Aging in China and its Impact on Vehicle Design

Chao Zhao
Bachelor of Arts
Master of Arts

School of Design
Faculty of Built Environment and Engineering
Queensland University of Technology

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Dedication

To the memory of my grandmother. She is the person who brought me up and gave me initial idea to respect knowledge.
Abstract

This study contributes to the growth of design knowledge in China, where vehicle design for the local, older user is in its initial developmental stages. Therefore, this research has explored the travel needs of older Chinese vehicle users in order to assist designers to better understand users’ current and future needs. A triangulation method consisting of interviews, logbook and co-discovery was used to collect multiple forms of data and so explore the research question. Grounded theory has been employed to analyze the research data.

This study found that users’ needs are reflected through various ‘meanings’ that they attach to vehicles – meanings that give a tangible expression to their experiences. This study identified six older-user need categories: (i) safety, (ii) utility, (iii) comfort, (iv) identity, (v) emotion and (vi) spirituality. The interrelationships among these six categories are seen as an interactive structure, rather than as a linear or hierarchical arrangement. Chinese cultural values, which are generated from particular local context and users’ social practice, will play a dynamic role in linking and shaping the travel needs of older vehicle users in the future. Moreover, this study structures the older-user needs model into three levels of meaning, to give guidance to vehicle design direction: (i) the practical meaning level, (ii) the social meaning level and (ii) the cultural meaning level.

This study suggests that a more comprehensive explanation exists if designers can identify the vehicle’s meaning and property associated with the fulfilled older users’ needs. However, these needs will vary, and must be related to particular technological, social, and cultural contexts. The significance of this study lies in its contributions to the body of knowledge in three areas: research methodology, theory and design. These theoretical contributions provide a series of methodological tools, models and approaches from a vehicle design perspective. These include a conditional/consequential matrix, a travel needs identification model, an older users’ travel-related needs framework, a user information structure model, and an Older-User-Need-Based vehicle design approach. These models suggest a basic framework
for the new design process which might assist in the design of new vehicles to fulfil the needs of future, aging Chinese generations. The models have the potential to be transferred to other design domains and different cultural contexts.
Keywords

Chinese culture
Context
Cultural meaning
Dynamic user needs structure
Future younger-old vehicle users
Integrated vehicle design approach
Older vehicle users
Practical meaning
Social meaning
Travel needs
Vehicle design
Vehicle meaning
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Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Chao Zhao
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1.1 Introduction

The World’s population is growing older. As in Europe, North America and Australia, Chinese older adults comprise the fastest growing segment of the population (United Nations 2001). At the same time, China has experienced tremendous growth in the number of motor vehicles in recent years (Committee on the Future of Personal Transport Vehicles in China, National Research Council, National Academy of Engineering and Chinese Academy of Engineering 2003). Therefore, over the next 30 years, the significant increase in the older population will place new and growing demands on transportation systems in China.

Mobility is critical to the wellbeing of older people. It is essential for maintaining attributes of personal choice and independence, familiar habits, and lifestyle. Mobile elderly are able to reduce personal isolation, participate in recreational activities, obtain goods and services, and remain active in a spiritual community. It is worth noting that although aging is accompanied by decline of strength, the needs of the elderly and disabled users are different (Donaghy, Poppelreuter and Rudinger 2005).

Designing for older populations becomes an important issue for the future. It is evident that ‘change in demographics brings with it important changes in the demands for products and services’ (Fisk, Rogers, Charness, Czaja and Sharit 2004, p. 3). Design is a crucial instrument for successfully meeting the above challenge. Through systematically design-oriented research and practice, not only can designers develop the age-friendly vehicle, environment, and services that are urgently needed,
they can also open up new commercial opportunities based on improving the quality of life of older people.

The primary motivation for this study is the desire to fill a knowledge gap about vehicle design for older vehicle users within the Chinese market. There is evidence that extensive research has been conducted into older drivers’ road safety and vehicle design issues in the Western countries (Burkhardt 2000; Coleman and Harrow 2000; Hakamies-Blomqvist, Siren and Davidse 2004; Herriotts 2005; OECD 2001); however, systematic data on the Chinese cultural framework are largely absent (Zhao, Popovic, Ferreira and Lu 2006). The purpose of this study is to explore the current travel activities of middle-aged and older vehicle users within the Chinese cultural framework and so predict the older vehicle-users’ future travel needs. It is envisaged that the theoretical travel needs model can be utilized to propose a new vehicle design approach – an approach that will help designers develop design concepts for vehicles suitable for the future, increasingly ageing Chinese population.

1.2 Research Problem

It is clear that the increasing number of older Chinese users demands new vehicle design to meet their particular travel needs. Although various older groups (e.g., pedestrians, public transport users and cyclists) are of interest for their role in the transport design research, the focus of this research is on the older Chinese drivers of the future (Sections 3.4, 4.3 and 4.4). Therefore, the terminology ‘older vehicle users’ in the current study refers to this particular target group. To explore this aging generation’s new travel needs, this study employs Fisk et al.’s (2004) concept to classify the older adults into two generation cohorts:

- Cohort 1: future younger-old vehicle users, ranging in age from approximately 60 to 75, who are the current middle-aged drivers (45-59 years old),
- Cohort 2: future older-old vehicle users, comprising those drivers beyond 75 years, who are currently younger-old drivers (60-75 years old).

It is worth noting that the target user groups of this study have been identified as the future younger-old vehicle users (Cohort 1). Compared with current older drivers,
current middle-aged drivers are the major driver population in China; these will potentially become the younger-old vehicle users, and compose a significant vehicle market segment in the next decade. Other groups (current middle-aged users, current older users, and future older-old users) are employed in this study as reference groups, for comparison during the data analysis. Figure 1.1 illustrates details of these study groups. In order to achieve valuable results through comparisons, two generation cohorts (current middle-aged and older users) involved in this study can be divided into four groups:

- Current middle-aged vehicle users
- Current older vehicle users
- Future younger-old vehicle users (current middle-aged users in the future)
- Future older-old vehicle user (current older users in the future).

Despite an increasing personal vehicle market and an increasingly older population in China, it is surprising that so little age-related vehicle design research has been conducted on the topic. Zhang, Huang, Roetting, Wang and Wei (2005) state that few research studies on Chinese drivers are available in either international or Chinese journals, and that these lack focus on vehicle users’ perspectives. In the design research community, a number of researchers have attempted to employ ergonomic design guidelines to drive vehicle design in ways that take account of the declining
age-related capabilities of older vehicle users. However, very few studies focus on how designers translate ergonomic guidelines to integrate a vehicle design approach with respect to older users’ needs (Steinfeld and Steinfeld 2001).

Designers realize the need for fresh thinking about design – new approaches to the subject, new strategies for practice, and new research methods that could help them better understand and respond to the needs of increasingly older users. It is worth noting that the emphasis in the development of the products began to shift away from the harder, technical and functional performance factors towards the softer, more human aspects of emotional engagement, lifestyle and aspirations (Coleman, Lebbon, Clarkson and Keates 2003). Moreover, most design-oriented research on older users tends to focus on older people in physiological isolation, rather than within the context of their social and cultural activities (Huppert 2003).

In addition, because users are less predictable in how they are living their lives, organizations have a decreased knowledge of how people live and what new things they truly need (Whitney 2002). This creates a gap in which company executives are less sure about what to make. Western companies that are strong in their local market are paying a great deal of attention to the growing number of older people with expendable income in developing regions such as China, where the cultures are very different from those in the West (Committee on the Future of Personal Transport Vehicles in China et al. 2003; Kumar and Whitney 2003). When exploring the solution for mobility of future elderly Chinese vehicle users, designers have to realize that different countries have different steering cultures, values, needs, and institutions. That leads to differences in how counties try to solve transport problems, depending on variations in social and cultural needs.

The literature reviews demonstrate that vehicle designers need frameworks for making transitions from the theoretical understanding of older vehicle users, to design implementation. Such frameworks incorporate models of older users’ needs – technologically, socially and culturally. Therefore, it is necessary to integrate considerations of the above problems and explore the valuable design approaches and solutions to fulfil older vehicle-users’ needs within the Chinese social and cultural frameworks.
Figure 1.2 identifies this research gap by reviewing the major literature related to understanding older vehicle users (Chapters 2, 3, 4 and 5). The two reference systems illustrate seven research directions that help to locate the relevant literature. The axes in map A indicate three dimensions related to older-vehicle-user research. The most relevant studies can be located in their proper place with respect to the physiological, social, and cultural dimensions (Chapter 2), based on their research contribution (a green circle indicates that the literature has no vehicle design content; an orange circle indicates that the literature includes vehicle design content). A huge gap appears in the social and cultural dimension of age-related changes (dotted orange line), especially for vehicle design research on older drivers. Notably, there are no relevant studies to link the three dimensions holistically from a vehicle design point of view (the central part, which is the overlap of the three circles). Map B helps to identify the detail of the research direction, by locating the vehicle-design-related literature on four axes. These axes illustrate the main directions of design-related
research: ergonomic design versus integrated design approaches on the horizontal axis, and Eastern culture studies versus Western culture studies on the vertical axis. By summarizing and reviewing the design-related literature, all of these studies can be located in their proper places with respect to the axes, based on their research content and contribution (different circle sizes show different degrees of research contributions). The huge gap located in the upper-right sector of Map B lies between the integrated design approach and Eastern (especially Chinese) culture. If a link is envisaged between these two, the research problem becomes clear. Therefore, from a user-centred design perspective, many questions need to be answered about developing an integrated theoretical design approach to assist vehicle design innovations for the older Chinese users.

1.3 Research Question

The inquiry of this study is: How do the future younger-old vehicle-users’ travel needs affect vehicle design in Chinese culture? This question has been broken down into the following six sub-questions that lead this study.

- What are the factors influencing the needs of older Chinese vehicle users?
- How do personal vehicles come to signify particular meaning for older Chinese users?
- How do these different factors interact to determine the vehicle related travel needs?
- What are the possible needs of the future younger-old vehicle users in China?
- What are the relationships among the different types of older users’ travel needs?
- How do the designers implement the future younger-old users’ needs into an integrated vehicle design approach?

1.4 Research Aim and Research Objectives

The problems related to research on the future Chinese younger-old population’s travel needs and travel patterns from a vehicle-design perspective lead to the design of the study’s research aims and objectives.
• To research the travel needs and patterns of current middle-aged and old Chinese vehicle users in China;
• To reveal a dimensional character of the meaning attached to old vehicle-users’ vehicles, as related to design innovations in China;
• To identify aspects of the older vehicle-users’ profile, comprising vehicle meaning, involvement with users’ needs;
• To develop a theoretical travel needs model that can assist vehicle designers to forecast future younger-old Chinese vehicle-users’ travel needs;
• To suggest design approaches which can assist vehicle designers to design new personal vehicles to meet the new aging Chinese population’s travel needs.

1.5 Scope of the Study

Different researchers have recommended possible ways to meet older drivers’ travel demands with respect to older drivers in Western countries. The literature review (Chapters 2, 3, and 4) demonstrated that the foci of this research have been on restrictive policies, road design standards and training programs from the age-related physiological decline perspective. The available evidence showed that this research and its outcome cannot contribute very much in providing new knowledge for automotive designers to assist them to design a concept vehicle that would satisfy older vehicle-users’ needs within the Chinese culture.

In addition, from a design point of view, the initial theoretical concept encompasses three areas (vehicle design, design for aging, and design for local culture and markets), in which three research dimensions emerged (physiological, social and cultural) (Figure 1.3). Although there are a number of research projects that focus on linking any two of these areas from a particular dimension, studies combining three such separated fields are little explored. Figure 1.3 illustrates the point that bridging any two research areas can inspire a series of research topics. For example, where researchers have linked the vehicle design and design-for-aging areas from the physiological dimension, their studies have explored the topics or perspectives such
as ergonomics design guidelines for vehicle interior design. However, the orange highlighted central area of the diagram represents the research domain gap. Therefore, this study attempts to fill this knowledge gap, not only from physiological, but also from social and cultural perspectives.

Figure 1.3: Scope of the study

The main outcome of this research consists of a theoretical model that supports designers in obtaining new knowledge about future younger-old Chinese vehicle users’ travel needs. From the user-centred design perspective, such a travel-needs model is integrated into a theoretical design approach. It introduces a methodological approach that can help designers to improve vehicle usability, accessibility and culturability (Barber and Badre 1998) in reference to the future younger-old Chinese vehicle users.

1.6 Structure of the Thesis

The early chapters (Chapters 2 to 5) in this thesis introduce the background information to this study as well as identifying the knowledge gap in the vehicle design for older Chinese users. Chapter 2 explores the older vehicle-users’ age-related changes from physiological, social and cultural dimensions. The knowledge of physiological age-related changes can only contribute to improving the measures to meet the safety needs of the older drivers. Social and cultural differences play
important roles in shaping the older vehicle-users’ needs that require further study. Chapter 3 examines the older vehicle users in the Chinese cultural context. The growth in numbers of older Chinese vehicle users is dramatic, based on the large aging population and booming automobile market. However, Chinese designers are still given little opportunity to contribute to their designs. This chapter also reveals that traditional cultural values still play an important role in contemporary Chinese society, in shaping the new aging population’s needs. Chapter 4 systematically analyses earlier design approaches for older adult and vehicle design issues. This chapter calls for developing a new theoretical design approach to meet the future aging generation’s travel needs, instead of continuing with traditional design guidelines. Chapter 5 links the human needs theories and product meanings. This chapter provides the theoretical framework for exploring the research questions.

Chapter 6 to Chapter 8 focus on the state of empirical research work. Chapter 6 presents important issues about research methods and techniques. The research design aims to identify the key factors that influence the needs of older Chinese vehicle users, and establish a theoretical travel-needs model for future older Chinese vehicle users. A methodological triangulation approach consisting of interviews, logbook and co-discovery helped to collect multiple forms of visual and textual data to explore the research question. Chapter 7 analyses how visual and textual data were interpreted using the developed coding framework. The interpretation is based on two areas: (a) identification of travel-needs-influencing factors that affect design, and (b) how these factors were interrelated to shape older users’ travel needs. Chapter 8 focuses on the main findings of the research. There are six core travel-related users’ needs that have been identified through integrated needs-influencing factors. Such a vehicle-users’ needs framework presents a dynamic structure to drive the design innovation within the local context. The last two chapters developed contribution to the state of knowledge and understanding of the topic. Chapter 9 discusses and compares the research findings with existing studies. An integrated vehicle design approach has been developed with reference to the older vehicle-users’ needs model. This approach might (a) assist designers to design personal transport for the older Chinese vehicle users and (b) inspire similar effort of developing culturally and socially appropriate products. Chapter 10 concludes the thesis by outlining the study’s contribution to knowledge and, finally, proposing future research topics that
have emerged from the study. A diagram (Figure 1.4) was generated to depict chapter links, progression of work and integration of the research areas; this will be referred to throughout the thesis.

Figure 1.4: Thesis structure and chapter links

1.7 Summary

China has a very large population base on which aging will occur. On the other hand, China has one of the fastest-growing fleets of automobiles in the world. The number of older personal-vehicle owners is increasing dramatically in Chinese urban areas. Therefore, the significant increase in the older population will place new and growing demands on transport systems in China in the future. In this context, vehicle designers need frameworks for making transitions from theoretical understanding of older vehicle users to design implementation. The aim of this study is to explore the travel needs of older Chinese vehicle users, and to develop a theoretical design approach to assist vehicle design innovation with reference to future older Chinese vehicle-users’ needs. The next chapter attempts to understand the older drivers.
Chapter 2:

Older Vehicle Users

2.1 Introduction

Fisk et al. (2004) defined older adults as those individuals who are 60 years of age and older. According to Hakamies-Blomqvist, Siren and Davidse (2004), the old adulthood can be divided into a ‘third’ and a ‘fourth’ age, where the third age (younger-old people) refers to the active, independent and healthy period of life after retirement (ranging from approximately 60 to 75 years old), and the fourth age (older-old people) to that associated with developing disabilities and increasing dependency on other people. It is clear that all of above definitions are non-specific to race, gender, region and culture.

Some researchers recognise that this third age (or younger-old adult) is a phase of enjoyment, individual fulfilment and activity (Boess, Durling, Lebbon and Maggs 2002; Laslett 1989; Meyer 2004). A condition for this is the ability to move easily from place to place; that is, the ready availability of means of transportation. For current industrialized society, the loss of the right to drive creates a crisis in the older adult’s life; that it does create a crisis supports the proposition that quality of life and personal transportation are closely related (Burkhardt 2000). Combined with increased aging in the world (United Nations 2001), older drivers (particular third age drivers) are the most rapidly growing segment of the population (Bittner, Long and Szylow 2000; Hakamies-Blomqvist, Siren and Davidse 2004; Maycock 1997; OECD 2001; Rothe 1990; Suchorzewski 2005). However, older drivers are defined as a social exclusion group by some researchers (Donaghy, Poppelreuter and Rudinger 2005) due to the age-related changes. Therefore, it is necessary to establish
a consistent definition of social exclusion (older drivers) and its relationship with mobility needs as accommodated by transport systems.

The literature shows that understanding older vehicle users and their age-related changes could be viewed in three dimensions: physiological, social and cultural (Figure 1.2, p. 5). Based on such a framework, this chapter reviews the relevant literature on the older vehicle users, particularly on elderly drivers; examines current trends in mobility behaviour; identifies the extent and limits of current understanding of travel activity of elderly vehicle users; and identifies issues warranting further exploration.

2.2 Physiological Dimension of Age-related Changes

There have been many research projects conducted to study older drivers’ age-related changes and improve road safety issues from a physiological perspective. Some researchers (Anstey, Wood, Lord and Walker 2005; Fozard 2000; Hakamies-Blomqvist, Siren and Davidse 2004) reviewed older drivers and identified three interconnected areas of deficiencies: (i) sensory, (ii) cognition and (iii) motion. According to the above research, these areas are related to three facts about aging:

1. Speed of behaviour becomes slower at older ages.
2. The interrelationships among elements of sensory and cognitive performance increase with older age.
3. With older age, skilled performance requires relatively more sensory information from the environment than is the case in younger persons.

Safe driving for the older vehicle users involves adequate sensory, cognitive and motor functions to ensure the correct responses are made within adequate time (Anstey et al. 2005). It is worth noting that these age-related changes might be variable, based on changes of environment. Fozard (2000) points out that aging is a very individual matter, and that intrinsic variability in aging resulting from genetic influences are amplified by environmental factors, lifestyle variations, and variability in manmade environments. For his study, the importance of age differences in reserve capacity for design or engineering applications needs to be critically
evaluated on a case-by-case basis. However, most studies (Anstey et al. 2005; Fozard 2000; Hakamies-Blomqvist, Siren and Davidse 2004; Keates and Clarkson 2003) looked at older adults as a general cohort to examine their sensory, cognitive and physical changes regardless of social and cultural differences. The reason is that from the physiological and biological perspectives, human beings have common sensor, cognition and motion capabilities, and most older people might experience homogeneous age-related changes.

Burkhardt (2000) found that younger-old people leave their houses each day for trips more frequently than those who are older. Persons in their sixties most frequently travel by their own car, but their reliance on personal cars decreases dramatically with increasing age (Burkhardt 2000) because they believe that physical illness, medication, and sensory and cognitive decline might impact on their ability to drive safely (Anstey et al. 2005; Persson 1993). However, other research, conducted by Meyer (2004), indicated that although most drivers suffered from two or more chronic diseases, relatively healthy elderly people continue to drive for as long as possible. People who are 65 years and older use a car for 80 per cent of their errands and trips (Meyer 2004) and older persons often wished to do more everyday trips if it was practically feasible (Hakamies-Blomqvist, Siren and Davidse 2004). The absence of a private car is responsible for inferior mobility and poor life quality, and giving up driving is a risk factor in terms of the older person’s depression and isolation (Kasper and Scheiner 2005). Therefore, the private car plays a major role in the mobility and quality of life for the aging population.

