Technology options for aged care in Japan

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NOTE

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Chapter 6

Assumptions underlying
the high-level technology option

6.1 Introduction

Earlier chapters established the historical significance of developing and implementing technology in Japan to address social and economic issues. In relation to the so-called problems of the current ageing Japanese society, research in robotics technology was discussed in the previous chapter. Developing robotics exemplifies the technology option for aged care of investing heavily in high-level technology. The matter of proper concern is not to classify technology into 'high' or 'low' but rather to identify the typical general characteristics which distinguish ‘high-level’ technology from smaller-scale technology. Focus is placed on the method of development together with its implications on society. The study aims to provide strategic assistance in examining devices and options within existing organisations so that policy decisions might enhance aged care and direct Japanese society into becoming a society for all ages.
In this chapter, the assumptions underlying the high-level technology option for aged care are examined by scrutinising robotics writings such as those cited in the previous chapter. I am using the term 'assumption' to refer to those beliefs that are so commonly accepted that they are often not even articulated or, if they are mentioned, it is rare for anyone to question or doubt them. The normal temptation is to take at face value what researchers express as being the purposes of developing technologies. Researchers do not always articulate the details of implementation or possible consequences. There are often many aspects of technology development that are not questioned. The purpose of exploring the underlying assumptions for developing robotics technology in addressing aged care is to further understand this technology option. The outcomes may not reveal clear-cut differences between options in relation to the underlying assumptions. However, critically examining and clarifying the underlying assumptions for the options heightens understanding of the options and provides valuable information for evidence-based policy making.

In order to discover the assumptions underlying this option, in the first instance, written materials regarding robotics for aged care in Japan were examined for revelation of reasons, aims, expected outcomes in developing the chosen robotics. These included a variety of academic, technical and popular writings regarding robotics development, particularly those addressing social, welfare and health matters. What was clearly discussed or justified in written materials were weighed up against what was not mentioned. I made lists of ideas that seemed to be commonly assumed in developing such robotics in Japan by
analysing the written materials. The resulting preliminary set of assumptions was tested against various articles more specifically describing robotics technology for aged care in Japan. Some of these assumptions were revised whilst others needed to be deleted. In due course, the ideas that were clearly not common were eliminated from the lists. By refining the list over time, I acquired a set of assumptions that seem to be common in the majority of cases that were examined. It was appropriate to amalgamate some of the assumptions, too, before reassessing them. This process was repeated a few times in order to derive at a set of assumptions that seems common to almost all writings in the field of robotics and health care, especially in aged care.

Furthermore, between 1996 and 2000, I interviewed a number of researchers in Japan working on developing robotics to assist aged care, as outlined in Chapter 5. The three main research projects that I focused on provide diversity in the functions of the robots. Moreover, the key researchers involved were accessible to discuss their work during my five visits to Japan over four years. They are Professor Takatoshi Ide, head of the team developing the Aid-1 robot for gait training, Professor Fumio Hara, head of the team developing interactive face robot, and Professor Tomomasa Sato, head of team developing robotic care beds. Similarly, interviews and discussions were held with officials in areas of developing robotics for aged care at the Ministry of International Trade and Industry, Ministry of Health and Welfare and with the head of a company marketing some robotics for aged care.
Through numerous meetings, I was able to further clarify the assumptions that appear to be made by these researchers developing robotics for aged care. Although these assumptions may not set out the total framework of robotics for aged care, they provide a tool by which the implications of developing and implementing this technology option can be considered in policy making.

In order to position the assumptions underlying the high-level technology option in this thesis, it is important to recall that this thesis examines three hypothetical technology options for Japan in addressing aged care: (1) implement only those technologies that become standard overseas rather than actively developing aged care technologies in Japan; (2) invest heavily in high-level technology, such as robotics; (3) invest heavily in smaller-technology, primarily barrier-free technology including assistive technology, universal design and kyoyo-hin.

Robotics technology research is being carried out because there are people who believe technological developments will address certain issues in aged care as it has for other economic and social problems in the past. In addition to the discussion in Chapter 4 regarding the historical evidence that technology has played a crucial role in transforming Japan, there is further evidence of this in the last forty years. High-level technology, such as robotics technology, exemplifies Japanese creativity in combining interdisciplinary technological areas of knowledge to strengthen its technological and economic dominance. ‘The classic example [of a successful technological fusion] is the Japanese
experience in mechatronics—a field vital for robots—which combined mechanics and electronics’ (Inkster and Satofuka: 2000, 39). Mechatronics is, ‘an integral part of a national strategy of enhancing resource-poor Japan’s position in the world through *gijutsu rikkoku*, or ‘building the state with technology’’ (Schodt: 1988, 43).

Before introducing and examining the main assumptions underlying the high-level technology option, it may be useful to give a examples of articles that I examined in the process of determining the assumptions. Hegarty (1992) investigated the barriers for robotics devices to become useable aids to independence and rehabilitation and found that, ‘technological over-ambitiousness, safety of users in intimate contact with robotics devices, large individual differences in the needs of people with disabilities, and the heavy requirement for innovators to design attractive and low-cost aids which people will want to own and use’ are the challenges for researchers (Hegarty: 1992, 5). The complex nature and the importance of cooperation between man and robot in application is argued by Bourhis & Agostini (1998), Dohi (1993), Dario (1996), Fujisawa (1993), Hara (1998), and Ohinish & Sugie (1996). Kawamura (1996) advocates better human-robot interfaces ‘in order to amplify the usefulness of the system [of service robots]’. Ikegami (1995) argues that expensive technological procedures are difficult to justify especially for elderly patients who are often cared for in hospitals over long periods. Despite the high cost of rehabilitation and personal care robots, researchers argue for the opportunities and potential for attractive solutions (Dario: 1996, Finlay: 1993).
For instance, Finlay argues that despite the relatively high cost of useful robotic systems for rehabilitation, they are often cost effective compared to the cost of full-time human care or the cost of institutionalised care. Most researchers outwardly demonstrate their keenness to be socially relevant and develop technology to address problems such as those of aged care (Erlandson: 1990, Crowell & Murakami: 1997, Hirano: 1996, Dohi: 1996, Siddiqi: 1994).

