became acutely aware that in the absence of medical technology to provide complete cure, technology could provide ways of assisting aged people to function when they become frail or disabled. This research aims to examine such technologies and does not focus on curative technology such as technology for a hip replacement. Aged care in this study includes care and assistance required in all aspects of activities of daily living.

In order to examine and analyse the different directions of technology development for aged care in Japan it is important to understand the social and economic background of aged care issues in Japan. By firstly setting out the changing demographic profile and societal changes, I demonstrate why the issues of aged care in Japan are so urgent. Then the background to technology in Japan is analysed to show why the Japanese are prone to seek ‘technological fixes’—utilising technology to solve socioeconomic problems. I have divided technology options for aged care into three categories. Option One uses only standard technology from other countries; Option Two calls for investment primarily for high-level technology development; Option Three concentrates on predominantly developing and using smaller-scale technology. Each option is separately described and assessed in terms of its various consequences. Detailed attention is given to Options Two and Three.

Clarifying the likely consequences of adopting each of the three options may assist in (a) assessing technologies for aged care and (b) introducing policies
that will be affordable to the society and (c) providing more options in aged care including ways of achieving a more independent future for the growing number of the aged.

This chapter presents an overview of issues involved in the research. Section 1.2 introduces the background to the increasing demand for aged care in Japan whilst Section 1.3 discusses possible ways to address the aged care issues in Japan. Whilst the thesis focuses on technology options for aged care, other possible ways of addressing the issue will be introduced in this section. Section 1.4 provides an argument that Japanese society possesses openness to technological solutions and Section 1.5 briefly spells out the three technology options for aged care in this thesis. Section 1.6 describes some major fields in technology studies and how the research in this thesis relates to them. The scope and contribution of the thesis are outlined in Section 1.7 with a conclusion to the Chapter provided in Section 1.8.

1.2 Causes for Japan's increasing aged care demand

There is an increasing demand for aged care in Japan as a result of the dramatic demographic transition where both the absolute number and the proportion of aged people are growing at a fast pace. From a nation with the lowest percentage of people over the age of 65 (the commonly accepted age of an elderly person) amongst the leading industrial nations in 1989, Japan is predicted to become the nation with the highest percentage of people over the age of 65 years by the year 2025 (statistical evidence for this is given in
Chapter 2. The socioeconomic challenges created by the demographic transitions have suddenly taken on a note of urgency in Japan. As the most aged country-to-be, the Japanese people cannot just rely on copying policies and models of other industrialised nations on matters such as aged care. Therefore, the country, in particular the Japanese government, is seeking innovative measures to address issues such as aged care.

Furthermore, not only is the Japanese population ageing at a rapid pace, the proportion of people over the age of 75 amongst the elderly is increasing (JARC: 1996, 67, Ogawa: 1993, 145). These older people are even more likely to require care.

The problem of meeting the need for aged care in Japan has been exacerbated by the declining availability of family care-givers and the inadequate supply of paid home helpers to compensate for this shortage. The challenge has been to find ways to ensure the delivery of aged care without excessively burdening the remainder of the population. As all economies are limited in their disposable resources (including labour, real assets, land, and natural resources), redirecting these resources for aged care diminishes resources available for other societal needs. There will be a heavier burden placed on those in the work force as the population continues to age. It is estimated that in the near future every two Japanese workers will be financially supporting one retiree. ‘The work force paying into the public pension system will outnumber the pensioners by only about 2.4 to 1 [by 2025], compared to 6 to 1 in 1993’ (Oshima: 1996, 44).
It is clear that without significant increases in labour productivity, the demographic changes in Japan will adversely affect the Japanese economy. According to Japan’s Economic Planning Agency figures, the average annual rate of GNP growth in the 1970s in Japan was 12.7 per cent. In the 1980s, this figure halved to 6.1 per cent and fell further to 1.65 per cent for the 1990s (average 1991-1999) (Asahi Shinbun Japan Almanac 2001, 287). Without a major growth in labour productivity, the relatively shrinking work force will struggle to produce adequately for its population for a number of reasons. Firstly, an additional burden will be placed on public finances as public pension obligations and social welfare needs continue to swell (this is further discussed in Chapter 3). Secondly, investment of capital funding for future production will suffer as individual incomes and personal savings of the elderly decline. Thirdly, the balance of trade that has remained strong for a number of years will weaken as the first two factors affect Japan’s ability to export. Should society rely more on imports as domestic production declines, this will also adversely affect Japan’s balance of trade. Fourthly, a shrinking work force may result in a labour shortage, which will raise the level of wages and which, in turn, will force manufacturing companies to relocate to other countries where wages are lower. Figures already indicate that an increasing number of companies are transferring their production overseas to minimise costs resulting in the ‘hollowing out’ of manufacturing industries in Japan. ‘In 1995-96, Japanese industry invested [US]$900 billion in overseas facilities, up some 50 per cent from five years ago’ (Ezrati: 1997, 98).

The Japanese government has attempted to take steps in addressing the above economic adversities. For instance, in order to minimise the depletion of the
work force and the rising cost of pension, the Japanese government has taken measures to encourage people to work longer than the traditional mandatory retirement age of 55, by gradually raising the compulsory retirement age.

As late as 1974, more than half of all firms using mandatory retirement required workers to retire at age fifty five or younger. Now, over three-quarters of all firms have established mandatory retirement ages of sixty or older (Clarke & Ogawa: 1996, 28).