2.2.1 Sensory Factors

Driving is a continuous control task that is largely guided by visual information. Hakamies-Blomqvist, Siren and Davidse (2004) claimed that visual function in a driving context refers to visual acuity, vulnerability to glare and contrast sensitivity. In their paper, they rely on the improvement of lighting conditions on the road design to solve these problems that older drivers may experience. When comparing younger and older adults, Fozard (2000) stated that responses to the questions relating visual problems to driving indicated that older age was associated with increased endorsements to statements in several areas: (a) unexpected vehicles — merging
traffic and cars entering the field of view, (b) vehicle speed — judging one’s own speed and other vehicles moving rapidly, (c) dim display — difficulty focusing on an instrument panel, (d) windshield problems — seeing in glare and seeing past haze on the windshield and (e) sign reading — reading street signs. He indicated some appropriate environmental interventions, which include larger and simpler lettering on signs, improved headlight design, better contrast and size of road markings, and improved lighting of vehicle interiors and display panels.

2.2.2 Cognition

Cognitive abilities of older drivers have consistent associations with driving safety, including reaction time and speed of processing, short-term memory and executive function (Anstey et al. 2005; McKnight and McKnight 1999). The effects of aging on attention are complex. According to Fozard (2000), personal mobility and driving require processing of information from the environment and retrieval of information from memory. However, the rate of retrieving information decreases with age. Meyer (2004) divided the driving-related attention skills into three parts: focused attention, divided attention and attention control. Hakamies-Blomqvist, Siren and Davidse (2004) claimed that attention is highly relevant for the issue of aging and driving, and these might partly explain the problems older drivers experience at intersections and in other complex traffic situations.

Although Fozard (2000) concluded that compensation for age-related slowing in sensory and cognitive processes requires task redesign and ergonomic interventions, he still insisted that skill training and physical training could significantly improve some skills involved in personal mobility and driving. Nevertheless, if learning a concept or rule is relatively harder for older persons when the materials are arbitrary or abstract than when they are familiar (Fozard 2000), the skill and physical training might be inefficient for improving older drivers’ capacity.

2.2.3 Motion

Other factors that may impair driving ability as a result of aging or age-related disease include (i) reductions in grip and muscle strength and endurance, (ii) flexibility and (iii) motor speed (Anstey et al. 2005). For instance, reduced neck
rotation may impair the ability of the older drivers to turn the head to see stimuli in the complex traffic situations. This sort of age-related change is also partly due to cognitive changes that have the same origin as changes in attention and reaction times (Anstey et al. 2005; Hakamies-Blomqvist, Siren and Davidse 2004).

In addition, the effects of most common age-related illnesses such as arthritis, heart disease, arterial hypertension and diabetes may be superimposed on the decline of motor capability. Hakamies-Blomqvist, Siren and Davidse (2004) state that heart diseases pose certain risks for traffic safety; patients with diabetes do not have an elevated risk for traffic accidents unless the disease is severe; dementias cause impairments in cognitive abilities and judgement skills that will lead to driving difficulties.

### 2.2.4 Older Drivers’ Accidents

OECD (2001) suggested that older drivers’ accident patterns reflected both their strengths and their weaknesses; when involved in serious accidents, they were more likely to be killed or injured themselves than to cause others to be killed or injured, both because of their greater physical frailty and because of the typical accident patterns. Older drivers have a smaller share of single-vehicle and speed-related accidents comparing with young drivers. This reflects their slow, conservative and cautious driving style: they drive more slowly, prefer longer time gaps for merging at intersections and avoid simultaneous activities such as smoking or adjusting radio controls while driving (OECD 2001). Moreover, the older drivers often avoid driving under stressful conditions such as darkness, wet roads, rush hours and under other stress-inducing situations (Carr, Duchek and Morris 2000; OECD 2001). These changes have been interpreted to reflect both their mature judgement and their behavioural adaptation to age-related changes in certain performance areas. In addition, OECD (2001) predicts that older drivers’ accidents will grow during the next few decades. They suggest that future trends in accident rates may present a discontinuous development because of differences among different cohorts of older drivers. The accident characteristics that are typical of older drivers are likely to emerge as younger cohorts age (Hakamies-Blomqvist, Siren and Davidse 2004).
2.2.5 Measures for Improving Older Drivers’ Abilities

Based on above research findings on age-related physiological changes, some researchers have recommended possible ways to improve safety with respect to older drivers. These include supportive actions, restrictive policies and infrastructure design. Firstly, current safety measures targeted at older drivers include older driver training and re-training, and rehabilitation of drivers whose driving ability has decreased due to health-related deficits (Hakamies-Blomqvist, Siren and Davidse 2004). However, these courses and programmes are still evolving and there are no published systematic evaluations. Moreover, the training programmes for older users might be inefficient due to the declining memories of these users. Secondly, the most commonly discussed safety measure related to older drivers has been the restriction of driving. However, age-related screening is based on the erroneous idea of older drivers as a high-risk group (Hakamies-Blomqvist, Siren and Davidse 2004; OECD 2001). Thirdly, some research projects (Bittner, Long and Szylow 2000; Hakamies-Blomqvist, Siren and Davidse 2004; OECD 2001) suggest changing infrastructure design to better meet older people’s safe mobility needs. They state that the road infrastructure improvements made specifically to accommodate older users will benefit all age groups. For this purpose, three specific areas require analysis: traffic control devices; geometric design; and intelligent vehicle highway systems (Bittner, Long and Szylow 2000).

It is important to note that beyond the above measures, the safety and mobility of older drivers can be enhanced by using modern technology to improve vehicle design (OECD 2001). Farber (2003) calls for redesigning automobiles to provide a better fit for older vehicle-users’ capabilities. However, there is a paucity of published data on the topic of vehicle design ergonomics (Herriotts 2005). Section 4.3 presents a review of literature on vehicle design, as this is the focus of this study.

2.3 Social Dimension of Age-related Changes

The aging process can be defined as ‘not only a physiological process in which biological systems undergo changes, but it is also a social process in which a person changes involvement in activities and obligations’ (Meyer 2004, p. 256). At the same time, the relation between mobility and quality of life is complex (OECD 2001), not
only spatially but also socially, demographically and economically diverse (Rees and Lyth 2004). Transport has a clear social function, and satisfies particular social-psychological desires. Changes in transport affect changes in society and social change in turn begets changes in transport activity (Donaghy, Poppelreuter and Rudinger 2005). The relevant literature demonstrates that linkage between older people and their mobility needs within the social dimension is not well understood.

Some researchers (Hakamies-Blomqvist, Siren and Davidse 2004; OECD 2001; Pickup and Giuliano 2005) note that car dependency can contribute to social exclusion for the aging population. Older people must use a car to go shopping, to access medical services, to attend social functions and to visit friends and family (Rosenbloom 1993). Moreover, empirical studies show that classical stratum variables (income, professional status) have become less important than age and education (Scheiner and Kasper 2005) in affecting older-users’ travel needs. It is important to note that although physiological exclusion presents as a universal characteristic in elderly vehicle users who live in the different countries (Section 2.2), the nature and pattern of social exclusion are quite different across countries and cohorts. In this context, understanding the differences of lifestyle and cohort in older vehicle users is required.

2.3.1 Lifestyle Differences

Different lifestyle groups are characterised by particular forms of mobility. The age variable is the most important predictor for a thorough examination of the influence of lifestyle on mobility (Scheiner and Kasper 2005). The literature demonstrates that aging has the potential to influence lifestyle in countless ways. Economic wherewithal, group memberships, activities, and environments are all vulnerable to change with age. In contrast, aging brings certain freedoms from social restraints that could alter lifestyle more toward a person’s values (Atchley and Barusch 2004).

Social roles change or are in transition with increasing age; for example from parent to grandparent, from employee to retiree, and from married person to widower. Hakamies-Blomqvist, Siren and Davidse (2004) state that the relationship to one’s social context also changes, which may trigger changes in attitudes and values and
these changes have direct effects on travel needs. For instance, older vehicle users need not to drive daily without considering the traffic and weather conditions because they cease to commute regularly after they retire from work (Meyer 2004). Burkhardt (2000) studied the interaction between travel frequency and travel mode of an aging US population. He points out that older persons try to compensate for not driving by utilizing several modes of transportation such as obtaining rides from family members and friends, using public transport, taking taxis and walking. According to Burkhardt (2000), older people whose usual means of travel is their own car, travel more often by any relevant measure of travel frequency. Persons who used public transportation or those who walked made the next most trips; persons who relied on relatives, friends and neighbours, and taxis more often took only one trip or did not travel at all.

Scheiner and Kasper (2005) stated that mobility research still focused on travel-mode choice, and the multiple variables of lifestyles in older people’s mobility research were unclear. Scheiner and Kasper therefore employed the interview method to investigate relationships between lifestyle and residential mobility. Their research concludes that the value of the concept of lifestyles for transport research lies in differentiation of social structures by subjective patterns of explanation, the aim of an activity, leisure preference, value orientation and cultural affiliations. They emphasize that their mobility research translated the concept of lifestyle into ‘mobility style’, and that the people’s mobility style is embedded in the social and spatial context. In addition, to exploring the vehicle users’ travel needs from a lifestyle perspective, the current trend of research has shifted from a trip-based to an activity-based approach. Compared with the trip-based approach, an activity-based approach analyzes travel in terms of daily or multi-day patterns of activity, which relate to and derive from differences in lifestyles among the population (Kitamura 1998). In the activity-based approach, motives and needs drive decisions made under constraints, which lead to response-based driving behaviour and travel demands over space and time (Stern and Richardson 2005). It is clear that this framework involves a richer, more holistic context factors.

It is important to note that the lifestyles of aging populations will become increasingly dependent on cars as they take longer journeys to enjoy leisure travel
Leisure lifestyle will become one of the crucial components of future life. In terms of car dependency of new aging generations, leisure will constitute one of the fastest-growing sectors of car-based travel needs. Regarding leisure mobility, a significant differentiation can be seen between different groups of elderly people for their chances of access to leisure options, and for leisure aspirations (Kasper and Scheiner 2005). Anable (2002) claims that leisure lifestyle is an expression of identity, personal values, and attitudes. Therefore, Geenhuizen, Nijkamp and Black (2002) identify that an equally unexplored field is the appeal of automobiles beyond merely utilitarian transport purposes.

Concerning this research gap, some research projects have been conducted to explore the positive aspects of driving for older people. These involve not only enjoyable activities, but also the ability to help others (Horowitz, Boerner and Reinhardt 2002), social status (Rothe 1990), ease of carrying packages, comfort, protection from bad weather, and door-to-door transportation (Gardezi, Wilson, Man-Son-Hing, Marshall, Molnar, Dobbs and Tuokko 2006). For elderly people, ‘comfort’ proved to be the most important criterion for the travel mode choice for the leisure lifestyle (Kasper and Scheiner 2005). Therefore, Burkhardt (2000) reports that persons who are used to a high level of mobility and the psychological rewards offered by driving may find it more difficult to adapt to life without a car than are those who have never been drivers. Moreover, the increase in active future older drivers is likely to change the older persons’ driving and travel habits, so that they will become more like those of the middle-aged (Hakamies-Blomqvist, Siren and Davidse 2004). If this principle is imported into the Chinese social framework, the future Chinese older generation who are used to travelling by driving in their middle-age will also need the independence provided by a private car.

### 2.3.2 Gender Differences

The literature shows that gender differences in travel habits emerged among all age groups. The studies conducted in Western countries (Hakamies-Blomqvist, Siren and Davidse 2004; Herriotts 2005; Maycock 1997) indicate that in the population aged 75 and above, women travel less than men, and also hold fewer driver licenses than men do. They also predict that these differences in driving might be cohort-related.
and will disappear as new generations reach older age, because the increase in the proportion of women drivers in all age groups, coupled with the increase in the elderly population as a whole, means that there will be a much larger number of elderly drivers in the future.

Siren and Hakamies-Blomqvist (2005) used a qualitative approach to examine the personal meanings that older women attach to cars and driving. In their study, a life-course perspective and feminist theorizing on marginalisation influenced the analysis. According to Siren and Hakamies-Blomqvist, gender differences in driving and travel patterns can be viewed as constructed by the gender regime and different gender conventions of everyday life. They claimed that because traffic research rarely approaches travel behaviour from a social constructionism perspective, these aspects have mostly remained unreachable in the previous research.

2.3.3 Cohort Differences

The cohort can be defined as a group of people in the same age bracket who have broadly experienced the same social and economic events that have an effect on their life choices (Rees and Lyth 2004). Meyer (2004) reported that drivers from different cohorts grew up in different cultural, social, and technological environments.

Cutler and Hendricks (2001) claimed that tomorrow’s older persons will be different from today’s. The meaning of old age will be different, too, as successive cohorts have distinct experiences, reaching old age in different social and cultural contexts. The future older generations will alter social structures and the meanings that accrete to various age categories. In addition, OECD (2001) indicates that today’s older people represent a heterogeneous group in terms of health conditions, travel needs and preferences for mode of travel. Future cohorts may well present different patterns in this respect. The future generations may defer retirement and continue salaried work over the next decades, become more active in their leisure time and be more capable of driving without problems. The differences between the current and future travel patterns of older people will arise from three sources: the age effect, which is related to the aging process; the cohort effect, which is related to each
generation’s experiences; and the period effect, a set of influences common to all generations at a given time (OECD 2001).

This idea was supported by Burkhardt (2000). He predicts that the future older generations will prefer to live and age in their own community rather than in an institutional setting; as drivers, these people will travel more miles than before, due to changes to lifestyle, patterns of residential development and driving behaviour. Even if favourable images of old age erode negative stereotypes and ageism becomes less rampant, large numbers of older persons will still not identify themselves as ‘old’ (Cutler and Hendricks 2001). The lifestyle differences (Section 2.3.1) are associated with cohort differences. According to Kasper and Scheiner (2005), the increasing differentiation of needs and activity patterns that goes along with the individualisation of lifestyles will be only partly altered by age because of cohort specific elements.

According to Rees and Lyth (2004), if knowledge of aging and transport is based on previous and current cohorts of the aged, then many of the assumptions about future cohorts and their likely travel behaviour and car use may be flawed. It is clear that such research will face the problem of having few focus cohorts to study. Therefore, how to design research methodology to investigate the future cohorts’ demands is a challenging task for researchers. Although Rees and Lyth (2004) give some examples on this issue, it is hard to evaluate and justify whether they are efficient. To explore similar questions, Giarrusso, Mabry and Bengtson (2001) suggest that there is a reciprocal relationship between life-course experiences and subjective states. Subjective states are influenced not only by the contemporaneous environment but also by early life-course experiences (George, 1996 cited in Giarrusso, Mabry and Bengtson 2001). This demonstrates that the future Chinese older generation’s travel needs might be affected by their early life-course (middle age) experiences such as driving the private car.

2.4 Cultural Dimension of Age-related Changes

Currently, people’s views on aging populations are strongly related to cultural variables (Atchley and Barusch 2004). Culture is a way of life handed down from
generation to generation, and influences people’s habitual ways of meeting their needs, their traditions and social environments. Culture provides the context within which an aging population’s life is lived at a particular time and place. Clark and Anderson (1967) claim that changed cultural value orientations promote successful aging and mental health. Fry (1999) states that aging and growing old are experienced in a specific cultural context, which is not necessarily transferrable across countries. To understand age is to interpret phenomena of change over time and the rhythms of the normal life course. Interpretations of such changes involve culture (Fry 1999). Therefore, the cultural dimension remains central to understanding older vehicle users’ experience.

2.4.1 Cultural Image and Value

The older vehicle users who have uniqueness of demand due to age-related physiological and social differences (Sections 2.2 and 2.3) will define car usages as particular cultural images and meanings. However, Siren and Hakamies-Blomqvist (2005) state that masculinity, youthfulness, speed, status and power are deeply embedded in the traditional cultural images of cars and driving. It is clear that cultural imagery of cars and driving has invariably excluded older people. For the older vehicle users, cars and driving were presented as mere practical tools for care taking (Siren and Hakamies-Blomqvist 2005). Moreover, retaining a driver’s license and continuing driving in old age represented a significant way to ward off an ‘old age identity’, and driving symbolised for older users a positive and vital status. Therefore, the culture surrounding the automobile, with its suggestion of freedom, autonomy and heightened self-esteem, fostered psycho-social car dependence (Gorham 2002; Sheller and Urry 2000) for the older vehicle users. Driving is a culturally bound procedure, around which manoeuvres, forms of etiquette and gestures of annoyance, for instance, are ‘proper’ in particular cultural contexts (Edensor 2004).

Cultural values influence older vehicle users not only to adapt their roles, relationships, group membership and activities, but also to choose a more meaningful lifestyle in later life. The values served by elderly lifestyle are determined in part by cultural and subcultural tradition and in part by personal experience (Atchley and
Barusch 2004). For example, Atchley and Barusch (2004) state that older people are significantly more likely to espouse humanist and collectivist cultural values comparing with middle-aged and young adults. This suggests that period effects are operating to change cultural values over time, while cohort effects (Section 2.3.3) maintain generational differences. On the other hand, Rees and Lyth (2004) define the motor vehicle as an essential tool to better manage daily lives, providing mobility, convenience and flexibility needed to survive and thrive in the contemporary culture. When translating these cultural values to the context of car use for the future aging population, Sheller and Urry (2000) referred to the motor vehicle as a democratising force, in that it has presented new freedoms, expanded choices, and greater empowerment.

2.4.2 Cultural Identity

Edensor (2004) points out that cultural identity is partly constituted out of the habitual performances of everyday life and the development of these mass routines may be inflected by class, ethnicity and gender as well as by nationality. However, his analysis ignores the demography (age) and lifestyle which are significant factors in social, cultural and design research (Riley 2002). Despite the disembedding effects of globalization and worldwide serialization of corporate outlets, Edensor (2004) states that most people live in recognizable worlds, distinguished by distinct material structures in which objects are distributed and institutional arrangements are embedded in familiar ways. He insists that familiar features constitute a sense of being in place in most motorized landscapes, since institutions, vernacular features and everyday fixtures embedded in local contexts also recur throughout the culture. From this point, older persons living in different cities/countries will experience different local contexts, which lead to their unique travel behaviour and which identify their relevant nationality status. As a result, product design and manufacture might realize the localization of product planning strategies in order to meet the local users’ demands. However, the fact is that users living in China may use the same Volkswagen or BMW designed by multinational carmakers as those living in Australia, due to the automobile industry’s global influence (Pullin 1998).
It is important to note that through the study of older people’s travel patterns in Western countries, OECD (2001) identified the future research direction from social and cultural perspectives. According to OECD, more research is needed in terms of the relation between quality of life, welfare and health costs, and mobility among older people in different countries. Comprehensive cross-country cohort studies are needed of travel patterns, preferences for retirement housing and activities in order to improve knowledge of the new aging population in different social and cultural contexts. Studies also need to be undertaken of mobility solutions (public and private) reached in different countries for older road users. Stern and Richardson (2005) also support such ideas, and claim that only cultural norms and value differences lead to travel pattern differences, because human physiological mechanisms of travel behaviour and decision making are universal (Section 2.2). Therefore, the study of older vehicle users’ travel needs from a social and cultural perspective opens the opportunity for future exploration.

2.5 Summary

Older vehicle users require the support of adaptations, because aging causes various physiological, social, and cultural changes. The current research shows that physiological factors play an important role in affecting road safety issues related to older drivers. The members of an aging population often wish to do more everyday trips if it is practically feasible. Driving is found to be safe compared to other modes of transportation for older persons. It is worth noting that automotive travel is a hard habit to break because of the nearly unfettered mobility it offers and because of the psychological and symbolic rewards that have been associated with it.