Articles in the Japanese press introduce some of these new innovations such as robots to assist elderly people in their own homes (*Nikkei Sangyo Shinbun* Sept 28, 1998), robot TEM for rehabilitating stroke victims (*Nikkei Sangyo Shinbun* July 26, 1999), robots to rescue people, example from fire, named ‘Robokyyuu’ (*Nikkei Sangyo Shinbun* Oct. 21, 1998) and a robot named ‘Wabian’ that can share laughter and anger, particularly helpful for people who are isolated (*Asahi Shinbun* Dec 9, 1999).

In section 6.2, the key assumptions are presented and examples of supporting evidence are produced. Section 6.3 provides a detailed analysis of key articles to illustrate how the assumptions underpin the work of particular researchers. Case studies from Chapter 5 are examined in light of assumptions in section 6.4 and concluding remarks are in the last Section, 6.5.

In the following chapters, similar methods are applied to examine another technology option for aged care purposes in Japan (Option Three)—to invest heavily in smaller-scale technology, such as barrier-free technology. The effect
on different social groups when one technology option claims preference over
the others is discussed in chapter 9.

6.2 Assumptions

Earlier, it was established that for the purposes of this research, assumptions are
defined as beliefs or understandings that are usually not articulated or
questioned because they are commonly accepted, often without people even
being fully aware of them. For instance, today it is reasonable to assume that
academics at an Australian university have access to a computer and are
computer literate, at least keyboard literate. Most Australian academics would
take it for granted that it is possible to communicate with other academics in
Australia using the e-mail system. Similarly, I sought to infer assumptions of
this taken-for-granted status about a high-level technology, robotics, in Japan,
particularly in health and welfare areas. The method of isolating the
assumptions was discussed in Section 6.1 and in this section I present my
proposed three main assumptions underlying the development of high-level
technology along with illustrations and concrete examples.

**Assumption R-1:**

Japanese researchers assume that high-level technology is capable of
providing solutions for certain problems in aged care.
The first assumption is that researchers in the field believe that high-level technology can be developed in a way that can address some of the current problems in aged care in Japan. Moreover, they believe that their high-level technology research can ultimately contribute in providing solutions for some of the problems associated with the increasing proportion of aged population. Not surprisingly and in general, Japanese researchers creating robotics for aged care seek to have their research accepted as being socially valuable in the same way that most researchers want to see their research applied in making worthwhile contributions to society.

For instance, in response to the anticipated demand for more care-givers in Japan, there are robotics engineers in this field who claim to understand this social issue and believe that the robots they are developing will meet this need. These researchers are keen to demonstrate how robotic nurses, robotic servants and even robotic pets can replace people in performing certain care-giving duties. Researchers of other high-level technologies utilised to develop devices that will lighten the workload of care-givers or increase independence of the aged also assume that their research addresses needs related to aged care demands. In essence, researchers in the field assume that their high-level technology research is socially relevant and valuable in solving the problem of inadequate supply of aged care-givers.

To understand Assumption R-1, wherein technology offers solutions to Japan’s economic and social problems, the historical background to Japan’s
technological progress discussed in Chapter 4 provides a number of clues. In
discussing the development of technology in Japan, the notion of a
'technological fix' is seen as naturally filtering into Japan as society discovered
the powerful and effective role of technology in solving its many social and
economic problems. It has already been stressed that 'technology' is widely
perceived as having played a key role in modernising Japan and rescuing the
nation from the depths of destruction after the Second World War. Thus, the
argument is that there is a natural tendency amongst the Japanese people even
today to consider technology as a means of solving the more current problems
associated with Japan's ageing society.

Chapter 4 included discussions that the mode of ideology described above may
be particularly strong in Japan for other non-historical reasons as well. For
instance, being a nation with relatively poor supply of natural resources, it
becomes more urgent to depend on technology to provide ways to best utilise
available resources in providing the most effective solutions to the country's
problems. Another factor that is relevant in considering assumptions underlying
the high-level technology option is the minimal psychological or religious
resistance to technology in Japan, even for creating human-like robots. Unlike
the Christian belief of one God who is the sole creator, the majority of Japanese
are comfortable with animism and with the concept of a spirit in nature and
even in inanimate things. Children are often introduced to technology as
something to 'befriend', as in the 1990s craze for technological 'pets', such as
Tamagocchi. Therefore, it can be argued that there is a general acceptance in
Japan to trust technology in providing some solutions to socioeconomic problems, such as those related to aged care. This in turn allows researchers to assume responsibility in understanding relevant social issues that their high-level technology development will address.

Although assumptions are defined in this thesis as beliefs and understanding that are taken for granted, they are occasionally explicitly stated. For example, in relation to Assumption R-1, the Japan Ageing Research Centre publication states as a matter of course that ‘The research, development and use of technology greatly contributes to resolving issues associated with ageing societies’ (JARC: 1996,134). This statement communicates very clearly that there are expectations in the Japanese society for ‘technofix’ in addressing social problems. The government also voices expectations that technology will solve Japan’s societal problems. Government publications often illustrate its expectations of science and technology to address socioeconomic issues.

The White Paper on Science and Technology of 1993 states that Japan is facing a crisis involving environmental and other problems of a global scale. These are depletion of the earth’s resources, as well as domestic problems of an ageing society and a low birth-rate in a materially prosperous society. If Japan is to overcome these serious problems and continue to develop as a peaceful and prosperous society, much is expected of science and technology in the future, according to the report (Sigurdson: 1995, 289).