Another step taken by the government was the enactment in December 1988 to introduce a 3.0 per cent national consumption tax from April 1989, as a means of raising funds for aged care. This tax was raised from 3.0 to 5.0 per cent as of April 1997. In terms of providing more aged care, the government devised its Gold Plan (1989) and then revised it (New Gold Plan in 1994) to develop and increase health and welfare services for the elderly. Furthermore, a third version of the Gold Plan (Gold Plan 21) was implemented in 2000. These government initiatives aim to develop and improve important aspects of aged care, such as increasing the number of government subsidised home helpers, in-home care support centres, nursing homes, welfare centres and so forth (Ministry of Health and Welfare: 1999).

In spite of such government measures as mentioned above, keeping pace with the rapidly increasing needs for aged care services has continued to be problematic in Japan. In order to alleviate some of the aged care problems that occurred in the past, a mandatory health-care insurance system for comprehensive aged care services was introduced in April 2000. This plan is aimed at providing security for care that may be needed in old age for all Japanese residents (Watts: 2000, 1249). Moreover, the plan is estimated to
generate a US$39.56 billion market in a wider area of entities which is expected to continue expanding (Fukunaga: 2000, 6).

Another issue is the concerns of the families of the aged. Because the Japanese population is ageing at a historically unprecedented speed, and because the family structure has been undergoing a number of social, philosophic and economic transformations, provision of adequate aged care services is increasingly difficult to ensure without added personal sacrifices by family members. The economy is also becoming depleted by a large section of its work force leaving paid employment in order to care for aged family members. In 1992, for instance, 80,000 persons, primarily women, were forced to quit their jobs to take care of an elderly relative, according to the Management and Coordination Agency (Oshima: 1996, 44). This represents approximately 0.4 per cent of the 20 million women in the Japanese work force in 1992 (JETRO: 1993, 33) and this percentage is expected to continue rising.

Social factors affecting the Japanese in addressing aged care demands are discussed in detail in Chapter 3. Having attained the world’s highest average life expectancy, there are very real concerns for the individuals facing old age. This growing concern is addressed in the light of Japan’s demographic and social changes.

The analysis of changing family structures and social values in Chapter 3 demonstrates further that the care of the aged is a pressing issue. Issues such as changes in ideologies regarding filial piety, the Japanese welfare system,
nuclearisation of families, women in the work force, the status of the elderly, and the declining fertility rate are discussed to demonstrate that it is no longer possible to totally rely on the traditional provision of aged care by families.

For the government the obvious problem is a financial one. The government is searching for innovative ideas and new policies to overcome the economic burdens brought about by the demographic changes. In the post-War era the government initiated major policy changes and now holds centralised authority on issues regarding aged pensions and the public welfare of the aged. Furthermore, the government also adopted the French legal system, which requires all contents of policies to be stated in the law. Any policy changes, therefore, need to be accompanied by amendments to the law. On the whole, Japanese laws dictate what a citizen is allowed to do, rather than regulating what a citizen is not allowed to do. Moreover, the traditional view in Japan was that government services were not citizens’ ‘rights’ but ‘favours’. During the many years of Liberal Democratic rule this view gradually changed. There have been numerous changes of government leaders during the last ten years.

People are seeking more accountability from the government and expectations of government are more clearly articulated than in the past. However, until recently, financial self-provision for caring for the aged has been more widely accepted by the Japanese compared with other advanced industrialised nations. Although the government’s obvious concerns may be more to do with its national economic strength than the social needs of an ageing population, many governmental papers and advisory boards point out the social importance of adequately caring for the aged (see, for example, The 1997,
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1999 White Papers on Health and Welfare). To summarise in a simplified way, the government faces the issue of providing adequate care for the aged without initiating a national economic decline.

The consequences of Japanese society ageing, therefore, affect not only the aged themselves but their families, care-givers, and policy makers as well as the economy of the nation. Whatever measures are applied to address the issues, they will affect different groups in different ways. In the following section, some possible ways of addressing aged care needs are suggested. Whilst some ideas—included for completeness—are neither practical nor plausible, the section demonstrates that there are numerous options to be considered when aged care needs are addressed.

1.3 Possible ways to address Japan’s increasing aged care demand

There are always multiple ways to address a social issue. Depending on the social and economic variables of a society, social issues are viewed differently and addressed accordingly. In this section, some possible ways of addressing aged care in Japan—other than technology-driven solutions—are discussed to help contextualise technology options for aged care.

If caring for the aged were to be given the highest social priority, an ideal way in an ideal society would be to provide free aged care that is of the highest possible standard. However, in reality there are fewer working people to support each aged person in Japan. For example, Yashiro predicts that 'by
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2020, each elderly person 65 and above will be financially supported statistically speaking, by only 2.3 persons of working age (15-64) compared with 5.8 in 1990' (Yashiro: 1996, 43). A well-known Japanese economics journalist, Asai, published a book in 1997 describing the gloomy future for those under the age of 45 now in Japan. The Japanese title, 'Ore no roogo o dooshitekureru?', asks what is going to happen or what is someone going to do about the author’s old age. The author is particularly critical of those in the Japanese government for not working out reliable, trustworthy policies so that people can face old age without fear. His gloomy predictions range from financial difficulties to both physical and non-physical burdens but he is prepared to provide advice to survive the turmoil ahead. One of his solutions is for aged people to organise living overseas, especially in ‘tax haven’ countries, at least part of each year (Asai: 1997, 246).