The research conducted in the physiological dimension of age-related changes only has implications at a universal population level, regardless of the impact from social and cultural differences. Moreover, investigations of driver competence and crash risks in older drivers have often lacked a multidisciplinary framework that incorporates physiological factors and vehicle design solutions. It is important to note that knowledge of physiological age-related changes can only contribute to improving the measures to fulfil the safety needs of older drivers. The literature cannot fill the knowledge gap about social exclusion (older vehicle users) because it
ignores the fact that older users firstly are normal human beings, and have multiple needs related to vehicle usage.

In addition, a number of research projects have focused on the issues of older driver population and homogeneity of travel patterns. However, the fact is that drivers from different age groups belong to different generations. These generations grew up in different cultural, social, and technological environments. More research is needed in terms of the relation between quality of life and mobility among older people in different countries. Within this context, and the identification of research gaps, the next chapter focuses on understanding older vehicle users in the Chinese cultural framework. This review of the relevant literature is based on the understanding that the increase in the older Chinese vehicle users will place new demands on transportation systems due to rapid growth of aging populations and the automobile market in the Chinese society.
Chapter 3:  

*Older Vehicle Users in the Chinese Culture*

3.1 Introduction  

With one fifth of the world’s population, China is the second-largest automobile market in the world in terms of the number of vehicle users. Its rapidly growing economy, rising consumer income, large number of aging populations and particular socio-cultural context present automobile manufacturers with enormous market potentials. It is important to note that the original Western or Japanese designed vehicles need to be redesigned or changed for the Chinese market. The optional design changes needed to adapt to local market factors, especially to local older users’ needs, are more difficult to make because the required information is not available. Therefore, it is necessary to study older vehicle users’ experience within the particular cultural context. During the past five years, social and behavioural scientists have paid more attention to aging research through systematic perspectives such as anthropology, social psychology, economics, and sociology (Binstock and George 2001). In this context, this chapter reviews the relevant literature and associated automobile market, aging population, and older vehicle users within the Chinese cultural value framework.

3.2 Rapid Motorization in China  

China has one of the fastest-growing fleets of automobiles in the world. The number of private car owners is increasing dramatically in Chinese urban areas (Committee on the Future of Personal Transport Vehicles in China et al. 2003). On the other hand, the car industry has also been an enduring signifier of national economic virility and modernity (Edensor 2004).
3.2.1 Industry Structure and Product Planning

The Chinese economy currently pins its hopes on the automobile industry. In 1991 the Chinese government published its five-year plan (1991–1995), which designated the automotive industry as a ‘pillar industry’ that would drive the economy in the twenty-first century (Committee on the Future of Personal Transport Vehicles in China et al. 2003). This policy was first formulated in 1987 and modified in 1994, with emphasis on three points: to shift the product mix of the industry from commercial vehicles to passenger cars; to boost economies of scale by restructuring the industry from a situation of fragmentation and miniaturization towards concentration; and to seek technology transfer by inviting the participation of foreign companies (Zhao 2005).

The competition in China’s automobile industry is from both domestic and foreign firms. Zhao (2005) reports that in China, there are more than 130 car factories, supplied by more than 3000 companies delivering parts, an industry covering almost as much as that of the United States, Europe, and Japan together; however, the internal production remains well below that of any of these big producer countries. The government therefore has designated seven national automotive firms as the ‘key firms’ to challenge the foreign ones. Furthermore, most of world’s major automobile manufacturers, such as General Motors, Toyota, Ford, Volkswagen, DaimlerChrysler, Nissan-Renault, PSA Peugeot Citroen, Honda and BMW, have established joint ventures in China. It is important to note that these joint ventures control about 90 per cent of China’s personal car market. Moreover, the industry must adjust to the effects of China’s membership in the World Trade Organization (WTO), which will allow independent foreign automobile manufacturers and importers into China for the first time, and may open the domestic market to an increased volume of imports that would challenge even the joint ventures in the Chinese market. It is clear that the Chinese automotive industry faces significant challenges in achieving independence (Committee on the Future of Personal Transport Vehicles in China et al. 2003).

In order to solve above problems, a decision support system (DSS) for automotive product marketing, design and manufacturing in China is presented in the study of
Guo, Wei, Li and Wang (2000). Based on a case study of the Chinese automotive industry, Guo et al. (2000) claim that issues such as balancing the trade-off on labour and automation, local content regulation and amount of design changes to meet local needs have to be carefully dealt with before major investments are committed. However, probably due to their lack of relevant design knowledge and background, the authors touch only lightly on design issues in their research. This contradicts their research purpose. Instead, they focus on competitive market vectors such as cost, technical features, quality expectation, strength of distribution channels and service by the manufacturer. It is clear that this study ignores the vehicle users’ demands and user-centred design issues. On the other hand, joint venture automotive companies’ design sectors are always located in their home towns, and their designs are not tailored for the Chinese local users (Committee on the Future of Personal Transport Vehicles in China et al. 2003).

3.2.2 Chinese Automobile Market

China’s automobile market posted very rapid growth in recent years, and it was the second biggest automobile market in the world in 2005 (People's Daily Online 2006). The statistics from the China Automotive Industry Association (CAIA) prove that the vehicle consumption went up approximately to 5.92 million units in 2005 from 2.731 million units in 2001, and China's auto market growth accounted for 23.2 per cent of the total global growth in 2005 (People's Daily Online 2006). Zhao (2005) reports that in the past ten years, the production of motor vehicles in China has seen an average annual growth rate of 15 per cent, compared to a world average of 1.5 per cent in the same period.

In addition, Riley (2002) estimates that overall, motorization in China will grow five-fold between 1997 and 2020 — as a result of increases in personal vehicles. China’s motorization rate will continue to grow to 54 vehicles per 1000 by 2020, an average increase of 7.3 per cent annually (US Department of energy 2000). In this context, a number of research projects have attempted to explore the factors that influence the growth of the Chinese automobile industry and market.
3.3  Impact Factors of Chinese Motorization

Rapidly increasing motorization in China, particularly private cars, creates both economic and individual benefits, as well as negative impacts. The literature demonstrates that China’s spectacular economic growth over the past two decades has resulted in high rates of industrialization, urban development, and motorization. It is important to note that population growth is another important fact, especially the increase in urban population, which is a result of rapid Chinese motorization. The details of impact factors of Chinese motorization involve economy, urbanization, social and environmental systems, technology and design, and demographics impacts.

3.3.1 Economic Impact

The growth of the economy plays an important role for the current motorization trends in China (People's Daily Online 2006; Riley 2002). Riley (2002) believes that industrialization and economic development in developing countries can have a substantial influence on the number and growth of motor vehicles within three primary factors (demography, urbanization and economy). He explains that the availability of excess income provides individuals and households with the economic opportunity to purchase more expensive durable items such as automobiles. In addition, growth in the business sector can lead to increased production or import of new vehicles (Riley 2002). The rapid economic growth of China has triggered sophistication levels of local customers (Zhao 2005). From this point of view, rising consumer wealth levels, especially future aging populations’ discretionary income, have been a major contributory factor to the sudden explosion in the size of the car market.

3.3.2 Urbanization Impact

A study conducted by OECD (2001) indicates that urbanization and widespread access to cars have facilitated the ‘urban sprawl’ that characterises many modern cities, not only in Western countries but also in Asian counties. This process of land development has led to high demands for mobility, often making the car indispensable for organising and carrying out everyday activities. Riley (2002) demonstrates that the large majority of vehicles in China are found in the populous
eastern provinces of the country. These areas are highly industrialized and contain China’s largest urban centres. In summary, urbanization has a significant influence on the number of motor vehicles in developing countries, and China currently boasts some of the world’s largest and most densely populated urban areas (Riley 2002).

3.3.3 Social and Environmental Systems Impact

Although the automobile industry’s rapid growth will bring many benefits to China, it will also present its social and environmental systems with serious challenges. Some scientists (Committee on the Future of Personal Transport Vehicles in China et al. 2003; Riley 2002) have directly challenged the Chinese government’s plans to develop a Western-style automobile-centred transportation system, arguing that there is not enough land to both feed its people and build the roads, highways and parking lots needed to sustain automobiles. They also point out that automobiles will increase traffic congestion and worsen air pollution. Some researchers (Schipper and Ng 2004) recommend integrated transport policies and mass transport system as an alternative to private cars. However, these solutions have limitations for the mobility of older people due to age-related changes (Chapter 2).

3.3.4 Demographics Impact

According to Riley (2002), population growth can have an influence on the number of motor vehicles in China because the size of the transportation sector is sensitive to these population changes. However, Riley does not mention the detail of Chinese demographics that impact on vehicle growth. For example, which population (by age) is a primary consumer of private cars in China at the moment? What is the future of the Chinese automobile market? To answer these questions, the research conducted by the Anbound Group (2006) predicts that the Chinese future aging population needs a minimum of 50 million personal cars in the next three decades. It is clear that this is a potentially large vehicle market in China.

3.3.5 Technology and Design Impact

In the longer term, Chinese automobile companies have to expand their capability in research and development (R&D), product design, and advanced manufacturing techniques in order to compete internationally in the car market (Committee on the
Future of Personal Transport Vehicles in China et al. 2003). It is important to note that the creation of a strong domestic R&D capability is an essential element in the development of a successful indigenous automotive industry. This capability will enable both the transfer of intellectual property from international companies and the creation of intellectual property that can be the basis for a strong, export-oriented indigenous automotive industry (Committee on the Future of Personal Transport Vehicles in China et al. 2003). If China hopes to develop an indigenous industry that can independently develop and sell vehicles that contain leading technologies in world markets, it must have the above capabilities. For this reason, Nieuwenhuis, Wells and Vergragt (2006) assume that the Chinese will lead the next automotive revolution and will rely on local talent and expertise to drive the innovation.

Today, world-class cars are being produced in China, but the designs and the technology contained in them are imported by the joint venture partners, and Chinese engineers/designers are still given little opportunity to contribute to their designs (Committee on the Future of Personal Transport Vehicles in China et al. 2003). Some multinational automakers intend to introduce the most advanced manufacturing techniques and design into China. For example, faced with the competitive intensity in Chinese market, most multinational automakers accelerate their introduction of new models which are designed for global markets. Zhao (2005) states that carmakers will continue to stock up from the increasingly competitive local market, and bring to market better quality products with added value. For the design point of view, this kind of added value come from design innovation for the particular local needs. Therefore, Sparke (2002) predicts that it is inevitable that China, with its deep aesthetic traditions, will develop an automobile design tradition that is bound to influence the rest of the world in a significant way.

3.4 Chinese Aging Population and Elderly Drivers

The automobile is not just a technology or mode of transportation; it is a fundamental determinant of the entire economy and society (Committee on the Future of Personal Transport Vehicles in China et al. 2003). The growth of the Chinese driver population is dramatic, and is based on economic and social development, and the large population. Furthermore, the rapidity of growth of the aging population in
China is also dramatic. Therefore, it is expected that there will be a large number of older drivers in Chinese cities in the next three decades.

### 3.4.1 Chinese Aging Population

The statistics show that China is facing serious aging problems in the future. Cutler and Hendrick (2001) predict that a distinguishing characteristic of the developing nations such as China is the much larger population base on which aging will occur. They report that projections for mainland China show an increase in the size of the aging population from 87 million in 2000 to 224 million in 2030 (the total population of the US in 1980 was 226 million). According to Cutler and Hendrick, China’s older population will double from 7 to 14 per cent in a span of 27 years (2000–2027) compared to France, which took 115 years for the percentage of older persons to double. By 2050, it is expected that China will have more than 437 million people aged 60 or over (United Nations 2001).

In addition, Du and Guo (2000) indicate that as the absolute number and the proportion of the Chinese older population become larger and larger, their support will have to be provided by combined efforts of individuals, families, communities and society. Nevertheless, facing the process of population aging in China, the corresponding social and market mechanisms have not yet been cultivated and formulated, and policy, organization and personnel still do not meet the needs (Du and Guo 2000).

Cutler and Hendricks (2001) define ‘structure lag’ as the increasing numbers and changing circumstances of the older population that have taken place faster than societal structures can be adapted to adjust to them. They report that the notion of structural lag has had its widest application to aging populations in developed nations, but it is also relevant to changes in developing countries. They suggest that developing nations must move quickly to implement appropriate infrastructures in the face of rapidly increasing longevity. In conclusion, structural lag puts pressure on social systems to adapt support and opportunity structures to the new realities of an older population. These pressures, and how they are accommodated, will vary
considerably according to pre-existing cultural, social, economic and political systems.

3.4.2 Chinese Driver Population

Driving safety has become a severe problem in China due to rapid motorization. The composition of the Chinese driving population has quickly changed from a dominant majority of professional drivers (driving for one’s organization as one’s career) to more than half being private drivers (driving for one’s own use) (Zhang et al. 2005). The rapid increase in the number of novice drivers is becoming a big challenge to driving safety (Zhang et al. 2005). Recent research conducted by the Anbound Group (2006) indicates that more and more older people get their driving licence after they retire from work. These will be a major sector of the novice drivers in Chinese urban areas in the near future.

Zhang et al. (2005) conducted driving safety research to explore Chinese driver attitudes and characteristics. By comparing Chinese driving behaviour with American driving behaviour, they demonstrate that the Chinese drivers concentrate more on driving skills and capabilities, whereas the US drivers concentrate more on practical safe driving guidelines. From a driving safety point of view, their research concentrated on driving behaviour such as the use of safety belts, running lights, headlights, and turn signals, rather than travel activity. These authors speculate that there are possibly more sources of distraction in China:

- More frequent use of mobile phones. Having a mobile phone is a ‘must’ to ‘survive’ in China, and keeping in touch with friends frequently is very important, even while driving a vehicle.
- More passengers per vehicle on average. China is still a developing country and not every family has a car. Accordingly, a vehicle is not only for driving to work.
- Most vehicles are equipped with manual transmission systems. These are more challenging for the novice drivers in cases of emergency.
- More mixed traffic with pedestrians and bicycles.
Nevertheless, these results are questionable, in that the researchers used a different age system between the two countries. In other words, elderly drivers were excluded from the China data but were included in the US data. The study ignores the Chinese aging drivers, probably because there are few older drivers in Chinese society at the moment compared to US society. It also demonstrates that few research studies on Chinese aging drivers are available.

3.5 Aging in Chinese Cultural Contexts

The cultural context in which an aging experience takes place influences the nature and meaning of that experience in many ways (Jernigan and Jernigan 1992). The symbolic interactionists view the social worlds of the elderly as established in their everyday activity and context (Gubrium and Holstein 1999). Ikels and Beall (2001) emphasise that researchers need to be alert to differences in their depictions of aging on national, racial, and cultural populations. It is important to note that too often a general account is given that ignores intrapopulation diversity (e.g., north–south divides in culture and/or politics are likely to make for important distinctions among Irish, Italian, Chinese and Korean elders). Furthermore, these general accounts are frequently frozen in time and no longer apply to more recent and future cohorts of aging population (Ikels and Beall 2001) (Section 2.3.3).

3.5.1 Chinese Cultural Values

A country’s culture is revealed in the commonalities in beliefs, value orientations, behavioural patterns, symbols of communication, and social relationships that are shared by members of that culture. Different researchers develop different cultural dimensions. Stewart and Bennett (1991) suggest that culture has two fundamental aspects. Objective culture is material, encompassing a society’s political and economic system, aesthetics, and geographic factors; subjective culture is psychological, reflecting on society’s values, expectations, theories of action, and patterns of thought. Objective culture is tangible; subjective culture tends to be experienced unconsciously.
Hofstede’s (1997) theory on universal cultural dimensions is one of the most widely cited. His study on cross-national differences revealed that national cultures differed mainly along four dimensions:

- **Power Distance**: the extent to which a culture encourages unequal distribution of power among people.
- **Individualism versus Collectivism**: this dimension describes the degree to which individuals are integrated into social groups.
- **Masculinity versus Femininity**: the relative desirability of material success versus quality of life and of assertive versus modest behaviour.
- **Uncertainty Avoidance**: the extent to which people tolerate ambiguity and risk or feel threatened by change.

Yau (1994) suggests that Chinese cultural values are formed and created from interpersonal relationships and social orientations. Such relational orientation, a fundamental Confucian philosophy, is reported to have the greatest implications on marketing to the Chinese consumers. Based on Kluckhohn and Strodtbeck’s (1961) theoretical model, Yau (1994) classifies Chinese cultural values into five orientations:

- **Man-nature orientation**: the Chinese regard man as a part of nature, and believe that man should not try to master nature but has to learn how to adapt to it so as to reach a harmony.
- **Man-himself orientation**: the Chinese are regarded as situation-oriented and pragmatic. They are less dogmatic and tend to be more flexible in following a learned principle.
- **Relational orientation**: the Chinese are primarily collectivistic, with emphasis on the group, authority and older people rather than the individual. The ‘face’ concept is a good example of the high value that the Chinese place on interpersonal relationships. One's face refers to the prestige one possesses by virtue of social achievement such as wealth and social status.
- **Time orientation**: the Chinese have a strong preference for past-time orientation. They believe that interrelations with objects and others are continuous.
• Personal activity orientation: the highest value in China is to live properly, which makes the social aspect of personal transactions of supreme importance.

Through cross-cultural research, Giarrusso, Mabry and Bengtson (2001) also support Yau’s findings and suggest that people living in Eastern counties such as China depend largely on fitting in with and accommodating others as a result of the Eastern cultural emphasis on interdependence and harmony. That is, individuals have an interdependent view of self, defining themselves in concrete ways and in terms of their relationships to other people. In contrast, self-esteem among Western countries relies on a sense of individuality and standing out, consistent with the Western cultural values of independence and individualism. It is worth noting that the primacy of individual or the collective seems to be the key consideration for the cross-culture relationships. Kluckhohn and strodtbeck (1961), Hall (1976), Condon and Youself (1975), Triandis (1988), Hofstede (1997), and Victor (1992) all explicitly reference this kind of cultural dimension. However, because researchers have limited their samples to young adults, it is unclear whether these findings would hold true for older adults (Giarrusso, Mabry and Bengtson 2001). In terms of the directions for future research, this is a gap that needs to be explored.

3.5.2 Cultural Tradition of Chinese Aging Population

There are significant differences between the experience of aging in the Chinese culture and experience of aging in the Western countries. Aging in the two cultures is different for many reasons, but primarily because the understanding of the experience of family is different. The life of the elderly population and family status are increasingly becoming a focus of attention in Chinese society because the family is the principal base of providing for older persons in the Confucian philosophy (Duan and Guo 2000; Jernigan and Jernigan 1992).

It is well known that Chinese family patterns and older-generation lifestyles are changing in modern society. Hareven (2001) reports that changes in the family must be interpreted in the larger context of social and economic change. He leaves the question to his readers: Are surface similarities between Asian and Western societies
a disguise for more profound cultural differences? Or do elderly parents now living in nuclear households in Eastern countries interact with adult children in similar ways to those of contemporary Western persons living in nuclear families?

In response to such questions, Jernigan and Jernigan (1992) state that Chinese older people prefer to live with their children, to keep the family as primary focus of their social interaction, and to find much of the meaning of their lives and their hopes for the future in their relationships with children and grandchildren. It is worth noting that changes in family structures, relationships, and lifestyles have not yet altered the basic cultural orientation toward family among the Chinese older people (Jernigan and Jernigan 1992). Cultural traditions have played a major role in shaping patterns of generational assistance and the expectations that generations have of each other. What may appear on the surface to be an ‘isolated’ nuclear family in China does not mean that elderly parents are isolated from assistance from their children and other kin (Hareven 2001). It is clear that Confucian doctrine is still a basic pillar of Chinese life today, and future research is needed to broaden this understanding and transform the result to other social fields (Hareven 2001).