Researchers working in the relevant fields express similar expectations that high-level technology, such as robotics, will be developed and utilised for social purposes in Japan:

Growing expectations are entertained of robots these days not only for industrial purposes but for supporting senior citizens and handicapped people
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in their daily lives and for supporting social activities, as well as for leisure activities (Hirano: 1996, 62).

Already introduced in Chapter 5, Professor Takeyoshi Dohi of Precision Machinery Engineering at the University of Tokyo, publicly expresses his expectations that personal robots will support and enhance the lives of Japanese elderly people:

At the beginning of the 21st century a quarter of Japanese population will be occupied by the elderly over 65 years old. This brings about the urgent necessity to develop new supporting technologies for making their life worthwhile and independent, for enhancing and keeping quality of life, and for taking part in social activities. To solve these problems, it is expected to develop personal robots by using Japanese high technologies for robots (Dohi: 1996, 34).

Other examples of expectations of robotics technology to address aged care issues are also found in a number of articles about robots. For instance, in an article titled, ‘Robot Revolution’ in The National Geographic, July, 1997, Suplee discusses the likelihood of developing robots that will some day ‘take on some tasks now done by humans in, say, nursing homes. This is particularly important in Japan, where the percentage of elderly citizens is rapidly increasing’ (Suplee: 1997, 85).

These examples illustrate that researchers in the area of high-level technology in Japan want their work to be socially relevant and believe that technology will provide solutions for some of the issues facing the Japanese ageing society (R-1). The following concrete examples of technological research carried out by
researchers further demonstrate their desire to be socially relevant by enhancing aged care:

a) A **shower capsule** was developed by Kitamura, ‘to make bathing easier for the frail, the elderly and the handicapped’. Kitamura claims that, ‘my job is to help make caring for the old easier for the family’ (Crowell & Murakami: 1997, 55).

b) A **robot for carrying food trays** is being developed to carry meals to patients in aged care institutions. The researchers claim that this robot will, ‘allow care-givers to concentrate on personal services and improve the quality of nursing care’ (Technology Research Association of Medical and Welfare Apparatus: 1998, 12).

c) An **evacuation-support system** is being developed with a simple functional robot which supports the elderly and the disabled to provide more dignity and independence so that ‘aged care-givers can concentrate more on interacting with their patients’ (Technology Research Association of Medical and Welfare Apparatus: 1998, 13).

d) A **new wheelchair** that can automatically move elderly or disabled from one room to another has been developed. The designer, Hiroaki Seki of Kanazawa University, claims that his research is socially relevant because ‘the rapid increase in the number of elderly people has become a critical problem in many societies ...Because there are often not enough staff in old people’s homes, patients can’t always be moved when they want to be’ (‘Ticket to ride’ *New Scientist* 6 May, 2000, 10).
Economic analysts also point out the social relevance of researching technologies in order to come up with innovations for aged care. According to Yasuo Kimura, a senior consultant at Nomura Research Institute, a think-tank of Japan’s largest stock brokerage firm, ‘rapid ageing is going on exactly as predicted, creating new needs in caring for the old. Technological innovations are keeping some manufacturers extremely competitive in such areas as electronics components, and liquid-crystal of optical technologies’ (Sangwon & Murakami: 1997, 45). Robotics and automation featured high on Kimura’s list of eleven areas expected to flourish between 1997 and 2010.

The efforts of researchers seeking to be socially relevant may also benefit a wider area of needs aside from those of domestic aged care. ‘It is often claimed that high-technology industries may generate externalities which spill over within national boundaries far more easily than across borders. Thus national welfare could be improved by the promotion of high technology industries’ (Hemmert & Oberlander: 1998, 35).

European robotics researchers also claim that the increasing number of elderly people in developed countries is an important factor influencing developments of robot assistance (Dario: 1996, 225). In the USA too, at the 5th International Service Congress in Detroit, Michigan, researchers used the increasing number in people requiring physical assistance to justify a robotics system to provide movement therapy. ‘Every year over half a million persons incur an impairment that interferes with coordination and control of movements required for general
mobility, the performance of activities of daily living, and vocational and recreational tasks’ (Erlandson: 1990, 160).

The social relevance of research therefore can be seen as being a commonly accepted assumption although aged care is only one of the areas of life that is addressed by high-level technology. For the purposes of this study, I have focused on the examples high-level technology development specifically targeted for the aged or for the aged and the disabled.

Assumption R-2:

Japanese researchers play a leading role in the development of technology for aged care with little consultation with the end-users in the research process.

The second assumption reiterates that researchers with specialised knowledge play a leading role in developing technology for aged care but also claims that this occurs with little consultation with potential end-users. This is partly due to the nature of high-level technology requiring specialised understanding of complex and/or leading-edge science (Hemmert & Oberlander: 1998, 35). Historically, too, there has been acceptance of and respect for hierarchical order of society in Japan where academics rank highly. In the past, this was fundamental to Confucian strategy for achieving harmony in Japan (Durlabhji: 1993, 8). As discussed in Chapter 4, one Confucian teaching is to honour those
who are one's elders and teachers. There is still a strong element of this teaching in Japanese society and established researchers naturally assume unquestioned leadership in their field of expertise. Therefore, members of the general public rarely even think of trying to influence researchers in the process of developing high-level technology such as robotics.

In the Japanese robotics research, professional advice is often sought in the process of developing robotics but research normally progresses without consulting potential users on the assumption that researchers understand societal needs.