Emigrating to a country where the Japanese currency, the yen, is particularly strong or to a country with a ‘tax haven’ can have advantages both for the aged and for the economy of the host country. By decreasing the number of people in the aged group, the load for the supporting group will be lightened. According to the official Japanese Annual Report of Statistics on Legal Migrants (Ministry of Justice: 2000, X I), there were 125,732 Japanese who emigrated in 1999 (122,869 in 1998) and 97,030 Japanese who left Japan to live with relatives overseas (92,621 in 1998). However, these figures do not indicate the aged component of the emigrants. In the 1980s, the Ministry of International Trade and Industry attempted to introduce a plan to create villages outside Japan for the Japanese elderly to emigrate to but this project was withdrawn in 1992 (Aita: 1994).
A partial solution suggested by a number of Japanese people to reduce the burden of aged care is to shift some aged people back into the working population (Kojima: 2000, 22, Sasaki: 1996, 1013) and/or to decrease the volume of care from labour services required by the aged population. Wada, a staff psychiatrist at a Japanese geriatric hospital, argues that testing has proven that the majority of those under Japan’s present life expectancy age (male 76 and female 82) do not lack the mental acuity required to work in normal office situations (Wada: 1997, 25-26). Even if the aged population needing care increases, Wada insists in his article that if the mandatory retirement age were abolished, the ‘burden’ of supporting aged people need not overwhelm Japanese society as there could be a sufficient number of people willing and able to continue working beyond the present retirement age.

Another solution to decrease the burden of aged care is to increase the number of Japanese residents in the 15 to 64 age group who are supporting the aged. A possible method of increasing the population of aged care providers is to import them from other countries. For instance, a training program for home nursing care in Japan began in Thailand but only Thais of Japanese descent are eligible (Cornell: 2000, 11) as there are complex social issues, such as language and custom differences, to address for this program to succeed. However, the need for assistance in aged care is urgent, as Ministry of Health and Welfare statistics reveal that ‘there are only 170,000 registered homehelpers in Japan but 580,000 will be needed by 2010’ (Cornell: 2000, 11).
If importing human care-givers is problematic, perhaps some of their tasks can be performed by animals or robots. Non-human assistance that can substitute for human care-givers requires much consideration. Later in the thesis, robots that can provide aged care will be discussed in more detail. However, it is not within the scope of this study to discuss or assess strategic suggestions that intelligent animals, like guide dogs, might be trained to assist in caring for the aged. Whether such options would be viable or acceptable to Japanese society is nevertheless an interesting option for future study. In this thesis, the objective is to determine the differing implications of adopting certain technological options in addressing the burden of aged care in Japan.

Some of the financial burden on working people and on society can be diminished by increasing retirement age and pension eligibility age (Friedland: 1993, Hurd & Yashiro: 1997, 13, Liu: 1994, Ogawa: 1996, 21, Iwamura: 1995). As long as those in need of aged care are adequately cared for, promoting measures to keep people healthy, active, independent and possibly even productive by choice for as long as possible is desirable and acceptable to the aged, the care-givers, families, and the government (Aoki: 1996).

When aged care is required, it is often labour intensive and therefore the relative labour cost is high. Developing and implementing technology to reduce the unit cost of aged care and enhance the quality of care as well as independence of aged people will be discussed in detail in later chapters. In Chapter 4 the development of technology in Japan is discussed to identify the background for the Japanese style of finding technofix solutions to its social and economic problems. The aim of Chapter 4 is to demonstrate the salience
and cultural compatibility of seeking and utilising technology to address aged care needs in the ageing Japanese society.

The following section introduces the background on the role that technology has played in Japan and the receptiveness of Japanese culture to adopting technology in addressing aged care.

1.4 Seeking technological solutions

The above simple diagram illustrates that technology can be utilised to assist elderly people with different levels of physical needs. For example, technology might assist permanently disabled elderly people with automated devices such as a fully automated wheelchair whereas a temporarily disabled person may only need manual wheelchair and a person who has become weaker with age may benefit from a walking frame. Technology can thus assist elderly people by providing ways to be more mobile, independent, and able to increase social participation.
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This thesis focuses on technology options to address the needs of the elderly who are disabled, whether temporarily or permanently as well as the elderly who need assistance due to physical deterioration. The purpose of writing this thesis is to present technology options for aged care and outline how their implementation might affect Japanese society. Having established that aged care issues need urgent consideration, the motivation lies in trying to create a useful tool to assist decision making on how technology can best be utilised to enhance the quality of lives of those requiring care and also to assist those providing care. But before launching into technology options in aged care, an investigation is made to demonstrate that Japanese people seem to be receptive to technology and that in particular, the Japanese government is more open to technological solutions than many other governments.

It is commonly accepted that technology, especially Western technology, played a major role in the Japanese industrialisation and modernisation process in the late nineteenth century. Furthermore, the speedy recovery from being totally defeated in the Second World War has also been partly attributed to technology, although other factors, such as the willingness of the Japanese people to work hard, were also important. There is a strong perception in Japan that technology was the key that solved major social and economic problems in the past. Therefore, it is natural for the Japanese to assume that a 'technological fix' can solve at least some of the complex problems associated with an ageing society.