In addition, Jernigan and Jernigan (1992) state that the Chinese elderly did not have major ‘physical survival’ problems. Major problems in any one of the areas of ‘physical survival’ could have interfered with their interactions with other persons and their place in life. The authors identify four aspects of older people’s experience within the Chinese culture, which:

- develops access to natural resources, tools, technologies, institutions, and systems that contribute to the survival of the elderly individual and Chinese culture;
- provides mutually supportive and need-satisfying forms of social interaction;
- defines the status and functions of elderly individuals in the light of the culture’s values and priorities, and enables the individual to experience a sense of personal significance;
- develops collective sources of meaning for life in which individuals can participate in the symbols and rituals of the culture.
All in all, Confucian thinking emphasizes the ideal of harmony and the collective, which have become the leading objectives of Chinese philosophy, and have influenced the experience of Chinese older people in modern society.

3.6 Summary

The Chinese economy is currently pinning its hopes on the automobile industry. China’s automobile market has posted very rapid growth in recent years, in that rising consumer wealth levels have been a major contributory factor to the sudden explosion in the car market. The factors that influence the growth of the Chinese automobile market include economy, urbanization, social and environmental systems, technology and design, and demographics impacts. In the meantime, the Chinese automotive industry faces significant challenges in achieving independence, because China spends a smaller percentage of its gross domestic product on its domestic R&D capability. Therefore, Chinese designers are still given little opportunity to contribute to their designs.

The growth in numbers of Chinese older people is dramatic, based on the already large population. The rapid increase in the number of novice older drivers is becoming a big challenge to driving safety in China. However, older drivers have not been included in the Chinese road safety and vehicle design studies.

Although physical anthropologists have examined biological processes, sociocultural anthropologists have been more concerned with the experience and phenomenon of aging populations. Most of these attempt to explicate the special role of cultural factors in the genesis, experience, and management of age-related changes in health and functionality. There are several research reports of investigations into such questions, and these provide critical evaluations of research on the social aspects of aging. Too often a general account is given that ignores intrapopulation diversity. It is worth noting that differing cultural perspectives of individualism and collectivism influence the nature of older persons. People living in China depend largely on fitting in with and accommodating others as a result of the Eastern cultural emphasis on interdependence and harmony. The literature demonstrates that traditional cultural values still play an important role in contemporary Chinese society. Future research
is needed to broaden this understanding, and transform the result to other social fields such as domain of design for the older adult.

Chapters 2 and 3 have presented a holistic vision of older vehicle users, especially Chinese older drivers. Due to the weak association among (a) age-related changes, (b) older Chinese vehicle users’ experience, and (c) vehicle design outcomes, further research is necessary to establish a methodological design approach that will link design features to the three dimensions of age-related changes in older drivers’ — the physiological, social and cultural dimensions. This approach might provide the framework for designing and assessing interventions to fulfil the older drivers’ multiple needs. The next chapter will explore design for older people.
Chapter 4:

Design for Older Adults

4.1 Introduction

It is a mistake to think of the older user as severely disabled, hard of hearing or partially sighted. According to Huppert (2003), older users in advancing age have little discernable impairment, and have a strong drive to remain independent and to contribute to the community, but are hampered by inappropriate design. Better design can play an important role in enabling older users to maintain not only physical but also social activity. Current design-oriented research about older adults’ design issues focuses on the interaction between older people and high-technology equipment such as computers and in-vehicle devices. Many researchers believe that being user-centred is critical to successful product design. In this context, this chapter reviews the relevant literature about usability, accessibility and inclusive design approaches.

Cultural framework and social context in vehicle design research need to be explored due to the scarcity of relevant literature. It is worth noting that older users do not represent a homogeneous group, due to differences in rates of change, patterns of changes, life experiences, compensatory strategies, motivation, attitudes and lifestyle (Sections 2.3, 2.4 and 3.5). When considering design, researchers and designers should not be focusing only on those similarities that allow them to optimise the design, but should be remaining aware of the social and cultural differences so that they can determine whom design can and cannot accommodate. From this point, it is envisaged that older vehicle users living in China have unique behaviours compared to those living in the US, even though they have the same physical limitations (Section 2.2).
The literature reviewed shows that the topic of vehicle design for an aging population, viewed as a public health issue, always has two main dimensions: safety and mobility (Hakamies-Blomqvist, Siren and Davidse 2004). A number of documents have recommended that studies be conducted in a variety of transportation-related areas. Some of these areas include those related to market, high technology and ergonomics issues. Moreover, from an environmental sustainability point of view, vehicle design researchers pay more attention to studying the public transport and alternative transport issues. However, they ignore that the social sustainability in transport design not only involves environmental issues, but also includes social accessibility. It is important to note that although these design researchers always focus on the relationship between the objects and people, there are few studies that take a sociocultural perspective in the vehicle design field (Edensor 2004). For the purposes of transportation design for aging populations, society will play an important role in transportation systems for elderly persons. Therefore, a research gap becomes apparent (Figures 1.2 and 1.3) if researchers link vehicle and aging issues in the sociocultural framework.

4.2 Design Approaches to Fulfil Older Adults’ Needs

Most current design research focuses on the relationships between older users and technology. Swigart (2000) identifies the gap between older users and technology as (i) adapting existing technologies for elderly users with perceptual, cognitive, and mobility limitations (Section 2.2); and (ii) adapting new technology to solving the unique difficulties of, or providing new opportunities to, older adults. It is worth noting that the future older user is likely to have far more experience with technological devices than today’s older user, and thus may be more prepared to accept them (Swigart 2000).

To fill the gap between older users and technology, a number of design guidelines have been generated by the design-oriented research in terms of accessibility, usability, and inclusive design. In this section, some of the discrepancies, overlaps, and obscurities inherent in the concepts of accessibility, usability, and inclusive design have been reviewed. This suggests that the description of usability and
accessibility problems — such as the description of the extent to which human needs can be fulfilled — is found in terms of activity performance in the social and cultural context.

Macdonald (2003) suggested that designers are supposed to develop scenarios for living and synthesising social and technological trends into user-centred products, and should provide products and services which give value and meaning to older users’ lives. Despite the issue of reduced functionality, designers should not discount that older users’ life experiences will have shaped many valuable capabilities and individual needs. Macdonald (2003) identified three characteristics in addition to quality, performance and reliability:

1. Dynamic adaptability and mass-customisation: any technological device should be able to accommodate and respond to the user’s body, senses, mind, and lifestyle changes over time.
2. Cultural sensitivity: designers need to think in terms of the deep cultural factors and broadest possible terms when tackling technology at the human-interface.
3. Aesthetic appropriateness: designers might extend the range of considerations of what constitutes pleasure and emotional content in the products.

It is clear that the choice and application of appropriate technology will entail an understanding of the dynamically changing physical, sensory, cognitive and lifestyle needs and desires of an aging population. Designers require an understanding of how products and services will meet older users’ functional needs, yet help address people’s aesthetic and lifestyle aspirations and provide a greater sense of elderly individual well-being (Macdonald 2003).

4.2.1 Relationship between Usability, Accessibility and Inclusive Design

To explore designing for older users, it is necessary to investigate the relationship between design for usability, accessibility and inclusive design. According to Keates and Clarkson (2003), products designed for inclusivity are designed for usability and accessibility, and older adults respond strongly to this. Inclusive design is defined by
the UK Department of Trade and Industry (DTI) as a business goal where designers ensure that their products and services fulfil the needs of the widest possible set of users (DTI Foresight 2000). It is clear that this definition of inclusive design underestimates the differences in the patterns of daily life in different cultures and therefore will fail to meet older people’s culture-specific needs.

Traditional inclusive design advocates design for the more extreme end-users. The principal weakness of working only with extreme users is that they may propose solutions that are in danger of becoming sub-optimal for many other users (Keates and Clarkson 2003). Based on Benktzon’s (1993) user pyramid (left diagram in Figure 4.1), Keates and Clarkson (2003) state that a top-down design approach involves extending from the top of the user pyramid (designing for the least functionally capable) towards the mainstream market. The weakness of this approach is that the products and services may be too specialised and optimised for a small user group, and fail to be transferable to other sections of the population, such as third age users (younger-old users). On the other hand, bottom-up approaches aim to take a mainstream product that is to be designed for able-bodied users and make it more inclusive. Although bottom-up approaches offer great potential for commercially successful products, they have two principle drawbacks: the companies may be tempted to settle for the able-bodied market only, and they may ignore what they perceive as a diminishing return; these approaches can go only a limited distance up the pyramid (Keates and Clarkson 2003).

This figure is not available online. Please consult the hardcopy thesis available from the QUT Library

Figure 4.1: The user pyramid and the Inclusive Design Cube (Keates and Clarkson 2003)
For the above reasons, Keates and Clarkson (2003) suggest that modular approaches are designed to minimise the difficulties of adaptation to particular users, and they can be best considered as bridging the gap between top-down and bottom-up. Moreover, they developed an Inclusive Design Cube (IDC) (right diagram in Figure 4.1) based on Benktzon’s user pyramid (Benktzon 1993) to illustrate their Countering Design Exclusion theory. According to Keates and Clarkson, a target population’s size and composition are independent of the negotiable maximum and included populations. It is clear that the negotiable maximum population is approximately equal to the older population. This means that a focus on the older users’ needs will include the whole population’s demand (Fisk et al. 2004).

In the field of transport research, accessibility can be defined as the distance to (or the time needed to) reach different activities or destinations in society for a population in question (Iwarsson and Stahl 2003). Currently, the ecological model (Lawton 1986) has been used as the main theoretical foundation in accessibility research. This model focuses on the transaction between individual physiological competence and environmental press. However, Iwarsson and Stahl (2003) suggest that the most common and obvious dimension when discussing disability issues is accessibility to the physical environment, while the social activity and services still are neglected.

Traditional usability research concerns fulfilment of functional requirements. According to ISO 9241-11 (1998), usability is a measure of the effectiveness, efficiency, and satisfaction with which specified users can achieve specified goals in a particular environment. It has been accepted that traditional usability method neglects social issues because it is too concerned with task-based issues such as performance rather than activity (Oulasvirta 2004).

In response to the above questions related to social and cultural issues in the accessibility and usability studies, Keates and Clarkson (2003) focus on acceptability of inclusive design, both practical and social, as being the key goal for the design of products and services. Their definition of practical acceptability divides it into cost, compatibility, reliability and usefulness. It is important to note that Keates and Clarkson not only focus on physical ergonomic issues, they also explore social
acceptability such as aesthetic characteristics. They claim that social acceptability is achieved when the product meets the expectations and aspirations of users. To achieve this, designers need to modify their perceptions of what the users really need. The presentation of users’ needs include additional factors such as the effects of age, experience and impairments. Designers need to be attuned to the aesthetic and aspirational values of the users (Keates and Clarkson 2003).

4.2.2 Design Guidelines to Achieve Accessibility and Usability

The current tendency for designing products and services for older people is that designers rely on guidelines and automated tools to achieve accessibility and usability. Fisk et al. (2004) state that the field of human factors develops the scientific knowledge base concerning the capabilities and limitations of people, and then uses that scientific knowledge about human behaviour in specifying the design and use of a human–machine (or human–environment) systems. In other words, the ultimate goal of the science and the practice of human factors is to develop guidelines and ensure that human–system and human–environment interactions will be safe, efficient, and effective. Based on an understanding of the general age-related physiological changes, Fisk et al. (2004) divide input and output device-design guidelines into four parts: physical characteristics, which may be influenced by age-related differences in perceptual and movement control capabilities; navigational issues related to manoeuvring within the system; information organization; and more general conceptual issues. They claim that a mismatch between the user’s model and the designer’s model is a prescription for failure. Based on these principles, the authors generate a number of detailed guidelines for designing for older users.

In addition, the Center for Universal Design (Story, Mueller and Mace 1998) developed seven principles, along with guidelines, to assist the design of products and environments for all people, especially older users:

1. Equitable use – the design is useful and marketable to people with diverse abilities.
2. Flexibility in use – the design accommodates a wide range of individual preferences and abilities.
3. Simple and intuitive to use – use of the design is easy to understand, regardless of the user’s experience, knowledge, language skill or current concentration level.
4. Perceptible information – the design communicates necessary information effectively to the user, regardless of ambient conditions or the user’s sensory abilities.
5. Tolerance for error – the design minimise hazards and the adverse consequences of accidental or unintended actions.
6. Low physical effort – the design can be used efficiently and effectively with a minimum of fatigue.
7. Size and space for approach and use – appropriate size and space are provided for approach, reach, manipulation and use, regardless of the user’s body size, posture or mobility.

Similarly, Macdonald (2003) identifies an inter-related set of factors, believed to be fundamental in maintaining and improving the quality of life for the aging population. These are design for (i) stimulation, both physical and cognitive; (ii) flexibility, to accommodate changes brought about by the aging process; (iii) independence, through choice and control; and (iv) social interaction, through family, friends and the wider communities.

It is clear that most design guidelines are established based on understanding age-related capability impairments. However, a key point acknowledged by Fisk et al. (2004) is that not all capabilities decline with age, nor do some older adults show age-related decline. The older adults’ mental models of how products should function may differ from younger adults’, not because they are older but because of their different experience. Concretely, older adults have a well-developed semantic memory base (i.e., their world knowledge) that may guide them in their interactions with technological products. ‘Designers must take advantage of this knowledge base and develop products and systems that are consistent with representations, expectations, and experiences’ (Fisk et al. 2004, p. 144).

Although the above research emphasizes the design guidelines from a different perspective, a number of other studies reveal that many designers do not adhere to
accessibility and usability guidelines during design practice (Milne, Dickinson, Carmichael, Sloan, Eisma and Gregor 2005). Design for the older users is not simply about access to guidelines and information about older people with functional loss. In a product adaptation design process, guidelines might not be sufficient in supporting performance of daily activities for the particular user group being targeted for the intervention. ‘Usability experts have failed to get across the message that guidelines are directions for good design that should be complements by deeper understanding of the issues, rather than simple rules or instructions that should be followed blindly’ (Milne et al. 2005, p. 565). The design process needs to accept and effectively deal with this complexity.

Iwarsson and Stahl (2003) also state that usability is not based on compliance with official norms, guidelines and standards. It is mainly subjective in nature, taking into account user evaluations and subjective expressions of the degree of usability. On the other hand, due to international differences varying over time, the context component is not consistent and stable. Therefore, traditional implementation of accessibility which is based on official design guidelines is not a constant phenomenon (Iwarsson and Stahl 2003). The activity component of the concept of usability is another source of variation, since different user groups display different patterns of activity. None of the design guidelines cover all the concepts and relationships necessary for further development in the field.

From a usability and accessibility research point of view, Milne et al. (2005) explore the limitation of design guidelines. They state the following:

- Accessibility guidelines are often presented in the format that is difficult to digest or implement by designers.
- Guidelines are often used strictly as rules or instructions rather than as intended. It is limited the design innovation.
- Conflicting priorities, such as aesthetic demands or time pressure, hinder the implementation of guidelines.
- Accessibility guidelines and tools focus on the basic level of accessibility and do not cover higher-level problems such as social and cultural issues.
- Guidelines tend to emphasize extreme disabilities, causing designers to
neglect larger groups of users with multiple minor impairments (e.g. third age or younger-older users).

To fill the above gap, a more sensitive approach to understanding the needs of older users should be developed. The user-sensitive design approach could address the dynamic diversity of the human species rather than splitting user populations into bipolar categories of ability/disability. Therefore, it requires the designers to move beyond mere guidelines (Milne et al. 2005). In addition, some research projects (Canadian Association of Occupational Therapists 1997; Iwarsson and Stahl 2003) represent the transaction between person, environment, and activity, which seems closely connected to usability. These studies focus on neither usability nor accessibility per se, but they elucidate activity as a basic human need and an important health determinant. Such theoretical models emphasize the actual execution of an activity and personal experience of engagement in activity within a context. All in all, there is an obvious need for design theory and approach development within the particular domain and cultural context.

4.2.3 Existing Models of the Design Process

The design-oriented research has generated different approaches to fulfilling the older users’ needs. A better model of design would show the need for forecasting and feedback within the process (Cross 2000; Keates and Clarkson 2003). Keates and Clarkson (2003) insist that such forecasting is possible only if feedback is obtained about the performance of previous products or prototypes of an emerging product. However, from a user-centred design principle, forecasting can be achieved through better understand of the target users’ needs and activities, rather than through the performance of previous products.

To translate the older user information into the design concept, it is incumbent on designers to ensure that the system functions match user needs and expectations. Keates and Clarkson (2003) develop the robust knowledge loop (Figure 4.2). This knowledge loop is a subtle representation of necessary information flows and activities which produce validated inclusive design. The loop can be entered at any
point, and reflects the wider range of possible end-users beyond the disabled and elderly, and designers respectively.

Figure 4.2: The knowledge loop (Keates and Clarkson 2003)

Figure 4.3: A system approach (Keates and Clarkson 2003)

For inclusivity, a systems approach is developed to evaluate the product system (Keates and Clarkson 2003). Figure 4.3 illustrates the ‘V-model’ to emphasise the
importance of user-product interaction design and product evaluation. The addition of a knowledge base on which to support the product design and system evaluation reflects the significance of the ‘knowing the user’ activities within the knowledge loop (Figure 4.2).

Currently, most design approaches discussed have their origins in ‘engineering’ design. The product design approach is different from the rigorous ‘define/design/evaluate’ cycles and more towards identifying and satisfying the user social acceptability requirements (Keates and Clarkson 2003). From a design practice point of view, IDEO changes the structure of the design process to develop an understanding of problem and concept generation (4 out of 5 stages), rather than the creation of the final product (the remaining 5th stage) (Figure 4.4).

Figure 4.4: A IDEO practitioner’s model of design (Keates and Clarkson 2003)

Although Keates and Clarkson (2003) assert that the knowledge loop is dynamic and robust, they still developed a 7-level design approach which is presented in a linear structure. In Figure 4.5, level 1 defines the user needs; that is, the social motivation for designing the product. Level 2 focuses on specifying the required utility of the
product. Assessments of rival products can provide insight into the necessary functionality. Levels 3 to 5 focus on the stages of interaction. Usability and accessibility techniques and guidelines can be applied to these levels. Prototypes of varying fidelity play an important role in these levels. Level 6 involves the evaluation of the complete system to ensure satisfactory utility, usability, and accessibility before the design can progress to the final level. Level 7 assesses the resultant system against the user needs.

French (1985) and Pahl and Beitz (1984) have developed similar models of the design process. Figure 4.6 shows the details of French’s model, which is based on the following activities: analysis of problem; conceptual design; embodiment of schemes; and detailing. The process begins with an initial statement of users’ needs, and the first design activity is analysis of the problem. French suggests that the statement of the problem involves three elements: a statement of the design problem proper; limitations placed upon the solution; and the criterion of excellence to be worked towards.

Cross (2000) suggests that models of the design process should be drawn in the flow-diagram form, with the development of the design process from one stage to the next, but feedback loops showing the iterative returns to earlier stages which are frequently necessary. However, most design approaches and processes mentioned above present a linear structure. Although few processes present part of iterative returns (e.g. Figure 4.6), the users’ needs and design task, which play important roles in the user-centred design process, only emerged in the early stage of the design process and did not represent central and iterative positions in the design processes.
None of these design approaches discussed the dynamic factors that can drive the designers following the iterate process, and inspire them to create tangible and intangible product properties to fulfil the older users’ particular needs.