Much of the written work discussing high-level technologies, such as robotics, to address aged care issues is found in robotics and technology journals rather than in journals for nurses and other care-givers. Indications are that high-level technological advances for aged care are being driven by researchers and are inclined to be discussed in technology journals before the new technology and some of its possible applications filter down to journals of care-givers. However, as the issue of aged care continues to take prominence in the media, increasing by groups and individuals are beginning to express their views. Most notably, the so-called 'grey power' movement that includes people who were in elevated positions of power before retirement is rising as a strong lobby group.

For the purposes here, the term 'researchers' can be taken to include those in the government and corporate sectors who have relevant, specialised knowledge
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which gives them power to influence the decision-making process in directing technology development. Assumption R-2 implies that researchers are the ones with the expertise and therefore, it is rarely a priority or even appropriate for them to seek the input of end-users when developing high-level technology, such as robotics. In theory, the government looks after the interests of the public in terms of directing science and technology developments. However, Low suggests that, 'much of what occurs might be better described as being for the 'national interest' as defined by some of the powerful actors who determine policy in Japan' (Low: 1999, 6). Therefore, Assumption R-2 suggests that researchers with expertise in high-level technology have considerable power to influence how technology is developed to address socioeconomic issues such as aged care.

The Japanese government has always played an active role in formulating science and technology research policies although much of the funding came from private corporations. There are strong links between the public sector and the corporate sector but public access and participation have traditionally been severely constrained. Obviously, those with specialised know-how have more power in determining the direction of technology development but there is an underlying assumption that they understand societal needs and therefore need not assess public opinion or seek public participation for the development of the robots. Moreover, as researchers are the people with access to specialised knowledge and understanding of say, robots, researchers are not inclined to expend time, money or energy in seeking public input.
Although external influences affect technology development, it has fallen on those with expertise to direct high-level technology development in Japan. Both the 1973 and 1978 oil crises provided powerful stimuli to utilise the flexible automation robots for production in a desperate measure to maintain international competitiveness when oil, a key raw material, became scarce and expensive. However, it was the Japan Industrial Robot Association (JIRA), chartered in October 1972 that took a leadership role in promoting the use of new technologies. The JIRA was the first association in the world to act as leaders and promoters of new advanced technologies, providing assistance to struggling manufacturing industries so that healthy economic growth in Japan might be maintained. The original membership of JIRA consisted of key men with expertise from big corporations producing robots, such as Mitsubishi, Toshiba and Hitachi (Schodt: 1988, 121). While there is little consultation with ordinary citizens in promoting and directing high-level technologies in Japan, consultation, such as in JIRA, amongst research institutions, companies and government is common.

Since Japan is a society where outward consensus between groups underlines harmony (Eccleston: 1989, 1-3, Nakane: 1967, 41-42), research developments may be slow at the stage of planning when groups with specialised knowledge meet. However, once the research commences, researchers are normally able to take control to develop their work. The end-users normally only trial new technology after the development has been completed by researchers. Take the case of researchers at the University of Tsukuba and their research for an
'evolvable hardware' chip robotics hand to assist amputees. On completion of this research, it was reported that 'so far the chip has been tested only in simulations, but researchers are now looking for people who want to get involved in clinical trials' (Grahame-Rowe: 1999, 16). This is a typical example of users becoming involved in the research only after the new technology has been almost fully developed. Researchers argue that technology has to reach a certain level of development before it can be trialed by a human being but should the end-user become more involved during the process of developing high-level technology? Assumption R-2 suggests that it is feasible and an accepted practice for researchers of high-level technology to develop technology for aged care without collaborating with end-users. Increasing interest and opportunities for the public to gain information in recent years may mean that in the future there will be more public participation in high-level technology for aged care. Appropriate timing and methods for collaboration with end-users may also enhance the outcomes of research, depending on the nature of the research.

The overall receptivity to robots in Japan was discussed in Chapter 5 and this characteristic may be a factor to bring researchers and end-users closer in the process of developing robots for aged care. In contrast to the Japanese view of developing and utilising robots, when Tilden, at the Los Alamos National Laboratory in New Mexico, was asked why his robots are not in use for real applications, he answered that, 'it's partly a schizophrenic public attitude to robots in general'. According to Tilden, some people are afraid of
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robots—something he calls, ‘terminator phobia’ (Kleiner: 1998, 44). This fear does not seem to apply to the Japanese for reasons outlined in Chapters 4 and 5. However, it can be argued that increasing collaboration with end-users in developing robots for aged care in Japan may further elevate the level of general acceptance for high-level technology in aged care.

There was little evidence of collaborating with end-users during the process of developing their technologies in the examples of recent research developments for aged care presented under Assumption R-I. However, despite the lack of consultation with end-users during the process of developing robotics as the above examples indicate, there is growing interest in and understanding of technology by people who will potentially be utilising the robots in future. As more people are better educated and have easier access to information about technology developments and policies, consulting with and informing users would seem a way to enhance research for outcomes that are acceptable. Although there is yet little evidence of researchers collaborating with end-users or seeking public participation in developing robotics for aged care, there are more interest groups becoming vocal about policies in Japan. Low observes that, ‘attitudes to public participation in policy-making are changing in Japan, and local residents are slowly becoming more empowered and more able to resist or oppose contentious projects such as Narita airport, which involve entrenched, vested interests’ (Low, Nakayama & Yoshioka: 1999, 7). However, in the case of high-level technology which requires specialised knowledge, the
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suggestion for a technology intermediary to act as a ‘go-between’ between the researchers and the end-users may be more effective, as described later.

There is no denying that researchers hold specialised knowledge regarding high-level technology, but the success of the application relies on the collaboration of those with different expertise as well as input from the end-users. End-users can provide valuable input having invested time in understanding the technology or through an intermediary (Figure 6.1). In Hegarty’s words, ‘the goal must be to prove usefulness of an engineering solution with at least one end-user and those who care for him or her, and then progress to others. The approach of the future will be multi-disciplinary. End-users and carers will collaborate with engineers and therapist to drive new ideas through to working prototype’ (Hegarty: 1992, 5).