Forester, in Silicon Samurai (1993), describes the aggressive manner and determination that the Japanese government and industries displayed in
catching up with the West after the Second World War and how they then
pushed to take and hold a leading position in the area of technology. Tatsuno
uses the term 'creative copiers' to describe how Japanese electronics
companies were quickly able to catch up with the West by being creative in
improving product designs and manufacturing techniques without 're-
inventing the wheel' (Tatsuno: 1986, 20).

More recently the Japanese government has set out strategies to maintain the
country's technological lead, well aware that 'anticipation, not reaction, will
be the name of the game, and government's new role will be that of catalyst,
strategist, cultivator, and adviser—a cross between a "think tank" and a
consulting firm' (Uenohara cited in Tatsuno: 1986, 35). Although no country
has the monopoly on available technology per se, the manner in which the
community perceives and approaches technology and the direction in which
technology is pushed by community expectations and government policy will
profoundly influence the outcomes of technological advancement. At present,
whether the technology is imported or domestically developed, many people in
Japan seem to expect that strategically developing and implementing
technology will ease the physical, emotional, economic and social tensions
surrounding aged care.

Initially, catching up to Western technology by technology transfer implied
that, as a result, Japan could also catch up to the Western world's economic
well-being. For a nation with relatively few natural resources, leading
technologically now gives people a feeling of security since many of them can
still recall the hardships following defeat in the Second World War and the
panics of the oil shocks in the 1970s (Low: 1999). Japan is one of world’s leaders in technology today and so, applying technology to solve the problems related to its ageing population is a plausible option for the Japanese policy makers.

Japan has advanced in technology developments to the extent that other industrialised societies now display reluctance to share their technology for fear of a boomerang effect wherein innovations are adopted, adapted and then re-sold to the initiating country. This has pushed Japanese industries to continue developing and innovating their own technology to stand ahead of other societies. There are numerous advancements in housing design, medical care and, leisure facilities to enhance the quality of life for ageing people. Making wise choices in developing and utilising such technologies is a challenge for Japanese policy makers as it has ramifications that affect all sections of society. The question is what are appropriate technologies to help solve the problem of the increasing cost of care, to relieve the family burden of aged care, and to empower the aged with increased independence as frailty sets in.

Technology options for aged care are divided into three categories in this thesis. Details of Options Two and Three are explored in Chapters 5, 6, 7, and 8. In the following section, both of these options and Option One are introduced.
1.5 Technology options for aged care in Japan

On the whole, there is a desire in human beings to improve their quality of life, no matter how subjective this 'quality' may be. For instance, over a century ago, technology was developed so that clean water could be freely accessible, an important development that profoundly improved the health of many people. Advanced medical technology developments arguably have played a role in further enhancing life expectancy at birth for many people, including the Japanese.

The longer people live the more assistance they are likely to need in later years. An increasing use of technology has addressed some of these needs and has enabled people to function comparatively well, despite disabilities and frailty in old age. There are numerous gadgets and appliances to make daily chores easier, especially for people with declining physical abilities. Some examples are remote control systems that have enabled people with little physical strength and mobility to operate televisions and other appliances or to open and close windows and special scooters and sophisticated walking frames that have enhanced mobility for those who had previously relied on walking sticks. There are also devices to alert a care-giver in an emergency and devices for a person who suffers from an illness, such as dementia, to be monitored without having to rely on a care-giver to be constantly in attendance. There are technological innovations for lifting and bathing patients so that the burden is eased on carers who, in the past, have experienced back injuries. Moreover, some technology developments have empowered disabled and aged people to become more independent.
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The above devices have evolved over time because there has been increasing demand for innovative ways of allowing ageing people to remain as independent as possible for as long as possible and for the care-givers' burdens to be lightened. Government is also keen to implement devices that will improve its provision of aged care within limited budgets. Some devices rely on cutting-edge technology whilst others have been developed with simpler technology.

In order to make sense of the varying technology utilisation for aged care, the idea of technology options is proposed in this thesis as a useful conceptual tool. Figure 1.2 illustrates the basic framework.

![Figure 1.2 Technology options for aged care assistance](image)

Technology is utilised in aged care in various ways: as household appliances; as modes of transportation; as means of shopping; as equipment for personal care; as medication and so forth. The focus of this thesis is technology specifically designed for aged care, although it is probable that this may have
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wider applications. For the sake of constructive application in policy making, three principal technology options for aged care have been delineated and analysed.

Option One involves adopting only internationally standard technology for aged care. The implication is that major Japanese investment will not be made to develop new technologies for aged care, though this does not rule out refining existing technology or choosing appropriate technologies from those that have become standard in other countries. Option Two involves heavy Japanese investment in robotics technology. Option Three involves Japanese investment in developing barrier-free technology.

In Option One, the research and development of new technologies are not initiated in Japan. Rather, technologies that have become standard in other countries are selected and adapted in Japan to address and meet the needs of aged care. According to figures from the Ministry of Health and Welfare, the 1998 market value of medical and dental equipment in Japan was 2.03 trillion yen (approximately 110 yen to US$1) of which 41.2% was made up of imported medical equipment. US products dominated the imported medical and equipment market (63.5%) (JETRO: 2000, 11). Imported products include surgical instruments, diagnostic imaging apparatus and general operating supplies.