### 4.3 Vehicle Design for Older Users

Chapter 2 has established that designing for older adults’ mobility is the core issue to improve their quality of life. Vehicle design and innovation play an important role in fulfilling the older vehicle users’ travel needs, and in making technology culturally acceptable. However, Fisk et al. (2004) insist that redesign of the automobile would not be necessary because older drivers would benefit from driver training (Section 2.2.5). To challenge this conclusion, many researchers claim that older users may have difficulty in learning to use new devices due to their cognitive changes, such as working memory, perceptual speed and attention. According to Coda and Gadeselli (2003), design innovation is of paramount importance in the modern vehicle market and research, in which technological and ergonomic validation are taken seriously, in particular where the needs of an aging population are concerned. Literature reviews find that the elements which affect vehicle design innovation for older people involve market, technology, ergonomics, lifestyle, and aesthetics.

#### 4.3.1 Market

The literature demonstrates that in the highly competitive private vehicle manufacturing industry, marketing has a very high priority in influencing design decisions. According to Swigart (2000), the challenge becomes to identify and quantify design targets for a diverse group that does not want to acknowledge its own identity, and then to design a product, incorporating new technologies, that will be positively perceived in the marketplace. It seems that automotive marketing executives feel that a vehicle identified as an old person’s car will not sell (Herriotts 2005; Swigart 2000).

In direct contradiction to this, Keates and Clarkson (2003) explore the inclusive design from a business perspective. According to them, the Ford ‘Focus’ was designed for the needs of older drivers as well as the usual younger target market. All of the features developed to make the car easier to operate and drive for older adults
have not adversely affected the enjoyment of the Focus for younger drivers. Therefore, this car had the sales success of its predecessors and is the top-selling car in the UK. Fiat sells around 20,000 cars a year though the Autonomy Programme, which is to promote and facilitate mobility for people with reduced physical capabilities, such as older people. This represents a valuable business opportunity and positions the company well to meet future consumer needs stimulated by disability legislation (Coda and Gadeselli 2003). Considering these phenomena, Cutler and Hendrick (2001) predict that a large older population will increase marketers’ attention to this population’s discretionary income, and further highlight age-related economic issues.

To respond to the increasing growth of the aging vehicle markets, most developments focus on interiors, and have not addressed the more difficult issues where there are conflicts with structural, aerodynamic, performance, and stylistic design goals (Steinfeld and Steinfeld 2001). Moreover, although design recommendations and guidelines for older vehicle users are typically directional (larger, simpler, easier), it is hard to see the automobile industry translating these principles into commercial products (Swigart 2000) (Section 4.2.2). On the other hand, Coleman, Roger, Lebbon, Clarkson and Keates (2003) argue that the business challenge is to develop a rounded consumer offer that appeals to older people by supporting their aspirations and changing lifestyles. The business can stimulate the economy in ways that are life enhancing and offer new opportunities for comfort, enjoyment and self-fulfilment for the aging population, rather than limited in the simple barrier-free principle. Herriotts (2005) concludes that there is a mismatch between the design of current cars purchased by older drivers, and their needs and abilities. Therefore, applying the user-centred design approach to fundamental architecture of the vehicles and to detailed design aspects will improve the likelihood that future car designs are suitable for a wide range of drivers, and that older drivers in particular are catered for.

4.3.2 Technology

High technology influences the designing of private cars for the aging population. Meyer (2004) reports that the new technologies that have been introduced into the
car can be divided into three categories: vehicle control devices, driving assistance devices, and driver infotainment and comfort devices. These different devices need to be integrated in one entity during the design process. Researchers need to develop appropriate design methodologies that take into account the unique characteristics of the driving situations and needs of the older driver (Meyer 2004).

Hanowski and Dingus (2000) provide a brief overview of research being conducted to improve older driver mobility through the implementation of intelligent transportation systems (ITS). They present the findings of three on-road studies using instrumented vehicles to shed light on the issue of whether these three ITS technologies can enable the older vehicle users to maintain performance at a safe and functional level. The three ITS technologies include in-vehicle routing and navigation systems (IRANS), in-vehicle safety advisory and warning systems (IVSAWS), and collision warning systems (CWS). Hanowski and Dingus’s (2000) study concludes that consideration of older driver issues and the utilization of a user-centred design approach may aid in the realization of ITS goals and objectives, making them safe, efficient, and usable for both younger and older drivers. It is worth noting that the successful application of ITS research findings for the benefit of older drivers will depend on their translation into product design (Swigart 2000).

However, high technology such as automation or ITS for older vehicle users is a double-edged sword. The systems that are designed to assist in safe driving may add mental and physical workloads and confusion to the driving task (Hanowski and Dingus 2000). Over-reliance on automated equipment can eliminate a person’s ability to function without it, which might have disastrous consequences if an automated technology fails. Moreover, the system may not do things exactly as the user would like, but the user is forced to accept what happens because it is too difficult to change the way the system operates (Norman 2002). According to Swigart (2000), there are three related points in Hanowski and Dingus’s (2000) paper that are worth consideration. First, if driver inattention or perceptual errors are the factors contributing to these accidents, the context of the experimental situation may induce the participant to maintain a higher level of attention and more conservative driving behaviour. Second, high traffic density would limit the discretion to maintain a longer headway and possibly influence the effectiveness of a CWS. Finally, the
results of the display modality study were not discussed (Swigart 2000). Although Swigart (2000) evaluates these shortcomings, the details of solutions are not explored, leaving the reader to assume the effects of technology in a negative context.

It is clear that much of the discussion related to transport technology is concerned with new technology innovation. The disadvantages of high technology have been technology driven as opposed to being driver-centred (Hakamies-Blomqvist, Siren and Davidse 2004). Geenhuizen, Nijkamp and Black (2002) suggest that further empirical research on vehicle users’ behaviour is needed to gain new insights on context of technology usage. In addition, the vehicle property is an important segment for the application of new technology that supports socially sustainable transport, such as new types of systems for converting and storing energy, new lightweight construction and materials, and advanced sensor and identification systems (Geenhuizen, Nijkamp and Black 2002). Improved optical technology and manufacturing, and lighter weight materials have been made more desirable due to improved ergonomics, styling, marketing, and their greater social desirability as a fashion item (Macdonald 2003).

4.3.3 Ergonomics

Considering the vehicle design for the older users, ergonomic factors play the most important role in current research. Ergonomics to be addressed in the design of a vehicle include the areas posing difficulty for older people, which will include not only physiological issues such as mechanical controls and visual factors (Herriotts 2005; Smith 1990), but also social and cultural variables in ergonomics (Chapanis 2004; Kaplan 2004).

Herriotts (2005) highlights the need for ergonomics research into vehicle design for older people. The findings of his study include some ergonomics-related issues: finding a comfortable driving position; getting into and out of the car; using the radio; ease of reversing and parking; using the boot or hatch; ease of wheel changing; turning around to look out of the rear window; and using seatbelts. Swigart (2000) attempts to explore integrated vehicle design, both interior and exterior, for aging
populations. However, the exterior design and styling issues are still weak, probably due to the author’s ergonomic knowledge background. Further, to this, Swigart acknowledges that there are limited valuable ergonomics to direct designers and the automobile industry in the effective design and integration of new technologies, especially for older drivers; this is probably because ergonomic combinations for the older vehicle users provide neither a sleek, sporty appearance nor a tough, off-road look — two of the most popular styles of the times (Steinfeld and Steinfeld 2001). Steinfeld and Steinfeld (2001) point out that priorities will have to change before usability improves when it conflicts with other goals, unless creative solutions can identify new approaches that satisfy all goals at once. Therefore, the gaps that need to be explored in this context are: How can interior and exterior design be merged into an integrated product for the elderly driver? How do vehicle designers translate limited ergonomic guidelines into effective design for the aging population?

Current ergonomic research related to vehicle design and improved driving safety is based on laboratory experiments. For example, the Autonomy Programme conducted by Fiat Auto (Coda and Gadeselli 2003) and Third Age Suit developed by Ford Auto attempt to improve accessibility and driveability of personal car design through the research findings generated from experiments conducted under laboratory conditions. These studies exclude the older users’ living context and lifestyle factors, which play important roles in stimulating vehicle design innovation. Within the laboratory context, only parts of issues such as safety and ease-of-use can be improved. In a more concrete approach, Ford’s ‘Third Age Suit’ assists in the design process by restricting the physical abilities of young designers, thus simulating the difficulties experienced by older vehicle users. The benefit of this tool is that designers can experience and understand the age-related physiological problems of older users, and incorporate appropriate measures into their design solution (Steinfeld and Steinfeld 2001). However, there are some disadvantages for using the Suit. ‘It is not possible for the suit to predict the extent of the difficulties which may be encountered, nor should it be used to quantify accurately solutions to problems’ (Hitchcock, Lockyer, Cook and Quigley 2001, p. 642). Such implementations can be misleading, as the designers have no experience of ‘coping’, of getting used to the situation over time. In the meantime, it is hard to study older drivers’ social activities because the suit simulates only age-related physical conditions. So, whilst these simulations might
provide some value, there is no substitute for the involvement of older users as unequivocal experts in their field.

Importantly, the ergonomics contribution to vehicle design for older users involves social and cultural variables. Based on the study of the Helen Hamlyn Research Centre (HHRC), Coleman and Harrow (2000) explored various strategies for designing personal vehicles for older people. They list some key design issues such as access and comfort, security, information, maintenance, refuelling, versatility and emotions. This work differs from the ergonomic research conducted by Herriotts (2005), Swigart (2000) and Hitchcock et al. (2001). Coleman and Harrow (2000) not only discuss traditional ergonomic factors that influence older persons’ travel needs, but also explore the design implications of emotional aspects, which are important factors in older people’s purchasing decisions. From a car styling design perspective, they provide some positive/negative comparisons for older people, which may be useful to designers, manufacturers and advertising companies. Another example of a design process that involves multiple ergonomic factors is the Toyota ‘Raum’ (Misugi, Kanamori and Atsumi 2004). From an industrial design perspective, the goal of the universal design for the Raum is to make mobility fun and exciting, while retaining excellent and active user-friendliness. Through design practice, Misugi, Kanamori and Atsumi divide Toyota’s universal design into two indices: the ergo-index and situational suitability. Based on these two indices, an objective evaluation of hard aspects (ergonomic performance) and soft aspects (delight in usage situations) has become possible, which can also be applied to future model development (Misugi, Kanamori and Atsumi 2004).

Kaplan (2004) suggests adding to existing sub-disciplines of ergonomics a new focus — a cultural dimension. Cultural ergonomics needs to be explored because many ergonomic elements are apparent in the influences and interactions of cultural variables relating to instances of human performance and human interfacing, especially products which are designed and used in the environments world-wide. For example, the design of vehicles to meet the requirements of worldwide markets involves the accommodation of many considerations that impact on successful cultural ergonomic design. Symbols are replacing words for the labelling of many controls and displays in an effort to overcome language differences. Research has
shown that while symbols have been used more extensively in Europe, many older American drivers are more accustomed to English words, and have some difficulty interpreting symbols (Swigart 2000).

According to Hougan, Hung and Wardell (2000), knowledge of a user’s cultural values and attitudes assists in understanding the place and use of a product in that user’s mind. There are four main areas that designers should take into account: information processing, pattern of use, perception of value and aesthetics. Ergonomics might work as a valid interpreter between users’ need, environment conceptions and their artefacts’ production (Bessa and Pizzocaro 2006). The automobile itself, in the hands of skilled designers, has experienced a cultural revival. While scientists, technologists, and politicians have been the ones who have to provide the real answers to car-related problems, culture can lead the way and show that change is possible (Sparke 2002).

4.3.4 Social Activity and Lifestyle

Recently, the vehicle design community has recognized that the ‘car was no longer an icon of modernity but rather a lifestyle accessory gave designer a new sense of freedom and they were swift to rise to the challenge’ (Sparke 2002, p. 202). Lifestyle analysis can reduce strategic risk prior to significant investment by gaining an understanding of users’ needs and activities to ensure that products and technology fit the ender user. For the design of transport, a better understanding of users’ needs can dramatically improve the independence and quality of life of the vast number of older users. To achieve such an aim, designers need to go beyond taking account of just age-related physiological disability; they should also understand the lifestyles of older adults within the social context (Huppert 2003).

The current trend of lifestyle analysis for vehicle design purposes focuses on the young generation. There is little design-oriented research exploring the older vehicle users’ needs from lifestyle and social activity points of view. Sparke (2002) points out that as society becomes ever more complex and niche markets more specialized (e.g. older users), so automobile manufacturers seek new formats to meet the needs of lifestyle and aspiration shifts, and create new kinds of cars by merging existing
typologies. The typical example is that the car takes on more and more domestic features, borrowing the soft forms of the living room. Its exterior becomes more of a ‘container’ rather than a visual symbol of power and speed.

4.3.5 Aesthetic

Although aesthetic and styling factors play an important role in the vehicle design domain, they are ignored by designers and researchers when exploring vehicle design solutions for older users. In vehicle design practice, the aesthetic and usability pose bipolar positions. Milne et al. (2005) state that despite a full understanding of issues surrounding the design of usable resources, designers are tied to producing material that is predominantly intended to make an aesthetic impact on the consumer, without sufficient regard for usability and accessibility. That is, designers mix aesthetic value with vehicle styling in a way that makes the resource very difficult or even impossible to use by older people without specific access needs. It is widely believed that this stems from the misinterpretation of design guidelines (Milne et al. 2005) (Section 4.2.2).

Traditional industrial designers (especially car designers) have been known as stylists. Margolin (1997) claims that this social perception of designers is changing from an emphasis on form to a focus on use. However, aesthetics is still a central concern for designers. According to Margolin (1997), aesthetics is one realm where designers have been most reluctant to gain more knowledge of user values, and this realm is the one where there is the least communication between designers and users. Chen, Kang and Hung (2007) claim that systematic investigation on influences of visual features on the perception of vehicle design is important for understanding aesthetic preference. By changing design features to manipulate the levels of factors, positive effects of typicality and unity on aesthetic responses can be achieved.

4.4 Sustainable Transport

Currently, a number of researchers emphasize the development of sustainable transportation. Most research advocates that walking, cycling and public transportation are the most economically and environmentally sustainable forms of human mobility in modern Chinese society. It is known that traditional sustainable
transport focuses on environmental issues such as utilizing new technology to prevent air pollution. However, this research ignores the point that social exclusion is the biggest challenge of sustainable transport for older people.

4.4.1 Current Practice

Public or mass transit can move large numbers of travellers efficiently, is more environmentally friendly, and makes possible a density of land use development (Burkhardt 2000). In the past, researchers could assume that the elderly population was more likely to use public transport, especially buses, as they were no longer able to drive or had never driven before. Rees and Lyth (2004) identify that the assumption is fine for those cohorts that grew up before the motor vehicle became so entrenched in urban society, but the condition might change for the new older cohorts who grew up with the motor vehicle.

Burkhardt (2000) points out that mass transit services are more limited than automobile travel in both the spatial dimensions of service (described as routing) and the temporal dimensions of service (described as scheduling). He concludes by defining the character of public transportation: it connects fewer origins and destinations; it provides service at more limited times of day, and days of the week; trips may appear to be more costly on an out-of-pocket basis; it requires certain levels of physical and cognitive abilities for its use; and it requires interaction with the pedestrian environment. Therefore, the disadvantages of public transportation include service quality, flexibility and control of one’s environment and activities (Burkhardt 2000). To overcome such shortcomings, Burkhardt (2000) suggests that the successful alternative interventions will be those that provide not only rides, but also provide feelings of security, independence, and dignity. He defines the alternative transportation as having two features: (i) the physical mobility to safely afford real connectedness with community opportunities and (ii) the consummately psychological rewards now associated with automobile ownership: independence, self-reliance, and a sense of dignity and self-worth. In his paper, however, the details of alternative transportation solutions are not explored, leaving the reader to be suspicious of its rationality.
To explore alternative transportation in London, Coleman and Harrow (2000) not only probed the travel needs and aspirations of older people, but also focused on moving from product to service. For their purpose, these two factors have been identified as powerful determinants in the future evolution of transportation design and development. Coleman and Harrow identify the research gap between people’s love of travel and the resulting environmental impact and degradation of city centres, which is high, and the growth in older age groups. Therefore, they encourage a shift in focus from individual vehicles to personalised transport services; from the private car to door-to-door travel on a pay-as-you-go basis. Coleman and Harrow defined such solutions as the seamless/integrated transport service that could reduce environmental impacts, increase accessibility, improve the quality of life of older and disabled people and offer new commercial opportunities. However, it is hard to link these separate ideas to a systematic integrated transport service for the readers. Unless older vehicle users are offered real alternatives to car ownership, either environmental objectives will not be met or dependency levels will rise significantly (Coleman 2003).

4.4.2 Social Exclusion

The relevant statistics show that the modal share of the above travel modes (i.e. public transport) is in decline (Donaghy, Poppelreuter and Rudinger 2005; European Commission Directorate-general for Energy and Transport 2002). Spatial spread in social networks, motorisation of private transport and policies contributed further to the decline in walking, cycling and taking a bus. Changes in residential patterns and mobility behaviour have been accompanied by a number of significant demographic changes. The socially excluded users (elderly) of public and private transport have different mobility needs, which are met less well by existing research (Donaghy, Poppelreuter and Rudinger 2005).

According to OECD (2001), as older people develop age-related health problems, they are likely to experience difficulties in walking and using public transport before experiencing difficulties with driving. The sustainable transportation must be viewed in a number of dimensions which include not only environmental and economic (World Commission on Environment and Development 1987), but also social (Heal
1993) and cultural dimensions from the socially excluded users’ point of view (Donaghy, Poppelreuter and Rudinger 2005). In other words, sustainable transport systems should be concerned with the levels of personal mobility and flexibility that are environmentally and economically sustainable, as well as the differences in transport service availability and effective access that are consistent with social cohesion (Donaghy, Poppelreuter and Rudinger 2005). In order to achieve such social sustainability of transport systems, Donaghy, Poppelreuter and Rudinger (2005) call for better understanding of the constraints on the mobility of older vehicle users.

Dijst and Kwan (2005) point out that the social aspects (besides the environmental and economic aspects) of sustainability are of increasing importance, and accessibility is one of the criteria for evaluating the sustainability of various spatial configurations. Geenhuizen, Nijkamp and Black (2002) state that care work in society, which consists mainly of caring for the elderly and its impact on sustainable transport, has been largely ignored by researchers. In view of these observations, future research on the sustainable transport should focus on issues such as a better definition of mobility, the opportunities presented by innovative transportation services and the social activities of older vehicle users.

4.5 Summary

Currently, many design approaches for improving accessibility and usability by older users focus on their disabilities. However, the principal concern for the designer is physiological capabilities, irrespective of cause and context. Therefore, there is an urgent need for design research based on a better understanding of age-related changes, which will lead to minimising the impact of impairments, and thereby extending the quality of life. To support design for older adults, it is necessary to understand the knowledge requirements of designers who are working in a particular domain such as transportation design. The knowledge requirements include information about the older users’ needs, and also the tools and approaches for making design decisions and developing solutions.
Earlier research into accessibility, usability, and inclusive design has generated a number of design guidelines from the physiological impairment point view, but cannot assist designers in creating new vehicles that meet the future aging generation’s travel needs. Moreover, current design processes do not discuss the dynamic factors that can drive designers to follow the iterative process and inspire them to create tangible and intangible product properties that fulfil the local older users’ particular needs. Therefore, it is necessary to explore the new design approaches for vehicle innovation within the Chinese cultural framework, and encourage informed decision making within the context of the unique requirements of the Chinese automobile industry.