Although the example is not Japanese, a case of surveying potential users of an electric wheelchair mounted robotics arm demonstrated the usefulness of collaborating with end-users during the process of development. (Prior: 1990, 143-54). This survey identified a number of tasks that users of the wheelchairs could not do and the information provided important design specifications for the engineers to address in order to achieve a more user-friendly, helpful outcome.

A similar argument arose from a study on the impact of microtechnology on a severely handicapped person. This study concluded that the successful
introduction of high-level technology devices requires a full appreciation of medical and social factors as well as those relating to the technology. Furthermore, the argument stresses that successful diffusion is achieved through close partnership between the clinical engineer and the rehabilitation consultant to the benefit of the users (Dymond: 1988, 483-90).

Some studies go further to advocate consulting the end-users throughout the development process. Bourhis & Agostini (1998) in their paper ‘The Vahm Robotized Wheelchair: System Architecture and Human-Machine Interaction’ discuss ‘the application of methods coming from mobile robotics to navigation assistance for people with motor disabilities’. They argue that, ‘the user has to be taken into account throughout the study and must not appear as an element grafted at the final stage’ (1998, 49).

Therefore, the assumption that consulting end-users is not a priority for high-technology researchers (Assumption R-2) seems to be challenged more often outside of Japan, since there are some engineers in the field who believe that ‘experience with potential users is vital at all stages of the design of equipment for the disabled, not least in the field of rehabilitation robotics’ (Hillman & Jepson: 1992, 187-92).

In another area related to aged care, professional care-givers, it is worth noting that Japan has been slower than in other advanced nations in adopting the practice of providing detailed information to patients and including patients in
the decision-making processes relating to their care, especially in cases of terminal illness. The traditional hierarchy implied that doctors know more and are superior and therefore, almost by definition, their judgement should not be questioned by patients. However, as Low points out in his chapter on ‘The Patient versus the Doctor’, the attitudes of care receivers are changing and ‘individuals are increasingly having to take responsibility for their own lives’ (Low, Nakayama & Yoshioka: 1999, 188).

An additional point regarding this assumption is that up until now, men, particularly in Japan, have been the main leaders in the field of technology. Therefore, the assumption extends to a general acceptance of delegating technological decision making to those with specialised knowledge who are mainly men at this stage. It can be argued that there needs to be more gender balance in what has to date been a male-dominated area, especially technology related to aged care. Well over half of the elderly population consists of women and similarly, the majority of care-givers are women. Therefore, it is important to consider gender issues in understanding the needs of end-users for researchers to develop aged care technology.

In her paper, ‘Women, Technology, and Power’, Professor Naghdy discusses the apparent gender disparity in the technological development process and, in particular, how women are disadvantaged as a result of being excluded from being part of the decision-making bodies concerning the development,

As more people become interested and educated in technology, one can expect that there will be increasing public participation, including women, in evaluating technology developments, especially in areas that affect them personally. Technology for aged care would particularly be of interest to most people in Japan as the proportion of the population involved in giving or receiving aged care increases. However, it is often difficult for end-users to constructively comment prior to or during the process of high-level technology development. Without something tangible, there is difficulty even perceiving what the technology can do or how it will do it or how it could be useful to them. Nevertheless, appropriate timing and methods for end-user participation can be crucial factors in achieving useful end products of high-level technology developments. As high-technology application becomes increasingly part of everyday life in Japan, it is likely that Assumption R-2 will be modified to include more and more participation outside research groups.

Because of the previous success of technology, a ‘gap’ has emerged between engineer-researchers and the aged end-users. In a similar way that financial intermediaries plays the role of connecting the group who want to lend money and the group who want money lent, I propose that it is important to develop ‘technology intermediaries’. The function of a ‘technology intermediary’ would be to supply relevant information to appropriately connect the group who
want to develop technology and the group who want technology developed. Like financial intermediaries, technology intermediaries must have a sound understanding of the groups for whom they are acting as a 'go-between', that is, expertise in available technology for aged care and understanding of the needs of the aged. The following diagram simply illustrates this point:

Figure 6.1 The role of technology intermediaries

The contribution of technology intermediaries can assist in maximising the effectiveness of developing high-level technology that will most benefit end-users. As high-level technology expands and becomes increasingly complex, it is more likely that the gap will widen between the group with the technological expertise and the group needing aged care. Technology intermediaries can narrow this gap. That high-level technology will increasingly affect every aspect of life is particularly relevant in Japan where an acute awareness of being at the cutting-edge of developing high-level technology prevails.
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Assumption R-3:

Japanese researchers assume that there is merit in being at the cutting-edge of international technology, including technology for aged care.

Chapter 4 and 5 described the Japanese people as being socially flexible in adopting technology and perhaps having more receptivity to technology compared to other countries. Numerous suggestions were made to help understand the role of technology in Japanese society. One explanation is that historically technology has been seen in Japan as an effective tool to strengthen the economy and enhance living standards. In his article, ‘Technofix-ation’, Rick Davis (1992), editor of the Japan Environment Newsletter, observes that, ‘the Japanese are enraptured by the possibilities of technofix because of their abiding faith in science and technology’.

Over the many years since Japanese researchers and businesses people began importing technology from more advanced Western nations, they have fine-tuned the art of modifying technology to best serve their interests. Earlier on, technology was repeatedly used to produce and sell cheaper substitutes of goods already appearing on the global market. This earned for the Japanese the reputation of being clever imitators with the ‘made in Japan’ goods being inferior in quality. In due course, overseas technology became strategically adapted to produce high quality goods at costs that were highly competitive as export goods. The Japanese government has set priorities in utilising technology in pursuit of economic strength and not merely for the honour of
being a 'clever nation'. The ability to remain at the cutting edge of technology is seen as a way to remain economically powerful. Initially, creating a technologically strong nation was important in order to defend itself in case of war or colonisation (Samuels: 1994, 193). As Japan remains a relatively small nation with poor natural resources, being at the cutting edge of technology remains important for national security in conjunction to maintaining an economic stronghold.