Aged care and other products to support the activities of daily life for senior citizens and disabled people are included in the category of home-care and rehabilitation products. This market is expanding as the demand for products

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to improve the quality of life for the growing aged population increases. The total market size of home-care merchandise rose from 773 billion yen in 1993 to 864 billion yen in 1995 and 1.018 trillion yen in 1997 (JETRO: 2000, 22). Additionally, the kyoyo-hin (common-use goods) based on the universal design concept has also expanded in market volume. According to the MITI, the home-care merchandise market volume which reached 1.018 trillion yen in 1997 would rise to nearly 2 trillion yen if kyoyo-hin is included (JETRO: 2000, 22).

Japan relies mainly on imports for some types of aged care equipment, such as wheelchairs and hearing aids. Taiwan, South Korea and the USA are the main providers of wheelchairs whilst Denmark, the USA, and the Netherlands supply nearly half of the hearing aids in Japan (JETRO: 2000, 23,24). Overall, Japan imports modern medical products and services from around the world. According to the Annual Report for Pharmaceutical Preparations: 1998 (Ministry of Health and Welfare), the value of imported medical equipment increased from 289 billion yen in 1990 to 835 billion yen in 1998. However, the value of medical equipment exported has only risen from 290 billion yen in 1980 to 327 billion yen in 1998 (JETRO: 2000, 11).

According to the Japan External Trade Organisation (2000, 1):

Historically, the health-care market in Japan has been import-driven, since foreign manufacturers, particularly American companies, have invested a great deal of energy in developing new health-care technologies and are expected to continue doing so. European companies have accumulated a vast amount of expertise in matters relating to care of the elderly. These companies remain the model on which Japanese enterprises base their efforts. In short, foreign products for the health-care market in Japan should continue to sell well.
Option One is, therefore, a feasible option for consideration. In pursuing it, it is of the utmost importance that sound decisions are made in selecting the most appropriate technologies that have become standard in other countries. Normally, the selection process follows the market mechanism of supply and demand. However, government can affect choices through regulations and taxing. The process of making the 'best' choice is important wherever the technology is developed but choosing from final products rather than creating new products will lead to a saving on research and development. What Japan saves in human and financial resources by adopting overseas technology can be channelled to meet other social needs. However, there are restrictions in choice and flexibility when Japan is not in a position to decide what technology will be developed for aged care. On the other hand, Japan has a reputation for cleverly adapting and refining technologies developed in other countries to enhance utilisation.

Assessing technologies developed by other countries also allows more objectivity without domestic conflict of interests with the developers. Researchers of frontier technology are often specialists in a narrow field and need to be so focused in their area that it is difficult for them to assess how their technology will influence society. For the Japanese government to be able to choose technology to import for aged care provides an avenue for controlling what technologies may affect the life of individuals and groups in Japanese society. Contribution to the process of such decision making can also be sought from a wider section of society as the potential technologies for importation can be seen and tested whereas assessing undeveloped technologies is more difficult without expert knowledge. Additional voices in
the decision making process will hopefully bring a more sensitive and appropriate outcome for better aged care provision. The potential consequences on different groups in the community of adopting Option One are described in Chapter 9.

Option Two, the development of specialised robotics, represents an area in which Japanese scientists and industrialists are collaborating with the government. The development of care-giving personal robots has slowly but persistently been researched whilst numerous single-task-orientated robots have been developed and implemented in aged care settings.

Chapter 5 focuses on the development of robotics in Japan from the original industrial robots developed to enhance productivity to recent research on humanoid robots with artificial intelligence that may provide care for the aged. As well as defining ‘robotics’, the chapter establishes the argument that developing robotics for aged care in Japan is a possible technological option.

Robotics technology research is pursued in the belief that it will make worthwhile contributions to society. Moreover, those researching robotics technology for aged care are aiming to address certain problems caused by the fast speed of population ageing in Japan. The assumptions underlying the high-level technology option, using robotics as an example, are examined in Chapter 6: that high-level technology provides solutions for certain problems in aged care; that Japanese researchers play a leading role in the development of technology for aged care in a situation where involvement of s in the research process is not a high priority; and that there are benefits in being at
the cutting-edge of international technology, including technology for aged care. Each proposition is discussed in detail with analysis of selected relevant writings by experts in robotics.

Option Three is discussed in Chapters 7 and 8. In this option, resources are channelled to develop barrier-free technology for aged care. In contrast to robotics technology, which utilises advanced and often complex technology, barrier-free technology tends to have a simpler approach to addressing specific problems faced by aged and disabled people. Barrier-free technologies carry advantages of being technologies that are well established and understood and therefore their application can be more flexible. Chapter 7 presents the benefits of developing goods and services using the concept of universal design, which evolved from barrier-free technology design by arguing that consideration for the special needs of the aged and the disabled in the initial designing stage produces user-friendly goods and services. The assumptions underlying the development of barrier-free, assistive technologies including kyo-hin and universal design are discussed in Chapter 8: that smaller-scale technology can effectively contribute to addressing aged care problems; that researchers, entrepreneurs and all play important roles in the developing process; and that products developed from barrier-free technology and universal design are likely to be acceptable and beneficial to a wider group than solely the disabled or the aged.

The likely consequences of the three technology options for aged care on various sectors of Japanese society are laid out in Chapter 9. In the last
chapter, Chapter 10, a summary and conclusion are provided, evaluating the different technology options for aged care.