There is a significantly increased awareness of the aging of populations in China, and the impact that this demographic shift will have on the use of automobiles. The automobile industries are aware that the aging populations are more and more potent as a consumer force in the marketplace. Thus, improvements in designs to accommodate these groups have become more common as the risk of neglecting the concerns of this market increases. For the automobile industries, using high technology and ergonomics research in vehicle design processes would improve the safety of aging drivers. However, high-technology and traditional ergonomics approaches are not panaceas to solve all of the problems which involve social and cultural issues. In addition, from a sustainability point of view, current research focuses on different vehicle design issues such as mass transportation and integrated transportation, and each of these has relevant disadvantages that need to be improved through future study. Beyond environmental sustainability, sustainable transport systems might be concerned with availability and effective access that can be consistent with social cohesion for the older users.

In summary, the literature search reveals that the details of the above issues are not explored, leaving gaps for future research. It is therefore necessary to translate research on older users, into meaningful vehicle design for the older adults’ unmet needs. The next chapter explores the relationships between design activity, product meaning, and users’ needs.
Chapter 5:  
Designing Meaningful Products for User Needs

5.1 Introduction

Products have different values and meanings for users. The consumption of material artefacts is motivated by the need to designate people’s particular being; matter serves to illustrate their values and choices as an individual. Some researchers (Baumeister 2005; Chapman 2005; Fuhrer 2004) acknowledge that users are not only physical and biological beings, but also socio-cultural beings. Earlier studies attempt to generate coherent understanding of human needs from the socio-psychological dimensions. However, few researchers have ever discussed the relationship between products and meanings from the design point of view. Therefore, artefacts meanings is a relatively untouched issue, and exposes a gaping hole in the knowledge field of user needs (Chapman 2005).

Products are not only physically formed within a culture, but also socially constructed in the ways that they are fitted into everyday social practice (Dant 1999). Products and services derive meaning from the related networks of schema that arise from users’ experiences, the opinions of others, and from a range of types of communication. The meaning can be functional or psychosocial and relates to product benefits and values (Antonides and Raaij 1998). Some researchers have studied users’ roles in defining the self and creating a sense of identity (Belk 1988). Others have emphasized the use of products within the culture’s social communication system (Fuhrer 2004; McCracken 1986). Moreover, Csikszentmihalyi and Rochberg-Halton (1981) attempted to identify the particular meanings of possessions that give them value. In such contexts, design can be defined as cognitive interfaces that enable reconstruction of intended meanings.
Designers are bridging physical form and users’ comprehension. Design has been approached as a semiotic phenomenon, which is based on cognitive processes. This chapter attempts to explore the relationship between user needs and product meaning from the design point of view.

5.2 Human Needs

The concept of human needs is complex. The variables involved and the measures for defining it are numerous. The literature shows that ‘human need’ refers to wants, demands, desires, interest, and propensities. Antonides and Raaij (1998) defined ‘need’ as the lack of something necessary for survival or well-being. The experience of needs motivates people to remove these kinds of shortages. Therefore, needs are motivating. From design point of view, Krippendorff (2006) conceives motivations as arising with the exploration of the opportunities artefacts afford users in specific contexts. For the use of objects, two kinds of motivation are distinguishable. Extrinsic motivation derives from using artefacts as means to an end, and refers to the instrumental cognition. Intrinsic motivation is rooted in the process of human-artefacts interaction, and it refers to the symbolic cognitive.

5.2.1 Physiological and Psychological Needs

Leiss (1990) claims that separation of needs into categories which imply that ‘physiological’ needs can be quantified and served independently from ‘psychological’ needs, which are qualitative, has been implemented in public-policy programmes around world.

The best-know need theory is Maslow’s (1987) hierarchy model, which distinguishes between physiological and psychological needs. According to Maslow (1987), need can be defined as a motivational force that directs human behaviour. This theory hierarchy recognizes five needs (Figure 5.1):

1. Physiological: associated to the state of being alive (starving, freezing);
2. Safety: linked to the guarantee of being alive (physical risk, freedom from risk);
3. Social: allied to love and belonging to a social or tribal context;
4. Esteem: affiliated to recognition of a social group;
5. Self-actualization: the subjective need to do your best.

For this pyramidal model, lower needs must be satisfied before higher needs emerge. Moreover, Maslow insists that human activity is determined by a person’s most urgent need. According to Popovic (2002), human activity and user-artefact interactions are the foci of design. Consequently, in order to design the artefact, it is important to explore the needs, because these can define a user’s individual activity.

![Hierarchy of need in general research (Maslow 1987) and design domain research (Jordan 2000a)](image)

Figure 5.1: Hierarchy of need in general research (Maslow 1987) and design domain research (Jordan 2000a)

The hierarchy of needs has also been proposed by marketing researchers. Hanna (1980) established a list of seven consumer needs based on reviewing the entire literature. These classifications are valuable to study because they have been used in a number of consumer studies:

1. Physical safety: the need to consume products so as to avoid harm or danger in their use.
2. Material security: the need to consume an adequate supply of material possessions.
3. Material comfort: the need to consume a large and/or luxurious supply of material possessions.
4. Acceptance by others: the need to consume products in order to be associated with a significant other or a special reference group.
5. Recognition from others: the need to consume products in order to be acknowledged by others as having gained a high status in one’s community.
6. Influence over others: the need to feel one’s impact on others’ consumption decisions.

7. Personal growth: the need to consume products in order to be or become one’s own unique self.

It is important to note that the hierarchy of basic human needs is contested. According to Rowan (1998), the hierarchy of needs does not move linearly in only one direction from low levels to high levels. He argues that an abundance or absence of motivation pushes each need in opposing directions. In addition, Murray (1938) proposes a list of 12 primary and 28 secondary human needs from a psychological perspective. Examples include autonomy, dominance, nurturance, exhibition, cognizance, and exposition. The author looks at human needs more microscopically so that each need is more focused, narrow, and specific compared with Maslow’s more broadly defined model.

Fromm’s (1969) views of human needs are marked by his distinction between the needs of humankind and the needs of animals. He points out that although humans and animals share the needs for food, water and sex, a human does not satisfy these needs in an instinctive fashion by following a rigid behaviour pattern. Human needs are psychological, and are influenced by social and cultural factors. This point is related to a design perspective by Jones (1977). Therefore, the unique character of human needs and motivations go beyond the mere physical, and include societal, psychological, and cultural needs.

### 5.2.2 Sociological and Anthropological Approach to Needs

Although physiologists and psychologists such as Maslow tend to assume that the user makes the decision to spend in isolation from all other users, sociologists and anthropologists view consumption as being socially determined. Sociologists look at social context and cultural difference as the basis for their explanation of needs.

There is no universal standard by which one can determine what is a basic human need, because society or culture fulfil human needs by the most disparate kinds of behaviour (Scimecca 1990). The system of human needs is variable, according to
particular cultural contexts (Nudler 1990). According to social explanations, most needs are by-products of the social group to which one belongs (Desmond 2003). Such explanations challenge the separate existence of physiological and psychological needs, arguing instead that all needs share a cultural component. Considering this point, Desmond (2003) emphasizes the ways in which artefacts make visible and stable the categories and distinctions of culture because physiological needs have no ‘cultural’, ‘aesthetic’, or ‘psychological’ component. Dant (1999) claims that the content of culture may not directly meet individual basic needs, but nonetheless provides the social contexts necessary for those basic needs to be met. The cultural and symbolic mediations of society can construct users’ needs, creating a demand for products (Dant 1999). Therefore, designers should not seek to separate ‘physiological’ from ‘psychological’ needs, as all needs are culturally defined. They need draw attention to the social context in which a need might be expressed.

When considering the needs of aging populations, some researchers believe that older people’s physical, social and cultural needs are associated. Macdonald (2003) claims that the future aging population has a much more diverse profile of physiological capability than that of today, accompanied by different lifestyle patterns for work, leisure, living and social interaction; consequently, this leads to diverse socially and culturally induced needs and desires.

Contrary to Maslow’s theory that the social needs only emerge after the others are satisfied, Baumeister (2005) suggests that social motives may be just as basic and powerful as physiological needs. It seems that the disadvantage of Maslow’s theory is that it proposes one hierarchy applied to everyone within every cultural context. For the different domains within different cultural contexts, each person’s needs model might probably be recognized and reconstructed as dynamic rather than static. In addition, Galtung (1990) claims that the hierarchy of needs deals not only with cultural diversity, but also with human diversity within cultures, and throughout any individual’s life cycle. Therefore, Galtung avoids building a hierarchy of human needs in his research:

Individuals and groups will have their priorities, and indeed their own concepts of needs. The purpose of need theory would be to inspire them into awareness, not to steer and direct them into well-structured need sets. A major purpose of development theory and practice would
have to be expand the range of possible, and this is better served by non-hierarchical than by hierarchical need sets where the priorities are universally given in advance (Galtung 1990, p. 312).

5.3 Design for Needs

‘Design for need’ is in fact a functionalist design reform call of the mid-1970s (Papanek 1985). Margolin (1997) suggests that designers should envision product possibilities based on a perception of what users’ need. Users are social actors who do not come to the product in a vacuum, but instead consider it in relation to their own activities. Despite various efforts in different corners of the world in the past thirty years, design for needs is not yet on the main agenda within the field of design (Margolin 1997). Understanding and responding to user needs, especially to older user needs, is regarded by many young designers as an unwelcome curb on creativity, rather than a spur to innovation (Coleman et al. 2003). Designers’ clients (e.g. product manufacturers) are usually not the users of the products designed. ‘To bridge the gap of not understanding and possible misinterpretation in the interface between designer and user, more direct channels of communication must be established’ (Preiser 2001, p. 9.2).

The design of technological artefacts is a cognitive activity that can be characterized as problem-solving activities undertaken by individuals (Simon 1969). Designers need to assess how technological products can support and transform the knowledge about the users’ needs and activities (Oulasvirta 2005). Thus understanding can be informative (providing useful research findings), predictive (providing tools to model user behaviour), or prescriptive (providing advice regarding how to design or evaluate) (Rogers 2004).

In addition, Patnaik and Becker’s (1999) need-finding method indicates that discovering motivational needs is not only important for designers; the activity can be useful for business, providing value beyond the development of single product. First, human need lasts longer than any specific solution. Second, needs are opportunities for design, not just guesses at the future. Product innovation does not have to depend only on predicting the future, because a crucial part of that future already exists in the form of human needs. Third, human needs provide a ‘roadmap’ for design (Kankainen 2002; Patnaik and Becker 1999).
Further, Oulasvirta (2005) argues that innovation, development, and evaluation of design ideas cannot be based only on the designer’s intuitions but must be grounded in human needs and activities. Through applying social and psychological sciences, Oulasvirta tried to understand how technology could qualify positive changes for users. Although most innovation of future technologies is technology driven, it remains that some alternative approaches such as user-oriented and activity-centred methods are emerging. Design is based on the understanding of social and individual needs and qualities of the context of use.

Kankainen (2002) also believes that human needs direct innovation and design. According to the author, there are two types of human needs: a motivation level and an action level. Motivation needs rationalize and motivate action in a context. They provide a promising starting point for discovering design opportunities at the level of the individual. Rooted in this idea, Kankainen and Oulasvirta (2003) conducted research to discover motivational needs for mobility in urban areas. In their study, three classes of needs related to mobility were found: personal needs, needs related to navigation and social needs.

Users’ needs provide the motivation to search for affordances, and individual characteristics of a user determine the content of the activity that effectively uses the affordance (Gibson 1979). The best-known design-for-needs approach is Lawton’s (2001) hierarchy, which is based on that of Maslow. From environmental and architectural design points of view, Lawton (2001) establishes a need-affordance analysis model for older people. In this model, if an environment cannot satisfy basic physical needs, there is no opportunity to pursue other needs higher in the hierarchy. On the other hand, a user’s willingness to pursue needs higher in the hierarchy may clearly involve taking the risk of loss of complete security. Similarly, Preiser (2001) suggests that physical accessibility such as being mobile is the first stepping stone toward satisfaction of many other needs. Lawton (2001) translates this theoretical array into an environmental design based on formal assessment. He emphasizes that this design process can be divided into four steps, of which the first is most important:

1. The systematic consideration of each need, for every prospective user.

Working from a need-affordance model at the very least reminds the
designer to take each into account systematically.

2. Systematic assessment of individuals on the characteristics of representative members of the user group. The competences in functional health and social behaviour can be defined as basic dimensions that characterize a user’s behaviour.

3. Assessment of an existing or prospective environment in terms of its affordances.

4. The design process itself is an art rather than a science. This art-of-design phase utilizes the material from the three previous steps but now depends on fitting patterns of expertise to the task.

From a human factor perspective, Jordan (2000a) developed the hierarchy of user needs (Figure 5.1, p. 67): level 1 – functionality, level 2 – usability, level 3 – pleasure. Moreover, Jordan established a four-pleasures framework which included (i) socio-pleasure, (ii) psycho-pleasure, (iii) ideo-pleasure and (iv) physio-pleasure. It is worth noting that Jordan’s hierarchy of user needs is also based on Maslow’s theoretical model. However, if Maslow’s theoretical model has been challenged, as mentioned above (Section 5.2.2), these kinds of hierarchy of user needs should be reconsidered by designers.

Fry’s (1992) discussion of different theories of need calls into question the ontological basis of design thinking. Using the work of Leiss (1990), Fry argues that the human system of needs in every culture is a binding unity of material and symbolic correlates. Basic needs cannot be distinguished from others. It is clear that this conclusion challenges Maslow’s basic-need category as well. Design shapes much of the world, and that shapes human beings. Fry insists that human beings, the world of human beings, their needs and design have to be thought of together.

Margolin and Margolin (2002) have responded to Papanek’s (1985) call, and sought to develop programs of design for social need ranging from the needs of developing countries to the special needs of the aged, the poor, and the disabled. Young designers need to find ways to empathise with older people they are designing for, to try and get under their skins and tap into their feelings as a source of insight and inspiration (Coleman, Lebbon and Myerson 2003). To understand older users,
designers learn from a direct engagement with user experience which gives insight into emotional and aspirational factors, and stimulates an empathic desire to respond to quality of life issues rather than just physical problems. Involving the older users’ needs into the central design approach is a spur to innovation. The product meaning which is interpreted by older users can be identified as an efficient empathy element to assist designers to better understand end-users’ needs.

5.4 Product Meaning Structure

The product initially has no meaning in its own right and physical property. Products are made in cultural contexts that are different from the one in which they are used. In using these products, users interact with the form of the object, which tells people about the functional and aesthetic design, the materials technology and the manufacturing techniques in the material culture of origin. These features of the material culture are embedded within the object and released as it is used (Dant 1999). Therefore, artefacts are not only material objects, but also function as signs which both denote and connote meaning. While artefacts may not be substitutable at the level of denotation (in terms of their use), at the level of connotation, many different artefacts may fill the desire beyond the utility value (Desmond 2003).

By means of constant association, products and their meanings, which are related to ‘real’ feelings, begin to mould the reality of how users experience the world. According to Dant (1999), product meanings, in the communicative interaction or aesthetic sense, are carried on the surfaces of artefacts as much as the meanings in the physical interactive are carried on the inside. Both types of meaning are built in by prior user action that is both aesthetic and physical. What artefacts mean depends to a large extent on how users view them, and this in turn depends very much upon how they interpenetrate with users’ experience and on the available linguistic codes with which designers classify them (Desmond 2003). Experience with the products of a different culture is a significant way to appreciate people of that culture; consequently, there are numerous possibilities for the international distribution of goods that increase designers’ awareness of this multicultural world (Margolin 1997).
In the meantime, constructionists believe that context organizes meaning and it is a form of ontological stability. The context fills a thing with particular meaning (Gubrium and Holstein 1999). Because meanings are potential things, things have no ontological status separate from how meanings work in the user’s experience. The meanings provided by the using context consist of the meanings in the products, the meanings of products in relation to other products, and the meaning of the whole structure of the setting (Kalviainen 2002).

According to Csikszentmihalyi and Rochberg-Halton (1981), the symbol embedded in the product is charged with psychic energy and transformative power precisely because much of its meaning is unconscious. Such unconscious drives include not only needs for physiological satisfaction but also a powerful desire for personal development and spiritual union with social and physical context. These strivings are expressed by archetypal symbols of collective unconsciousness. Further, these transformative processes must be rediscovered by each user in a different way, depending on his or her location in cultural space and time.

Simon (1969) designates nature as the ground of meaning against which a science or broadly conceived practice of design would be defined. However, the poststructuralist and deconstructionists challenge the idea of the equation of the natural with the real. Margolin (2002) recognizes that today’s artificial is a much more complex phenomenon than postulated by Simon (1969). The various critiques of positivism, the deconstruction of scientific discourse, and the multiple new voices that fill the space of social debate are all part of a different situation within which the artificial needs to be rethought. In such a context, an artefact’s meanings become a strategic concept that exists pragmatically at the interface of design and use. Its value is determined by operation rather than semantic concerns (Margolin 2002). According to Baudrillard (1988), the system of products is more coherent than the system of needs. In order to explore the user’s needs, it is necessary to study meanings embedded in the product system and transfer meaning into those needs.
5.4.1 Meaning and Cultural Context

According to Dant (1999) ‘culture is the set of common human practices that surround material object – the ways of using material, of sharing it, of talking about it, of naming it and of making it’ (p. 11). Dant (1999) argues that material culture is an important component of the social world people live in, which affects their values, activities and lifestyles. The context of cultural meaning helps people interpret the artefacts (Csikszentmihalyi and Rochberg-Halton 1981). ‘It is culture that gives products meaning, that provides the ritual within which they are used and the values that are often reflected in their form and function’ (Press and Cooper 2003, p. 12). Therefore, Dant (1999) shifts the thinking in the cultural and social sciences about the nature of material objects from treating them as products or technology to thinking about them as allies, as meaningful artefacts that make up a substantial part of the context of users’ social lives.

Fuhrer (2004) argues that cultural developmental psychology processes include culture (as action opportunities) which individuals experience themselves as agents of their own meaning-making activities or practices to cultivate their selves. Cultural mediation occurs as a unit of social-cultural structure referred to as context, setting, situation, activity, or practice. According to Fuhrer, identity as a meaning-making practice refers to people’s use of cultural artefacts as opportunities towards structuring an I-world relationship. Artefacts serve to give a tangible expression through signs to users’ relationships, experience and values. Meaning lies in self as much as in culture. Meaning is neither the stimulus artefact nor the individual self, but rather lies in the coming together of the self and artefacts at the particular cultural context (Fuhrer 2004).

Chapman (2005) supports Fuhrer’s theory from a design perspective. An artefact’s meaning is cultural-context specific. Object meanings change significantly in relation to their contextual surrounding and cultural environment. Designers must embrace this unpredictable quality as it enables artefacts to reflect multiple users’ needs. According to Chapman, artefact meaning can be divided into three essential characteristics: polysemy (a given object can mean many things), contextual sensitivity (a given object can have different meanings in different contexts), and
consensus (an object’s meaning should be shared by people in order for them to communicate about the object).

Csikszentmihalyi and Rochberg-Halton (1981) explore the implications of the triangular relationships among the self, the object, and the other. Cultural meanings embedded in artefacts are constantly being created by people through their lives, some embodying enduring meanings in new forms, others expressing new meanings in forms that can either be traditional or unprecedented.

5.4.2 Meaning and Experience

Social constructionisms share the understanding that the world of experience is a world composed of meanings, not of things (Gubrium and Holstein 1999). Experience broadens the discussion of function. Margolin (1997) suggests that designers move from a focus on the product’s mechanical operation to the way it fits into a user’s activities and product’s meaning, because product becomes meaningful only in relation to a user’s experience. According to Csikszentmihalyi and Rochberg-Halton (1981), the meaning of artefacts is interpreted in the context of past experiences, either consciously, or unconsciously in the form of habit.