In keeping with this context, the third assumption suggests that researchers believe that society gain from being at the cutting edge of technology and that there is merit in their pushing the cutting edge of technology. Even in light of robotics research alone, Schodt observes that, 'in this high-tech age, the number of robots a nation has is a symbol of its commitment to modern manufacturing and automation and can convey considerable prestige' (Schodt: 1988, 39).

In a report on Japanese R&D published by the British Chamber of Commerce in Japan in 1987, robots and automation are argued to have raised labour productivity without compromising reliability and quality. As Japan had twice as many robots working as the remainder of the industrialised world combined when this report was written, the economic merit of pushing the cutting edge of robotics technology is apparent (British Chamber of Commerce in Japan: 1987, 38-9).
In summary, the assumptions discussed in this section and the examples substantiating them reveal that Confucian teachings and historical events have strengthened the position of researchers as leaders in developing technologies in Japan. Moreover, the belief that technology can solve societal problems and the desire for researchers to have their work accepted as being socially relevant work together in developing technologies to address one of today's main social concerns, that of an ageing society. History has also taught Japan the importance of being at the cutting edge of technology and hence, this goal is one widely accepted in the Japanese community, including researchers.

6.3 Discussion of selected articles illustrating the assumptions

Three articles from different journals regarding development of robotics for aged care in Japan will be examined in this section to illustrate how the assumptions manifest themselves and relate to each other. The first article, by David Concar, focuses on the ideas of a well-known Japanese robotics engineer, Ichiro Kato. The second article, 'Living under the same roof—people and robots', is a more general report on the direction of Japanese humanoid robotics research in the light of Japan's ageing society. Both articles appeared in non-Japanese journals and were written by non-Japanese. The third article, titled 'Humanoid Robots: the Goal of Robotics in Japan', is by a Japanese professor researching in robotics at the Waseda University in Tokyo.
In the first article, Concar reports on work and ideas of Ichiro Kato, who was a former head of the Robotics Society of Japan as well as being the founder and a former chairman of the Society of Biomechanisms (Schodt: 1988, 202). At the time Concar’s article, ‘Can robots come to care for us?’, was written, Kato was the dean of Waseda University’s School of Science and Engineering in Tokyo. He was responsible for an extensive list of robotics developments but his ultimate goal was ‘to replicate man in metal’ (pg. 203) and to add ‘my robot’ into the Japanese community (pg. 204) after ‘my car’ and ‘my house’ became the norm.

As reported by Concar (New Scientist, October 2, 1993), Kato’s vision was for robots to provide care to the elderly. This is an important article because, for the first time, a Japanese engineer was reported to have publicly promoted the concept of robots replacing humans in activities outside factories. This article introduced to the general public the possibility and practicality of robots replacing human care. It was one of the first cases where a respected Japanese engineer not only forecasted that, technologically, robots would soon be able to replace human care but also that this would be socially acceptable in Japan. The main justification given for developing humanoid robots is to meet ‘the needs of an ever-growing army of old people is pushing Japan’s technical ingenuity to the limit’ (pg.41). The following paragraphs give a summary of Concar’s report with quotes from his article, plus an assessment of assumptions R-1, R-2, and R-3.
Concar sees the Japanese music prodigy robots, Wasubot and Wabot-2, that caused a sensation in the 1980s as providing a 'springboard' for researchers to visualise and develop future robots modelled on these robot musicians. It was anticipated that future robots 'could be whizzing around Japanese hospitals helping to fetch, carry and nurse the sick, or helping elderly people fend for themselves at home' (pg.40). Concar reported that Kato strongly advocated the development of humanoid robots to address the problems of aged care. He believed that the speed of Japan’s population ageing whilst the labour force was shrinking warranted urgent solutions. In Kato’s prediction, one solution to meet the societal need for aged care would come in the form of humanoid robotics.

Numerous social and economic measures that also needed to be implemented to address the problems arising from the coming ‘demographic avalanche’ were discussed in the article. Moreover, a staggering prediction of 1.2 million ‘bedridden’ senior citizens and 2.4 million victims of strokes or Alzheimer’s disease by the year 2025 (pg.40) was used to strengthen Kato’s argument that humanoid robots might relieve some of the social and economic burden of caregiving.

As reported by Concar, Kato’s philosophy was that care-giving robots need ‘friendly anthropomorphism’ as elderly people will not be able to manipulate machines easily. To this end, his team was reported to be working to develop humanoid nurses that have the ability to adapt themselves to humans. Furthermore, Kato reputedly did not see robots providing aged care as being in
anyway heartless. In a quote in the article, Kato said ‘elderly people would find themselves more at ease with a personal robot than being a burden to their families’ (pg.41).

Clearly, in Concar’s article, robotics technology was seen as being socially relevant (R-1). Kato and his team at Waseda University were reported to be working to create agile, intelligent robots with a streak of kindness which, ‘promises the ultimate in high-technology solutions, robotics slave, to the time bomb ticking at the heart of Japan: an unprecedented increase in the number of old people’ (pg.40). Besides providing a high-level technology solution to this social problem, ‘if history is any guide, the solutions Japan comes up with could end up as exports to ageing industrial rivals’ (pg.40). Japan strove to position itself as one of the dominant science and technology nations as well as one of the strongest economies. It is therefore argued that the importance of maintaining leading technology and economic placing in the world was built on the underlying assumption that there is merit in pushing the cutting edge technology development, especially with potential export markets (R-3).