1.6 Situating the research in technology studies

Discussion in Section 1.5 of technology options for aged care suggested that technology development and the management of technology changes generate consequences for society. Moreover, there are various social, historical and economic factors that affect development paths of technology. This research, therefore, does not ascribe to the popular view of technology being neutral or autonomous. Rather, the thesis assumes that technology is embedded in its social context and that socioeconomic factors are very important in examining and assessing technology options for aged care.

The approach used in this thesis can be situated in technology studies most conveniently in relation to two frameworks commonly used in the field: social shaping of technology and social consequences of technological choice. The research assumes that social context and social input play important roles in shaping technology and that technological choice has socioeconomic consequences. In essence, how the development of technology has been affected by Japanese society and how it affects the Japanese social context are important issues in examining technology options in aged care in Japan. In attempting to understand this, as Forrest and other scholars have pointed out, there are too many variables—historical, economic, political, sociological and so forth—to produce a simple model of technological change (Forrest, 1991, 439-453).
Despite the complex nature of social factors that affect technological changes, it is important to examine the social context in order to understand, assess and utilise technologies that will best serve the society. Moreover, it is also important to identify the people or interest groups who shape technology polices and those that are affected by those choices. The groups are often formed because of a variety of interests in certain technology and they hold different levels of persuasive power in how technology is shaped. The strength of the interest groups depend on factors such as the membership number, gender balance, financial support and expertise in technology. The common interest of the group will be reflected in its choice of technology option that will affect not only the group but also a wide range of groups in society.

In essence, although the process can be complicated, policy can be created and used to influence technology development. Policies that are formulated regarding aged care in Japan can influence how technologies are developed and utilised for aged care and that in turn, will affect the dynamics between different groups in society.

The social shaping of technology is an important theory in technology studies (MacKenzie & Wajcman: 1993). In this framework, economic and social factors that shape technology are examined because the way society is organised and its cultural values are assumed to profoundly affect what technologies are developed and how they are developed, designed and
diffused. In essence, this framework emphasises social factors and cultural values as having significant roles in the development of technology.

Technology is not culturally neutral and can only be useful if it fits into the social values and framework of the users' social context (Pacey: 1983, 1-4). Pacey uses the example of snowmobiles to illustrate how the same technology is used very differently in different cultures: the social context strongly influences the use of technology, rather than the artefact itself determining how it is used. Similarly, there are many different ways by which Japanese society shapes technology for aged care. For the technology to be successfully implemented, the technology needs to be modified to fit into the social context or the social context needs to change to accommodate the technology. As Pacey has demonstrated, it is too simplistic to believe that technology is neutral, as social context plays an important role in the way technology is utilised. For example, historical and socioeconomic conditions favoured the adoption and utilisation of industrial robots in post-War Japan (see Chapters 4 and 5); however, different historical and social circumstances may have not favoured this technology. Therefore, it is imperative to analyse the social factors and assumptions underlying technological options for aged care as well as examining how different options affect society.

How does social shaping theory, as a subfield of constructivism, relate to social choice? Bijker, in his article 'Life after Constructivism' (Bijker: 1993), examines and assesses the direction for research in science and technology studies in the light of constructivism. He argues the importance for society of realising the possibilities and the constraints of choosing or changing
technology; that is, technological options need to be clearly identified and presented to the people who will be affected. Bijker makes the point that the general public needs to be stimulated into active participation in the processes of democratically controlling technology (Bijker: 1993, 131). Accordingly, the theoretical concept of the technological frame that Bijker proposes calls for an active interaction between technology and society in shaping technology. He concludes that constructivist science and technology studies can continue to contribute to a better society and suggests that the ‘social-constructivist program’ be pursued as a sound approach to understanding the relationship between technology and society. The four problems of technology studies that Bijker expounds in his study—relativism, reflexivity, theory, and practice—are all addressed in the ‘social-constructivist program’ that:

- can be extended in perspective (sociotechnology rather than technology should be the future subject matter),
- in depth (explanations can now be developed on the basis of the empirical research of the past decade),
- with political relevance (the analyses are being directed toward issues of power distribution and reshaping society) (Bijker: 1993, 131&132).

Social shaping of technology theory typically focuses on the production of specific artefacts. This thesis presents a macro view of why different technological trajectories for aged care have developed in different ways within the Japanese social context, thus drawing on a more general form of social shaping theory. Specifically, the thesis acknowledges that the development of technology to address aged care is affected by social forces including economics, politics, culture, psychology and other technologies. That is to say social factors, such as cultural values, influence technological changes that occur in aged care. Shortage of care-givers, for instance, motivates technology development to address this problem. The technology
shaped by social factors, in turn, affects the dynamics between different groups of people.

Another important framework for looking at technology directs attention to impacts on society, the social consequences of technological choice. This need not assume that technology is autonomous. A good starting point is Winner who, in his article ‘Upon Opening the Black Box and Finding It Empty: Social Constructivism and the Philosophy of Technology’, raises the question, ‘how well does it [social constructivism] help orient our understanding of the place of technology in human affairs?’ (Winner: 1993, 364). Although he applauds social constructivists for examining the dynamics of technology developments and changes, such as the structure, workings and social origins of technology, Winner stresses the importance of taking this process further to examine how society views and reacts to technological developments and changes (Winner: 1993, 366). A social constructivist interpretation of technology, according to Winner, ‘emphasises contingency and choice rather than forces of necessity in the history of technology’ (Winner: 1993, 367). Whilst acknowledging the valuable contributions made by social constructivists’ studies, Winner identifies a number of important aspects lacking in their writings, such as the disregard for the social consequences of technical choice and lack of an evaluative stance to aid society to assess technology.