Csikszentmihalyi and Rochberg-Halton (1981) emphasize that the artefacts appear to be signs on a blueprint that represent the relation of man to himself, to his fellows, and to the universe. These three levels can be described by two modalities: differentiation and integration. That is, artefacts serve a process of differentiation, separating the owner from the social context, emphasizing the user’s individuality. On the other hand, the artefacts symbolically express the integration of owner and user’s social context. Also, artefacts serve to express dynamic processes within people, and between people and the total environment. These processes lead either to a more-and-more specific differentiation, or to increasing integration. Transitions with artefacts include representation (a model of some aspect of environment) and active stimulation and creation (a model for the environment) (Csikszentmihalyi and Rochberg-Halton 1981).
Csikszentmihalyi and Rochberg-Halton (1981) conclude that the potential significance of objects is realized in a transactional process of ‘cultivating’ a world of meaning. The meaning of the artefacts becomes realized in the activity of interaction that this activity indicates: physical and psychological growth. They distinguish three modes of transaction (cognition, affection and conation) that seem essential to understanding how products can come to acquire significance. Most psychological theories focus on meaning construction from the cognition dimension and ignore the other two dimensions (Fuhrer 2004). Csikszentmihalyi and Rochberg-Halton’s (1981) three modes are important to experience and cultivation of the self, and serve to mediate the user with the product. The cognition mode might assess the nature of the user–artefact transaction. Aesthetic experience as a cognitive mode of transaction is not limited to art alone, but is considered a potential factor in all user experience. Moreover, activity can involve novel elements that make the experience unique and support the cultivation of self. The affective mode of the transaction between users and artefacts relates to how psychic energy is conducted. The flow of experiences (integrated attention), which serve to direct users’ psychic energy toward realizing their goals, contributes to a cultivation process by stimulating growth through the intrinsically rewarding nature of transaction with artefacts. The conative mode refers to the outcomes of person–artefact transactions.

In addition, product taste is a significant factor incorporating embodied aesthetic experience, identity building and social display. Users’ constructions of meaning in product use are based on their capacity for symbolic thought and coding, which is determined by the individual’s cultural capital such as knowledge and experience (Kalviainen 2002). Moreover, Jaasko, Mattelmaki and Ylirisku (2003) defined product meaning as the role that artefacts take in users’ lives. It is about the historic perspective of the use and possession of the product, the product’s attachments and stories reflecting these memories. The methodologies that can be used to explore product meaning include storytelling, interviews, collages, role play and product personality assignment (Jaasko, Mattelmaki and Ylirisku 2003; Jordan 2000a).
5.4.3 Meaningful Vehicle

In considering issues of vehicle design, Beckmann (2002) defined the automobile as a metal container that can be filled with any number of social and cultural meanings. The vehicle user as a subject imposes his or her wants on the object and defines the car’s uses according to his or her own needs. Simultaneously, the user is defined by the vehicle’s particular way of responding to the user’s needs. That is, a vehicle is used by many, and for many purposes. It is no longer only a machine for travelling through space, but a car that is ‘constructed’ to overcome a variety of other daily life problems.

According to Edensor (2004), the automobile can be defined as ‘the quintessential manufactured object’, and is ‘the most iconic 20th century artefact’. Automobility is construed as a ‘hybrid assemblage’ or ‘machinic complex’ (Sheller and Urry 2000) comprising humans, machines, roads and other spaces, representations, regulatory institutions and a host of related businesses and infrastructural features (Edensor 2004). Therefore, Coleman and Harrow (2000) claim that the vehicle should fit within the city environment, and the cultural aspects of the city might be reflected in the vehicle design.

Edensor (2004) suggests that automobility highlights the multidimensionality of national identity formation. The linkages between automobility and national identity are multiple, including state regulation; the geographies of ‘roadscapes’; driving practices, styles and cultural activities carried out in cars; the automobile service industries; types of journey; the range of representations which centre upon cars; everyday discourse; the economic importance of the symbolic motor industry; and the affordances of vehicles and roads. Cars become naturalised codes whose operation reveals not the transparency of linguistic or visual codes, but the depth of cultural habituation of the codes in operation (Barker, 1999, cited in Edensor 2004). As symbols, cars possess a mythic quality in their ability to absorb various meanings and uses, to remain open to a range of interpretations and thus remain ‘ideologically chameleon’ (Edensor 2004). The national identity can be entrenched in numerous symbolic, material, spatial and habitual ways. Such identity-making practices are accompanied by habitual practice grounded in vehicle user’s quotidian experience.
The grounded and habitual understanding of cars, their properties and potentialities, and the ways in which their weight, shape and mechanical aptitudes foster notions and practices about travelling and driving, produces an everyday relationship which is at once cognitive, sensual, affective and instinctive. Distinct sensations are produced by bodily interaction with particular cars, which possess particular affordances – the feel of the wheel, the seats, the rate of acceleration and the ease of changing gears – and they impinge on how the car can be manoeuvred (Edensor 2004, p. 116).

Considering the above discussion, designers take responsibility to translate multiple changes such as technology and material into forms with credibility and cultural validity. Car design offers an opportunity for individual countries to define their national identities. According to Sparke (2002), different nations and cultures interpret that freedom in different ways. For example, in Sweden, car design developed a pre-war philosophy that had a strong social program contained within it to identify unique national characteristics. Conscious of the particular needs of Sweden’s population, the Volvo and Saab companies aimed to create Swedish cars for Swedish users. It follows from the above literature that the growth of economies and the unique cultural traditions in China at this time require China to distinguish itself both as a means of consolidating an Eastern orientated identity for its own users and so show a distinctive face to the rest of world. On the other hand, vehicle meaning can be constructed differently due to different users’ cultural backgrounds. From this point, do Chinese drivers look on their private cars the same way that American drivers do? If cultural differences lead to meaning-making differences, why do drivers who live in different cultural contexts drive similar vehicles designed by multinational vehicle manufacturers? These questions need to be explored through focusing on differences of user–artefact meaning in different cultural contexts.

5.5  Design as Meaning Making

The making of meaning is vital to the design process. ‘To design is not to create things that make the world more fundamentally true, rather to create a world that has more meaning’ (Nelson and Stolterman 2003, p. 157). Simon (1969) believes that a process of design underlies everything in a culture, both material and immaterial. Designers can be defined as cultural intermediaries who help users find meaning, identity and sense in a highly confusing world (Press and Cooper 2003). Design
innovations developed to cope with a specific problem have a way of changing the way people do things and of altering how they relate to each other; eventually they affect the way people experience their lives (Csikszentmihalyi and Rochberg-Halton 1981).

Krippendorff (2006) argues that design is making sense of things, and making sense is the result of human activity. He distinguishes five applications of the concept of meaning:

1. Meaning is a structured space, a network of expected senses, a set of possibilities that enables handling things, other people, even oneself.
2. Meanings are always someone’s construction, and always embodied in their beholder.
3. Meanings emerge in the use of language but especially involving human interactions with artefacts.
4. Meanings are not fixed… meanings are constructed from previous experiences, expanded on them, and drift, much like imagination does.
5. Meanings are invoked by sense, and sense is always part of what it invokes.

Table 5.1: Design interpretation and meaning (Nelson and Stolterman 2003)

Nelson and Stolterman (2003) introduce interpretation as a part of the design process. Interpretation is the designer’s attempt to grasp the context that exists, and will set the stage for new ideas and new designs because every artefact is embedded in a context. Design and interpretations are intentional. The process of design interpretation is an act of decision making. The authors distinguish between different acts of interpretation and different purposes and outcomes. Table 5.1 shows that the found meaning and the possibilities of meaning are fused into an interpretation that embodies both a holistic and systemic character.
Krippendorff (2006) develops a similar framework, and suggests that designers should focus on users’ three modes of attention when they design artefacts. This framework includes recognition (correctly identifying what something is and what it can be used for), exploration (figuring out how to face something, how it works, and what to do to achieve particular effects) and reliance (handling something so naturally that attention can be on the sensed consequences of its use).

The artefact may adopt the language and deliver the message that implies a significant reinterpretation of its meaning (Utterback, Vedin, Alvarez, Ekman, Sanderson, Tether and Verganti 2006). Users can give to this object new meaning when they find new connections to their socio-cultural context and explore new symbolic values and patterns of interaction with the product. Therefore, the innovation of meaning demands profound changes in socio-cultural regimes. In this context, Nelson and Stolterman (2003) defined design as an emergent event that is made possible when value and meaning in a design are in resonance with a particular situation.

5.5.1 Product Semantics

In the traditional design areas, semiotics has been concerned with the nature of meaning. In the terminology of semiotics, visible product property, possession, and usage are signs that are interpreted by observers in a given context by means of an interpretive code. According to Kalviainen (2002), meaning is interpreted both from denotative and connotative messages in the object. ‘In denotation an object conveys information about its functions and what it stands for. Connotation refers to an aesthetic dimension, which conveys a subjective impression and emotion about product’ (Kalviainen 2002, p. 84). Barthes (1968) emphasizes the term ‘connotation’ or ‘connotative meaning’ which is used to refer to the subjective meaning an interpreter attaches to a sign in light of his or her cultural values.

The denotation–connotation dichotomy is contested, however. Heilbrunn (1998) suggests that there are the possibility of conflict between the denotative and connotative messages. For example, the form of a product can indicate its use, but
also adds an aesthetic dimension, which may contribute to a redefinition of the artefact’s function. According to Noth (1988), the semiotic essence of products cannot be exhausted in dichotomies such as utilitarian versus symbolic. Nor is the denotation–connotation dichotomy a sufficient tool for the description of the plurality of meanings associated with products. Noth (1988) proposed a multi-framed sign model in which products are prototypically perceived within three signs: utilitarian, commercial and socio-cultural. The author emphasizes that the most important role of industrial design should be to deal with socio-culture meaning.

For designers, the relationship between form and meaning is a fundamental concern of product semantics. Products must have form to be seen but must make sense to be understood and used. Challenging Louis Sullivan’s slogan ‘form follows function’, Krippendorff (2000) suggests that form may not follow function, but follow meaning, and designers need to understand not only the contexts in which their forms are used, but also how these forms are made sense of, or what they mean to some particular user. Therefore, Krippendorff (2006) has developed the theory of meaning for products in use, which addresses how users understand their artefacts and interact with them in their own terms and for their own reasons.

Krippendorff (2006) defined product semantics as a study of the symbolic qualities of human-made forms in the cognitive and social context of their use, and the application of the knowledge obtained to artefacts of industrial design. Different from traditional semiotic, product semantics is not a style, program, or movement. It
is a concern for the sense objects make to users, for how technical products are symbolically embedded in the fabric of society, and for the contribution they thereby make to the autopoiesis (the process of self-production) of culture. Krippendorff believes that artefacts are always seen in the context (of other things, situations, and users, including the observing self). Meaning-making is a circular cognitive process that starts with the initially incomprehensible sensation, which then proceeds to imagining hypothetical contexts for it, and goes around a hermeneutic circle during which features are distinguished and meanings are constructed until this process has converged to a coherent enough knowledge (Figure 5.2).

It is important to note that semiotics should seek to describe the mechanisms both of perception and representation (Solomon 1988). The perception meaning refers to understanding users’ activities and needs; representation is related transferring users’ needs to product properties.

### 5.5.2 Metaphors and Metonyms

Metaphor and metonymy provide a foundation for users’ understanding and communication of meaning in daily life (Kalviainen 2002). Metaphor is the most powerful tropes for creating new realities in the linguistic field. According to Kalviainen, metaphor is structured through the similarity relationships that enable users to adapt to new contexts by conveying an unfamiliar domain in terms of one that is familiar. On the other hand, Krippendorff (2006) defined metonyms as parts taken to stand for the whole to which they belong. For the artefact, ‘a metonym informs users about something on account of being a part of it, about the features of an artefact not in view, about the possible contexts of its use’ (Krippendorff 2006, p. 115). Metonyms provide the basis for a human-centred theory of signs. Designers can use common metonyms as metaphors to explore usability of artefacts.

Krippendorff (2006) concludes that metaphors and metonyms are the essential conceptual models for understanding what products come to mean to their users. Metaphors are indispensable in facilitating interfaces with novel or conceptually difficult objects. By contrast, metonyms increase the efficiency of exploration. Designers need to enable users to explore their artefact naturally. Artefact meaning
presupposes understanding and use. Because all understanding involves metaphors (understanding one thing in terms of familiar other things) designers should rely on metaphors from positive human experiences.

Age-related changes in cognition can be important to consider in designing for older adults. Although most cognitive capabilities show age-related decline, people’s semantic memory and procedural knowledge do not decline with age (Fisk et al. 2004). That is, when designing for older populations, designers should utilize these two kinds of positive cognitive capability and previous experience to assist innovation. Metaphor is one of most import approaches when designing for older adults because elderly people perceive and respond rapidly to artefacts that they expect on the basis of their experience. On the other hand, metonymy involves cultural tradition that is deeply embedded in older users’ activities. Such knowledge can assist designers to create proper artefacts to fulfil older people’s needs.

5.6 Connecting Design for Needs and Design for Meaning

All artefacts are social agents in the limited sense that they extend users’ activity and need, and mediate meaning between users. According to Dant (1999), the artefacts are shaped by a culture which defines what certain types of things can do. The material culture is an important component of the social world people live in that affects their needs, values, activities and lifestyles. When considering social exclusion, such as in an aging population, Lawton (2001) states that cultural tradition and meaning are the related sources of need fulfilment, in the sense that merging with an organized symbolic system is a source of a user’s strength and affective experience.

Baudrillard (1975) introduces the semiotic theory of consumption to link consumers’ needs and products’ meanings, in which commodities are not valued for their use but understood as possessing a meaning which is determined by their position in self-referential system of signifiers. From a post-modern cultural perspective, Baudrillard (1993) describes a contemporary detachment from reality toward a fabricated, and deeply abstracted, culture of signs. This process of reality fabrication can be
described as simulation. It is essential to note that consumption is motivated by need for the simulation, rather than physical products themselves.

The meaning of a product to a user can be seen to be closely related to the individual’s values in terms of trans-situational needs (Schwartz 1994) and the degree to which the artefact’s possession and use can elicit and satisfy the various functions incorporated in the user’s needs (Helfenstein 2005; Sites 1990). It is of great theoretical and practical use if designers can identify the key value dimensions in terms of meanings and evaluations that users attach to a particular artefact (Helfenstein 2005). According to Nelson and Stolterman (2003), value and meaning have an intricate relationship. The meaning of artefact can be ascertained by linking it with something of value, and something of value can gain meaning by being linked to something else of value. According to Fry (1992), human needs not only underscore human behaviour, they also highlight value because value posits need. Moreover, meaning of artefacts can be shown in a ‘means–end’ chain which captures the meaning structure of a brand, product attributes, benefits and values (Antonides and Raaij 1998).

Oulasvirta (2004) believes that human values have their source in experience and culture, which lead people’s meaningful lives. To link product meaning and human-centred design, Oulasvirta translated this idea into three guiding research goals: (1) relevance — design should aim to explore problems or needs that are relevant to people, (2) understanding — design must be based on a holistic understanding of people’s needs and activities, and (3) empowerment — the objective of design is to provide tools and services that empower and enable users to address their social, rational, and emotional needs.

According to Battarbee and Mattelmaki (2004), artefacts of choice carry personal meaning which can vary over time and over products. The empathic understanding of existing meaningful relationships with products can be used for designing products to satisfy users’ unmet needs. In order to look at meaningful product relationships from a design point of view, their study developed three main categories of products’ meaning: meaningful tool, meaningful association, and living object. The tool is needed for a purpose, in which the activity is meaningful to the user. The tool is an
integral part of the human experience. The meaningful association carries a meaning given by culture or an individual, in which personal meanings are constructed through experiences, and products are associated with them. In the relationship of a living object, an emotional link is created between the user and the individual product. People have various, overlapping relationships to meaningful artefacts, at the same time depending on their experiences.

Margolin (1997) suggests the need for a new theoretical model that can help designers use the power of users’ collective experience to create a product context that can better represent users’ needs. However, social scientists have given little attention to the product context. Sociologists and anthropologists have concerned themselves more with issues of consumption than with issues of use. There is no theory of social action that incorporates a relation to products, nor are there many studies of how people acquire and organize the aggregates of products with which they live their lives (Csikszentmihalyi and Rochberg-Halton 1981). According to Margolin (1997), the consequences of lacking such research include:

- Designers do not know enough about the relation between products and how people construct ideals of human emotions.
- Poorly researched products fail in the market place and waste valuable financial resources.
- There are few studies of technology innovation on which to base proposals for social policies or legislation that would link human wellbeing to the presence or absence of particular products.
- There is no systematic way of developing a social needs inventory to simulate the invention of beneficial new products.
- There is no pool of studies that can be used by cultural researchers in related fields to better understand the role of products in human society.
In conclusion, human needs contain different elements such as physical variables, social variables, psychological variables and cultural variables. Figure 5.3 shows that sociologists and psychologists study human needs from general and abstract levels. Because sociologists and psychologists focus on explanations, not design, their theoretical model differs from that of designers. Moreover, they do not discuss actual experiences that people may have had in their lives with concrete artefacts such as personal cars. Therefore, it is hard to provide designers with new knowledge to assist their innovations. The literature demonstrates that there are many crossovers between human needs and product meaning (Sections 5.2, 5.3, 5.4 and 5.5). Meaning is structured by users’ experiences, and artefact meanings reflect detail of user needs. That is, the meaning of artefacts can be an echo of human needs. The narrative of objective meanings can be used as a tool that reveals motivation and needs of activity that are important for future lifestyle (Kalviainen 2002). Therefore, from a human-centred design perspective, designers ought to adopt meaning as central to design in order to meet particular human needs.

5.7 Summary

The term human need refers to wants, demands, desires, interest, and propensities. In the classical literature on human needs, many more perspectives are found, ranging from physiological and psychological behaviour to sociological and cultural anthropology. It is clear that different classification schemes are simply different ways of dividing the same underlying structure. The models differ in the level of detail. Most researchers have studied human needs from a general, abstract level.
However, their theoretical models cannot provide new knowledge to designers to help them design artefacts. Therefore, despite various efforts in different corners of the world over the past thirty years, design for needs is not yet a main agenda item within the field of design.

Based on the hierarchy-of-human-needs model, the most universal aspect of the design process assumes that all people share common needs and all design must spring from the accommodation of such needs. However, human needs are often context-specific, so that the design specifics may be less than universal. Designers have to recognize that needs, competences, preferences, and cultural traditions may not all be universal. These factors play an important role in motivating creativity in design. On the other hand, metaphors and metonyms are the essential conceptual models for understanding what products come to mean to their users. Synthesizing different needs definitions with the current research purpose, means that users’ needs can be defined as the state of drive or arousal that impels users’ activities towards a certain lifestyle or experience within the particular social and cultural context.

Values and meanings related to products and services form a central theme in consumer research, because they can reflect human behaviour, users’ needs, lifestyle, market segmentation, positioning and brand extension. Exploring the relationships between values and needs may help clarify not only what is being said concerning meaning, but other needs as well. Users’ values are important in terms of organizing predictable social worlds that provide meaning. On the other hand, people value what they need when they interact with the artefacts. Therefore, values are related not only to meaning but also to the needs. The literature shows that there are many overlapping elements between human needs and product meanings. Meaning is structured by users’ experiences, and objects’ meanings reflect the detail of user needs. In order to explore design for needs, designers should focus their research on artefact meanings.

For current research purposes, culture specifies how users make sense of shapes, colours, textures, strengths and channelling of energy, and so determines how users make use of and live with their vehicles. The vehicle is an object which contains a multiplicity of functions oriented to the overarching function of transport, and of
aesthetic statements that add up to the overall style of the vehicle. It is important to note that a personal vehicle is a complex object with a capacity for many different uses; consequently, its production is based on many different intentions, so that it cannot be reduced merely to a function or aesthetics.