Kato’s reported reflections are poignant in his reminder that, ‘after all who would have predicted forty years ago that a computer the size of a building could be shrunk to a single chip?’ (pg.41). He defended the position that those who have specialised knowledge understand socioeconomic issues for which their research applies. Kato therefore did not put forward the research for public scrutiny. He assumed that elderly people would prefer personal robots to
burdening family care-givers without any reference to the opinions of aged people themselves (R-2). It did not appear to be an essential part of the development to consult the users if they would indeed accept or choose to be cared for by robots in their old age. This does not in anyway imply that Kato did not care about the feelings of the potential elderly user. In Concar’s article, Kato is quoted as saying, ‘In the case of developing robots for elderly people, we must install some kind of capacity for emotions’ (pg.41). This supports the underlying assumption R-2 that engineers understand users’ needs without an obvious procedure or process of consulting those users.

The second article analysed here is a research report, ‘Living under the same roof—people and robots’ from the December 1998 Robotics Newsletter. This report was introduced in Section 5.2. The International Federation of Robotics publishes its quarterly Robotics Newsletter introducing new products, research, and events from around the world. The following paragraphs summarise and discuss the article, alluding the three assumptions.

This research report argues the importance of finding practical uses for robots that live and work in a human environment. ‘Now, as Japan moves towards an ageing society, there is growing demand for people-friendly machines capable of supporting and even enhancing human life-styles and activities, such as nursing and personal services required by the sick and the aged’ (pg.4). There is an assumption (R-1) that high-level technology addresses social concerns and solves problems such as growing aged care needs. Moreover, there is an
underlying assumption that researchers understand what and how people prefer to have these needs met. The assumption in this report is that the researchers believe that the development for human friendly robotics is socially relevant without seeking confirmation from the general public despite acknowledging the complexities of developing technology that pushes the cutting edge of technology (R-2).

The article continues by describing the national program to develop humanoid robots to help the population at large. As leaders in technology, the Agency for Industrial Science and Technology (AIST) is developing both physical and virtual robot platforms with the expectation that ‘it will be possible to find practical uses for robots that work in a human environment’ (pg.4). The description of the design and functions of these robots further indicate the assumption that the engineer researchers believe that their work can provide solutions for certain social problems (R-1). There is, however, no indication that users should be consulted in the development process. Moreover, whilst addressing social issues, the precise nature of the problems that the robots will be addressing is unclear. The assumption seems to be that developing the cutting edge technology itself is important (R-3) and ‘later, consideration will be given to demands made in applied fields in which practical use of robots in the human environment can be anticipated’ (pg.4).

The reader is left with no doubt that humanoid robotics has the potential to contribute in many varied ways in Japan, especially in addressing the issues of
its increasing ageing population. However, research reports such as this tend to extol the virtues of pushing the cutting edge in technology. Readers are told how valuable the new technology will be in addressing the societal issues with little or no reference to the way other users think because the users’ opinions and contributions are minimal in the development progress.

The third article analysed in this section is titled, ‘Humanoid Robots: the Goal of Robotics in Japan’. Although it appeared in a non-specialist journal, Pacific Friend in May 1998, the author, Atsuo Takanishi, is a highly respected Professor in the Department of Mechanical Engineering at Waseda University in Tokyo. Takanishi’s article is a part of a special report by Ota, ‘Where are Robots Headed?’, that also appears in the May 1998 Pacific Friend. The following paragraphs discuss Takanishi’s views as well as those expressed by Ota, and associated assumptions.

Takanishi begins his article by claiming that, ‘one of the ultimate goals of robotics technology is to create a humanoid robot—a robot that is as close to a human being as possible, both in form and function’ (pg.26). Ota also writes that ‘the ultimate goal of robotics in Japan is to develop robots that can communicate and interact with human beings in real human society’ (pg.18).

Takanishi spells out the importance that a robot resemble a human being if it is ‘to be regarded as a machine that goes into operation while cooperating and coordinating its movements with human beings in their living environment’
An example of one of the roles Takanishi hopes that humanoid robots will be able to fulfil in the future is, ‘a humanoid robot that could hear what programs an elderly person who does not know how to operate a video deck want to have recorded and then set up the deck to that it will record the programs he or she wishes to see’ (pg.27). Whilst not directly associated with aged care, Takanishi demonstrates the social relevancy of robotics research by providing numerous examples of robots that are serving society's needs in Japan (R-1). Among these examples are the guard robot—a robot for patrolling and guarding buildings; an excavation robot performing work in underground spaces; a wireless robot to inspect inside gas pipes even while the gas is still in them; and a welding robot used in shipbuilding which has increased labour productivity by ten-fold (pp. 26-7).

There does not seem to be obvious objection by the ordinary people in Japan to technologically driven solutions. In the introduction section of the special report ‘Where are Robots Headed?’, Ota argues that, ‘In Japanese society, where the population is ageing rapidly, it is conceivable that robots will some day be providing care for the elderly ... A large number of researchers believe that if humans are able to develop a communicative bond with their robot, humans and robots should be able to live together quite successfully’ (1998, 23). Note that Ota says, ‘researcher believe’ with no mention of what users might believe. It is the specialists, researchers, and professionals who play leading roles in the directing the research with little or no consultation with the potential users (R-2). The underlying assumptions are that society is looking to technology to
address societal problems and that researchers want to be seen to be socially relevant whilst being at the cutting edge of technological developments.

Ota ‘was really surprised when gathering data for this special report that nearly every researcher interviewed commented that the world of Astro Boy was indeed the ultimate goal of robotics R&D in Japan’ (1998, 21). This suggests the assumption that being at the cutting edge technology development toward creating human-like robots, like Astro Boy, is a priority both individually and collectively for researchers of robotics in Japan (R-3).