Because purity of social science methodology is of such preeminent concern, it is likely that social constructivists will continue their research without taking a stand on the larger questions about technology and the human condition that matter most in modern history (Winner: 1993, 372).
Chapter 1: Introduction and overview

Following Winner, it can be useful to analyse ways in which given technologies, themselves the product of social changes, in turn affect society. This process can provide information to policy makers and other interested groups in understanding the consequences of human decisions related to introducing, diffusing, and promoting given technologies. Drawing on his example of the low-hanging overpasses on Long Island (allegedly deliberately designed to exclude access for certain groups of people) (MacKenzie & Wajcman: 1993, 28-30), Winner illustrates clearly how technology choices can profoundly impact on society.

Taking the different perspectives of technological frameworks into account in the research, the approach in this thesis has been firstly to demonstrate that the Japanese industrialisation process cultivated acceptance of technological solutions to socioeconomic situations, with the focus being the increasing demand for aged care. Secondly, because there are various types of technology, the thesis identifies the necessity for examining options in seeking appropriate choices. Thirdly, in assessing technological options, the thesis illustrates the importance of examining underlying assumptions in developing certain technologies. Therefore, the approach of the research in the context of the above science and technology theories takes into consideration that technology can be shaped through social context and policy choices. Moreover, the research acknowledges that technology produces social consequences and therefore argues that it is important for technology choices to be guided by likely consequences and knowledge of underlying assumptions in order to create policies that will best serve society.
1.7 Scope and contribution of the thesis

A sound rationale for researching is that, as Dear suggests, 'cultural studies of science and technology takes people doing things that seem somewhat unexpected and makes sense of their behaviour or ways of doing things look normal by appropriate contextualisation' (Dear: 1995, 150-1).

The subject matter of the thesis potentially covers a wide range of disciplines, including demography, sociology, history, engineering, science and technology, and public policy. In order to provide a balanced background to the problems of the population ageing in Japan, a wide range of subjects needed to be examined. Each of these areas has the potential to be a research project on its own and thus, there was a limit to the depth of background that could be investigated. Some suggestions for future research are outlined in Section 10.4. The concept of aged care in this thesis was limited to mainly physical care relating to all activities of daily living, excluding curative technology such as those used in medical procedures.

At the beginning stages of the research, there was a lack of literature on barrier-free technology but towards the end, this topic had become widely publicised in Japan and, thus, the organisation of the thesis required major modifications. However, by changing the balance of the thesis from analysing mainly robotics technology to giving more consideration to barrier-free technology it was possible to effectively conceptualise and elaborate on the differing technology options for aged care in Japan.
The process of making contacts in the Japanese government ministries to investigate policies for developing aged care technologies required enormous effort and time. Each section or department in the ministries exclusively dealt with their assigned areas and it was difficult to put the pieces of information together to create a complete picture. Under such circumstances my status as a native speaker and reader of Japanese and my understanding of and familiarity with Japanese cultural practices enabled a degree of access that might have proved difficult for other researchers. On my frequent research trips to Japan I was able to check archive material that was unpublished and available only in Japanese. I was also able to visit hospitals and aged care facilities, and to interview people both formally and informally in their workplaces. This provided me with access to a range of perspectives and experiences at a practical level that I was then able to integrate with my framework of technology options. This first hand experience of current practice in the field combined with my knowledge of theory in the field has allowed me to develop an original approach to technology for aged care in Japan.

Elderly people do not cause problems per se. However, as people age it becomes increasingly probable that deterioration occurs both physically and mentally. For instance, as the aged population increases in Japan, mental disabilities, such as dementia and Alzheimer’s disease, are increasing in number:

As the number of senior citizens increases, those requiring health care (including the bedridden, those afflicted with senile dementia, and the infirm) will likewise increase in number. There were about two million infirm elderly persons in 1993, a number projected to reach 3.9 million by 2010, and 5.2 million (or 15% of the total population) by 2025 (JETRO: 2000, 4).
Chapter 1: Introduction and overview

Although this thesis does not classify different levels and types of illness and disability of the aged, the classification used by the Japanese government to assess aged care needs is referred to in later chapters. The technology options discussed in this thesis focus more on addressing the care of the aged with physical disabilities rather than mental disabilities. There are some areas of technology that overlap, such as in the concept of 'universal design' or barrier-free technology where both mental and physical disabilities are addressed. Some research into high-level technology developments for aged care also includes care of dementia patients. Another area of technological advancement supporting care of the aged is medical technology. Whilst acknowledging its developments and contribution, the technologies investigated in this thesis concentrate on those that assist aged people to remain independent and to lighten the burden on care-givers.

It is common to distinguish between technology referred to as 'cutting-edge' or 'advanced' or 'high-level' or 'big' or 'sophisticated' and technology described as 'low-level' or 'small' or 'simple'. Examples of 'high-level technology' are nuclear power and aircraft carriers; examples of 'low-level technology' are toothbrushes, paper, hats and chairs. Between these two extremes, though, there is a wide range of technology. In this thesis, high-level technology is exemplified by 'robotics technology' and smaller-scale technology by 'barrier-free technology'. Table 1.1 summarises typical characteristics of high-level technology and those that are typical of smaller-scale technology. This is purely a typical configuration and not a rigid definition. In quite a few cases, there are deviations from the typical characteristics. For instance, a miniature robot will have all the characteristics
of high-level technology according to the table except for large size. Similarly, some innovators, particularly non-professional innovators, spend many years developing what may seem to have all other characteristics of a smaller-scale technology. In this thesis, using labels such as ‘cutting-edge’ or ‘unsophisticated’ is a convenient way of categorising specific technologies without assuming that all characteristics rigorously apply.

Table 1.1 Typical characteristics of two types of technology

<table>
<thead>
<tr>
<th>Typical Characteristics</th>
<th>Type H (high-level technology)</th>
<th>Type S (smaller-scale technology)</th>
</tr>
</thead>
<tbody>
<tr>
<td>size</td>
<td>large</td>
<td>small</td>
</tr>
<tr>
<td>cost</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>expertise</td>
<td>high-level</td>
<td>not necessarily high-level</td>
</tr>
<tr>
<td>reliability</td>
<td>uncertain</td>
<td>high</td>
</tr>
<tr>
<td>complexity</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>development time</td>
<td>long</td>
<td>short</td>
</tr>
<tr>
<td>receptive to consumer needs</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>labels</td>
<td>High tech, cutting-edge, sophisticated, advanced</td>
<td>Low tech, simple convivial, unsophisticated</td>
</tr>
</tbody>
</table>

The high-level technology option (Option Two) in the thesis consists of technologies with characteristics along the line of type H in Table 1.1 above.
The smaller-scale technology option (Option Three) includes technologies generally fitting the description of type S. Medium-level technology for aged care, falling between these two types of technology, is included in Chapter 7 (Section 7.7) with barrier-free technology. Option One has not been included in the comparison as this option deals only with technology that have been developed, tested, and has become standard outside Japan.

The study was carried out by firstly identifying how the growing population of aged people is seen as causing serious concerns in Japan. These concerns can vary depending on the different interest groups in Japan. Relevant information was obtained by examining the extensive media coverage as well as books and journal articles addressing socioeconomic aspects of population ageing in Japan in recent years. I had informal discussions with numerous families in Japan, revealing elderly people's fears of not being able to afford aged care or not having sympathetic care-givers in old age. Moreover, middle-aged people with ageing parents expressed worries concerning their ability to adequately provide necessary aged care for their families. Younger people were often vague and uncertain regarding future aged care issues.

In order to link technology and aged care, a literature survey was made firstly covering the development of technology in Japan, and then in the field of technology in addressing aged care issues. Technology developments for aged care were found in reports of some robotics developments, a number of which were followed up by interviewing researchers, agencies, and employees at aged care homes where the robots were being used. Robotics represents one form of technology consisting of high-level, advanced technology, while
barrier-free technology represents a different form, namely simpler and cheaper smaller-scale technology, to assist aged people and their care-givers. After reviewing literature in relation to the development of barrier-free technology, researchers and those involved in barrier-free technology organisations were also interviewed periodically over four years. The development of these two styles of technology in providing aged care in Japan was researched and analysed.

Research illustrated that some technologies and devices for aged care were also being imported into Japan. Thus, the thesis has included relying on non-Japanese technology for aged care as one option. Systematic analyses of assumptions underlying two very different technological options for aged care in Japan were developed. An assessment was made of how each of the three options is likely to influence different areas of society in Japan.

The most significant original contributions of this thesis are:

- The description and interdisciplinary analysis of technology for aged care in Japan
- The conceptualisation and elaboration of three technological options for aged care
- The explication of assumptions underlying these technological options for aged care
- The presentation of the technology option approach as a possible model for further technology study
Chapter 1: Introduction and overview

• The development of a reference list for robotics technology and barrier-free technology in aged care
• The creation of a check list of considerations for implementing robotics for aged care
• The outlining of possible effects on different sectors of the society for each technology option

1.8 Conclusion

In this chapter, the rationale for the research has been described and justified in terms of both the general problem of the increasing aged population in Japan and the particular issue of addressing this problem with technological solutions. This chapter has argued that the rapidly increasing proportion of elderly people in Japan’s population has been a cause of profound concern for Japanese society. Policy makers have been reported as being in a ‘panic’ in light of the growing demand for aged care whilst family care-giving has become inadequate in meeting these needs. Examining the assumptions and impacts of different technological options for aged care provides a valuable tool in implementing appropriate policies to ensure adequate aged care services, particularly when resources are limited.

This thesis demonstrates that choices of technology options to address the issues of the growing demand for aged care will affect society in different ways, and provides a simple, practical framework for considering technology options for aged care in Japan. This framework provides an essential tool for
formulating procedures and standards for development and appraisal of appropriate policy for technology in aged care. This is to ensure optimal measures of care-giving within given economic and social boundaries. Gaps in public policy concerning the variable impacts of different technology options on the different sectors of the economy also provide a rationale for investigating the assumptions underlying technology options and their impact on Japanese society. The outcomes of the research presented in this thesis provide potential practical contributions both for policy makers and also for other interested parties in developing and utilising technologies for the aged and their care-givers.