This section analysed journal articles about developing robotics in Japan which reveal the assumptions underlying high-level or sophisticated technologies, particularly for aged care in Japan. In summary, all the articles depict the nature of the Japanese research environment and illustrate how the assumptions discussed earlier manifest themselves. In the next section the developments of two specific robots for aged care will be examined in light of the assumptions being discussed in this chapter.

6.4 Assumptions in developing specific robots for aged care

Specific aged care robotics were analysed as case studies in Section 5.5. In the first case study, Aid-I (a gait training robot), the researchers played a leading role in assessing social need by gathering background information and statistics
to verify the relevance of their research. In a survey article, 'Expectations for medical and healthcare robotics', the researchers outline the shortages of hospital staff in Japan, both in medical and non-medical fields. The important roles of medical and healthcare robotics are examined in light of this labour shortage, described as an urgent social need in Japan. The researchers argue that, 'Finding ways to prevent an increase in bed-ridden elderly and to enable patients to return to society' (Ide: 1993, 191) will help solve this short supply of hospital staff (R-1). The article expounds on the serious nature of the shortage of nursing staff in particular, and how too often nurses resign from 'burn-out' in their efforts to give as much care as possible where the demand is inexhaustible (Miyauchi: 2000, 228-9). The researchers argue that, 'as the situation concerning [the supply of] staff in Japan is unfavourable, the development and introduction of robots will be necessary' (Ide: 1993, 191). This concern was discussed in earlier chapter, too, that, 'the ensuing demographic changes is often not [seen] as triumph of public health, but [rather] as an indication of a potential healthcare crisis for elderly people' (Nakanishi: 1995, 334). The difficulty of obtaining sufficient care providers, especially nurses, in Japan's ageing society is partly due to a shortage of young workers (Nishimura: 1993, 117) and is a major social problem to address.

The researchers of Aid-1 sought development in robotics for walking rehabilitation which traditionally requires 'a large amount of time and effort ... of medical staff, nurses, doctors, and special practitioners ... especially in the case of older people' (Ide: 1993, 192). It was assumed that the rehabilitation
robot, Aid-1, would replace some human labour required for gait training in walking rehabilitation. Functionally, the Aid-1 has many merits such as decreasing the work-load for staff, providing means of some independence and flexibility of training schedule for patients, as well as possible favourable outcomes and requiring less time for rehabilitation compared to traditional methods of rehabilitation. However, there is little evidence that the users, patients and physiotherapists, were consulted in the process of the development (R-2). In fact, the anxiety of some physiotherapists led the research team and the marketing agency to emphasise that Aid-1 is not aimed to replace medical personnel but to positively assist the staff and to enhance the quality of care.

In practice, the foreign exterior and the size of the robot (considerably larger than human beings) overwhelmed some people, particularly the elderly patients. Others expressed concern over safety at being controlled by machinery. Consequently, the technical goal is not always matched by practical outcomes and technology, such as this Aid-1, seems to reflect more of the priorities of the researchers than those of the users, the patients and the care-givers. That is not to say that researchers are insensitive to the needs of the end-users—just that consultation with them was not a priority in the development process (R-2). The researchers of Aid-1 also articulate that, ‘human beings are the focus of medicine: if this fact was not taken into account, the research and development of robots for medical purposes would not be realised’ (Ide: 1993, 189). Modifying the robot’s appearance and providing support to staff and patients may gradually increase acceptability and accessibility for Aid-1.
The assumptions that were discussed earlier in this chapter can be identified in examining the Aid-I robot development. The researchers assumed that high-level technology was a way of solving social needs and that they should play a leading role in seeking cutting-edge solutions (R-3) with little collaboration with end-users during the development process.

In the case of the development of an interactive face robot designed to display emotions, researchers have been keen to develop a state-of-the-art technology (R-3). This robot will, ‘recognise human facial expressions and mimic them … a charge-coupled device camera in the face robot’s eye records patterns of darkness and light on a human face, and matches them with a stored databank of expression’ (Stone: 1996, 182). Researchers have played a leading role in directing the development (R-2). Furthermore, the new technology is matched with a practical application that demonstrates the social relevance according to the research team (R-1).

My study revealed that Japanese researchers of high-level technology for aged care undertook their projects on the assumption that they understood societal needs. Moreover, the researchers also considered the needs of the end-users and concluded that users might find it easier to accept care from robots if the caregiving robots can express emotions and can interact with people, in particular the aged. Researchers seem to assume that society seeks technological answers to social issues. An article, ‘Future of a super power’ in New Scientist (Oct. 2 1993) describes the Japanese way of ‘looking for solutions where Japan has
always looked before—in technology' (pg.19). Although there is little evidence of researchers consulting with potential users during the process of developing the robot, professional advice regarding human facial expression was sought. It may be that the complex nature of the research inhibits collaboration with end-users until the later stages of the development.

6.5 Conclusion

This chapter focused on the assumptions underlying the development of robotics technology, as a prime example of high-level technology, for aged care in Japan. The study demonstrated that researchers are convinced that robotics offers technological answers to some of the aged care issues which are predicted to increasingly affect society as the aged proportion of its population continues to increase. Moreover, researchers usually believe that they understand social problems and can address them in their research without necessarily collaborating with the end-users. Although much of the technology for robotics is complex, it is possible that increasingly more people in Japan will seek to provide input in the development of technology that will personally affect their aged care. This is because people are beginning to understand and take an interest in the ways that robots as care-givers affect them.

In contrast to a high-level technology option, such as robotics, to address aged care, the next chapter will describe the development of smaller-scale
technology, such as barrier-free technology including universal design, a very different technology option for aged care, with the assumptions underlying this option presented in Chapter 8. The implications of adopting standard technologies (Option One), adopting high-level technologies (Option Two) and adopting smaller-scale technologies (Option Three) are addressed in Chapter 9.