Having reviewed and synthesized the relevant literature on older drivers (Chapter 2), older vehicle users in China (Chapter 3), design approach for older adults (Chapter 4), and designing meaningful products for user needs (Chapter 5), the next chapter proposes an empirical research methodology which can assist in attaining the study’s aims and objectives.
6.1 Introduction

This chapter presents the research plan and research method which are designed to explore the future Chinese aging generation’s travel needs. This study consists of qualitative research that continued to focus on the design direction until it was clearly articulated. This satisfied the investigation’s aims of exploring the older vehicle users’ travel needs, and so developing a theoretical model to support vehicle design.

6.2 Research Strategy and Paradigm

In order to develop a proper strategy to answer the research problem, it is important to state one’s research philosophy and inquiry paradigm. According to Creswell (2003), the research philosophy establishes what is believed to constitute legitimate problem solving, and therefore a possible approach to respond to the problem. Identifying a research philosophy involves investigation of the problem solving assumptions made in developing a strategy to explore the problem definitions. How a researcher determines an approach to a research problem depends on the personal position the researcher has taken concerning ways of creating new knowledge. The results are further dependent on the chosen methods used to answer the research questions.

There are two research paradigms, known as qualitative and quantitative research. This study employed qualitative research methods to answer the research questions. The qualitative paradigm is supported by a constructivist/interpretivist philosophy. It supposes that knowledge is subjective and multiple, and can only be understood through the researcher interacting with the focus of the research in a personal yet
biased inductive process (Creswell 2003; Miles and Huberman 1994). Qualitative methods such as interviews and co-discovery can help fill the gaps left by quantitative techniques (Clifton and Handy 2003). In the qualitative paradigm, theories are inductively developed to form a deep understanding of the meaning of the data, collected within a rich context-bound setting (Creswell 2003; Miles and Huberman 1994; Silverman 2000). Moreover, according to Siren and Hakamies-Blomqvist (2005), because transportation studies rarely approach travel behaviour from a social constructivist perspective, the qualitative research might remain unreachable in earlier research.

Hertzog and Light (2004) state that the research tools must be flexibly adapted to the complex problem of understanding how the population is embedded in, and responds to, a rapidly changing historical context. They further explore the idea that no context is more complex than the flux and rapid growth in the use of technology. Therefore, there is a critical need for effective and reliable methods for judging the efficacy of technological interventions for improving the functioning of older persons, for assisting them in performing tasks necessary for everyday living, for enhancing their capacity to engage in desired behaviours, and for generally improving their quality of life (Hertzog and Light 2004).

Recently, some researchers (Clifton and Handy 2003; Gardezi et al. 2006; Mehndiratta, Picado and Venter 2003) in transportation studies have claimed that qualitative research is vital to understand the complexity of transportation activity, which rests upon the subjective beliefs and behaviours of individual persons. Qualitative studies of travel behaviour have produced important insights about the future trends of travel needs, aging populations in car-dependent environments, growing levels of motorisation in developing countries and non-work travel activities (Clifton and Handy 2003).

In addition, qualitative research can refer to research about persons’ lives, lived experiences, behaviours, emotions and feelings, as well as about organizational functioning, social movements, cultural phenomena, and interactions between nations (Strauss and Corbin 1998). Therefore, the qualitative research paradigm has its roots in cultural anthropology. Gubrium and Sankar (1994) also support this idea:
in situations where cultural issues are the key, where it is important to understand the texture of differences within the study population and where the focus is on the dynamics of a situation or the development of a relationship, qualitative research can bring clarity and understanding through its attention to meaning, process, and context. Further, traditional aging-related research uses quantitative research techniques; however, over the last decade, there has been an increasing acceptance of qualitative methods in the aging research because these topics clearly are central to understanding aging as a cultural, social, experienced, and biological phenomenon (Gubrium and Sankar 1994; Rubinstein 1994).

6.2.1 Research Plan

This study was designed to investigate travel activities of current middle-aged and older vehicle users, and predict the future older users’ travel needs. To address such concerns, the study was organised in four stages: (i) data collection, (ii) data analysis, (iii) findings and (iv) theoretical model development.

Figure 6.1 illustrates this research plan. The first stage of the research plan comprised the pilot study and the main data collection. The pilot study was conducted in order to validate selected research methods and develop the initial coding framework to guide further data analysis in the main experiment. The findings from the pilot study were used to clarify and modify research methods in the main experiment. The data collection involved qualitative methods such as co-discovery, interviews and travel logbooks.

The second stage entailed the analysis of the experiment. Results from the analysis of visual and textual data were used to identify the similarities and differences between Chinese middle-aged vehicle users and older vehicle users in regard to their travel needs and activities. Based on grounded theory (Strauss and Corbin 1998), these analyses assisted in gaining insights about key factors that influencing the Chinese middle-aged and older vehicle users’ needs. Such identifications could help this study to do cross-age comparisons and explore future aging generations’ travel needs.
In the third stage, findings from the previous analysis were used to identify a conceptual framework about future older vehicle users’ travel needs from a design perspective. Through integrated comparing and interpreting of each travel need category between two age cohorts, this study identified future travel need relationships and structures.

To implement previous research findings in designing vehicles, the forth stage focused on the development of the theoretical design approach. The older user information structure model and the Older-User-Needs-Based design approach were developed to assist vehicle designers proposing new vehicles for the Chinese future aging population. This theoretical implementation is based on the discussion of the significance of the research findings.

Figure 6.1: Research plan
6.2.2 Research Methodology

In order to choose an appropriate research method, an extensive literature review was conducted on the methods other researchers have used in similar circumstances. To minimize the problems that older people encounter in using products, Fisk et al. (2004) relied on applying systematic user-centred design processes. They suggest that the key to such a procedure is the timely application of various methods at different stages in the design process. According to Fisk et al., user-centred design incorporates user requirements, user goals and user tasks as early as possible into the design of the product, when design is still relatively flexible and when changes can be made at least cost. Based on these discussions, a number of methods and issues involving user-centred design were discussed. These methods include interviews, questionnaires, focus groups, task analysis, safe-environment analysis, observation, and verbal protocols. Fisk et al. point out that familiarity with these techniques can provide designers with both knowledge and insight when older users are being considered. They also suggest that the most useful methods for determining design for older users depend on the product.

Based on the above understanding, the empirical experiment was designed to investigate current travel needs and predict future travel needs for the older Chinese vehicle users. The experiment was divided into two sections (Sections A and B) in relation to the following two objectives:

- To investigate current older and middle-aged vehicle users’ travel activities and needs;
- To explore and forecast the future older Chinese vehicle users’ travel needs.

In Section A, the co-discovery method was employed to explore the older Chinese vehicle users’ future travel-related needs. The participants were divided into eighteen groups to discuss and envisage their future travel activities and lifestyles, and sketch their own future car. Section B was designed to investigate present older and middle-aged vehicle users’ travel patterns, experiences and needs. Sections A and B of the experiment are summarised in Tables 6.1. Findings from the pilot study (Section 6.4.2) helped to clarify the research methodology.
Table 6.1: Experiment structure summary

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<th><strong>Section A</strong></th>
<th><strong>Section B</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td>To explore and forecast future older Chinese vehicle users’ travel needs</td>
<td>To investigate present older and middle-aged vehicle users’ travel activities and needs</td>
</tr>
<tr>
<td><strong>Data collection method</strong></td>
<td>Co-discovery</td>
<td>Interview</td>
</tr>
<tr>
<td><strong>Setting</strong></td>
<td>The meeting room</td>
<td>Inside participant’s vehicle</td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td>One hour</td>
<td>Half an hour</td>
</tr>
<tr>
<td><strong>Data collection technique</strong></td>
<td>Following the structured topic list, two participants discuss their future lifestyle related vehicle use.</td>
<td>Semi-structured questions to clarify participants’ experiences and activities related to vehicle use.</td>
</tr>
<tr>
<td></td>
<td>Participants need to imagine and draw their future car and explain their sketch each other.</td>
<td>Use of digital video to record the products and accessories in the participants’ vehicle.</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td>Digital video recorders are used to record verbal and visual data.</td>
<td>Digital audio recorders are used to record verbal data.</td>
</tr>
<tr>
<td></td>
<td>Pencils and paper are prepared to support participants’ sketches.</td>
<td>Digital video recorders are used to document products.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Three pages structured the log books are given to participants.</td>
</tr>
<tr>
<td><strong>Participants</strong></td>
<td>Eighteen middle-aged vehicle users (45-59 years old)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eighteen older vehicle users (60 years old and above)</td>
<td></td>
</tr>
</tbody>
</table>

To ensure the research validity, the experiment was based on a data triangulation approach consisting of co-discovery, interviews and logbooks. Triangulation of methods can make good use of different methods that overcome each other’s weaknesses (Potter 1996). In the travel needs research, the triangulation in information acquisition ensures rich information feedback from the different frameworks for the users’ needs. Figure 6.2 illustrates the research methods. Black bold fonts in three large circles illustrate the data collection methods. The white bold fonts in small orange circles which are attached to the large circles show the relevant data formats generated by data collection techniques (Table 6.2). It is envisaged that this study might predict the older Chinese vehicle users’ future travel needs by comparing the data generated from this experiment.
6.2.3 Maximum Variation Sampling

Different qualitative methods require different minimum sample sizes. Morse (1994) has recommended that grounded theory studies should include about 30 to 50 samplings. Therefore, the main experiment conducted in China involved 36 participants. Such in-depth rich information from a small number of people is valuable in exploring research questions (Section 1.3).

According to Coyne (1997), in-depth information can be achieved through purposeful sampling strategies. Sample size in qualitative research may refer to numbers of persons, but also to numbers of co-discoveries (Appendix 3), interviews (Appendix 4), and logbooks (Appendix 5) conducted, or numbers of events sampled (Sandelowski 1995). Based on the above understanding, each participant in this study took part in three data collection methods. That is, the main experiment collected the 36 interviews, 36 logbooks and 18 co-discoveries to ensure variation in theoretical sampling. Therefore, there are 90 sampling events involved to ensure the validity of the research methods.
6.2.4 The Role of the Researcher

The qualitative research raises an important concern about how the researchers are to present themselves in the community being studied. In this study, the researcher identified himself as an active observer; this allows participation, but only to a limited extent, and then with controls (Potter 1996). At the launch of the co-discovery and interview sections, the researcher was active, gaining access and being involved in the discussion to ensure that the conversations were closely related to the research problems. The researcher then tried to be passive once participants started to have a clear understanding and direction on what to talk about. This researcher’s role was adapted in this way because qualitative researchers need to observe phenomena or conversations in their natural state and as undisturbed as possible. Moreover, during the logbook section, the researcher also assumed the role of a passive observer because it is a safe way to maintain distance between himself and that which is being studied (Foster 1996; Potter 1996).

6.3 Data Collection Procedures

The fieldwork took six months in China. The data collection procedures aimed to obtain a rich and detailed descriptive account of the travel activities and needs. Therefore, the data triangulation approach generated multiple forms of data to ensure the reliability and validity of the research. According to Galtung (1990), the non-verbal data obtained from observations and sketches are more valid but less reliable, partly because replication is less feasible. The verbal data is more reliable, but less valid. For computer aided data-analysis purposes, all formats of raw data have been transcribed into textual and visual data (Table 6.2).
### Table 6.2: Data collection sources

<table>
<thead>
<tr>
<th>Forms of data</th>
<th>Type of data</th>
<th>Definition of type of data</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Textual</strong></td>
<td>Co-discovery transcription</td>
<td>Structured iterative protocol generated by two participants’ discussion which related their future lifestyle.</td>
<td>Textual data used to explore participants’ future travel needs</td>
</tr>
<tr>
<td></td>
<td>Interview transcription</td>
<td>Semi-structured interviews consisting of asking open-ended questions related to participants’ travel needs.</td>
<td>Textual data used to investigate participants’ current travel needs</td>
</tr>
<tr>
<td></td>
<td>Travel logbook</td>
<td>Dairy reports written by participants about their current daily travel patterns and travel behaviours.</td>
<td>Textual data used to investigate participants’ current travel needs</td>
</tr>
<tr>
<td><strong>Visual</strong></td>
<td>Sketches in co-discovery</td>
<td>Images and sketches generated by participants to illustrate the ideas about their own future car.</td>
<td>Visual data used to explore participants’ future travel needs</td>
</tr>
<tr>
<td></td>
<td>Video in co-discovery</td>
<td>Video data used to record the participants’ speech, emotion and behaviour during the co-discovery experiment</td>
<td>Visual data used to back up co-discovery textual transcriptions and sketch analysis</td>
</tr>
<tr>
<td></td>
<td>Video in interview</td>
<td>Images of objects which were used or taken by participants in their private car.</td>
<td>Visual data used to back up interview textual transcription data analysis</td>
</tr>
</tbody>
</table>

#### 6.3.1 Participants

This study gathered responses from two types of Chinese participants: eighteen middle-aged vehicle users (45–59 years old) and eighteen older vehicle users (60 years old and above). It was easy to compare and identify the similarities and differences between two age cohorts based on the equal numbers of the two participant groups. During the experiment, the researcher reviewed the selection, sampling and screening processes of participants. The recruiting process was divided into two stages. In the first recruiting stage, the participants included Tsinghua University’s academic staff, and family and social networks of the researcher. In the second recruiting stage, the participants net was cast more widely by sequential sampling (snowball sampling) (Patton 2002), obtaining only a few suggested respondents from each source. In other words, Participant A suggested Respondents B and C from the list of characteristics, B suggested D and E, C suggested F and G and so on. A simple screening of potential candidates was conducted to make sure the participant pool comprised different gender, educational background and occupation representatives (Appendix 1).
The research sites involved two Chinese cities: Beijing and Dalian. Both cities are facing high levels of motorisation and aging problems. Beijing is considered the best city for comparison purposes because it is the capital, and has drivers and vehicles from all over the country (Zhang et al. 2005). In addition, Beijing has the largest number of drivers and vehicles in China. It is also one of the biggest cities which face aging problems in China. Dalian is a typical middle-sized harbour city which is located in the north-east of China. There were six participants involved in the study when the experiment was conducted in Dalian. The purpose of including the Dalian participants was to understand if the categorizations generated by the analyses of elderly vehicle users’ travel needs in the primary research site would be consistent with those in a middle-sized Chinese city.

6.3.2 Co-Discovery

The co-discovery method can be defined as two participants exploring a product and working together to perform tasks while an investigator observes (Hom 1998; Jordan 2000a). Participants who worked in pairs could describe their expectations in more detail and enjoy voicing their experiences and opinions aloud to another person (Braun 2006). Therefore, the co-discovery protocol was employed to investigate the elderly Chinese vehicle users’ future travel needs as it offers answers to many of the ‘what’ and ‘why’ user problems.

During the experiment, the co-discovery process was conducted in the meeting rooms at Tsinghua University (Beijing) and Telecom Company (Dalian) (Figure 6.3). The participants were divided into eighteen groups (two participants per group). Each group was organized on the understanding that the two participants had common social interactions and knew each other well. This was to help them to communicate naturally during the co-discovery experiment. The co-discovery process consisted of two stages which lasted one hour. In the first stage, the participants needed to discuss and imagine their future lifestyle and social activities related to vehicle use for about 30 minutes. The co-discovery topics were semi-structured to ensure that the participants’ discussion contents were relevant to the research questions (Appendix 3).
In the second stage, participants were asked to design their future vehicles using pencils and paper within 20 minutes. This technique produced sketches that describe images of the participants’ concepts. In previous design research, sketches and drawings have been used as one of the generative techniques to elicit people’s past experiences and dreams of the future, and to express people’s thoughts about the product’s scenario of use (Sleewijk Visser, Stappers, Van der Lugt and Sanders 2005). Further, the sketches drawn by users might help researchers and designers to explore design features that users desire, and identify users’ unmet needs related to vehicle use. Following the sketch, two of participants talked to each other to explain their sketch. This kind of retrospective verbal report immediately after drawing helped the participants to determine the meaning of the drawing. This also diminished the risk of participants forgetting aspects of the information embedded in their sketches, and the risk of the researcher misinterpreting the visuals (Chamorro-Koc 2007). Digital video cameras were used to record this experimental process. The recording devices were placed as inconspicuously as possible, but participants were made aware of their use and assured of their privacy. The verbal data were transcribed and sketches were collected by the researcher for further analysis.

Figure 6.3: Co-discovery

6.3.3 Logbook

The second primary data collection technique involved travel logbooks (Appendix 5). In order to investigate the present older and middle-aged vehicle users’ travel patterns and needs, participants were asked to fill three pages of a diary about their daily travel activities on Tuesday, Thursday and Sunday. These three days, selected
from one week, involve work days and a week-end to ensure validity and reliability. The intent was to obtain a holistic picture of the participants’ daily travel activities with an emphasis on portraying the everyday experiences of individuals. Compared with traditional trip-focused travel dairies — which concentrate on the quantitative study of travel patterns such as distance of trip and time of travel (Clifton and Handy 2003) — this study designed a structured activity-travel logbook to conduct an in-depth investigation within the context (Zhao, Popovic, Ferreira and Lu 2008). The logbook followed a structured format so that the results from each participant’s daily travel patterns and activities could be easily compared with the others. In the logbook, the participants needed to report their daily travel scenario such as journey course, travel destination, trip purpose, number and affiliation of people they travelled with, and other activities performed during the journey. The setting of this method depended on participants’ choices. For example, they could finish the travel dairy in the vehicle or at home. The travel logbook generated textual data for daily travel patterns and scenarios with related user needs and habits. The textual logbooks were collected when participants finished them.

6.3.4 Interview

 Interviews produced data about current travel activities of middle-aged and older vehicle users. According to Hertzog and Light (2004), interviews have been thought of as social exchanges with fairly circumscribed roles for the older participants. They state that interviewers tend to produce more significant changes in question reading, more probing, and more feedback for responses with older participants. Similarly, for this thesis, the interviews helped this researcher to define what behaviour might be taken into account and pointed to the need for activity diaries rather than travel diaries (Clifton and Handy 2003).

Individual interviews were administered, and lasted for around half an hour. All interviews were conducted inside the participants’ vehicles. This setting provided the context that was relevant to aspects of the users’ travel experiences that might help design researchers to understand those preferences in a meaningful context. The semi-structured questions were employed to explore participants’ experiences related to vehicle use (Appendix 4). The interviews were audio-recorded and transcribed.
During the interview, video was taken to document the accessories of the vehicle, the products in the vehicle, and the participant’s activities. These visual data generated a wealth of data related to the vehicle context, and were available to be used to back up and clarify the textual and verbal data.

6.4 Data Analysis Procedures

Grounded theory (Strauss and Corbin 1998) was employed to analyse the qualitative data of this research. The rigor of the grounded theory approach offers qualitative researchers a set of clear guidelines from which to build theoretical models that specify relationships among concepts (Charmaz 2000). The analyses of user-vehicle interactions in this study had their roots in the empirical data and interpretations to build the theory from the design perspective. Therefore, this study utilized grounded theory to analyze the travel activities of two age cohorts and compare these data in order to develop a theoretical model on the future older Chinese vehicle users’ travel needs.

The analysis procedures were based on four steps for interpretation of outcomes that were performed during the pilot study and the main experiment. In the first step, this study focused on transcribing verbal and textual data collected from the experiment, and developing a coding framework to start the chain of theory development. In order to get an in-depth understanding and to develop sensitivity to the meanings in the data, the verbal data were transcribed into Chinese, which is the original language spoken by the participants. The researcher analyzed the textual data in Chinese to ensure the intangible meanings embedded in the native language context were clear. The coding procedures helped to identify, develop, and relate the concepts that were the building blocks of theory. The coding started with open coding (based on the sentence), then proceeded through examining each line of data and defining actions or events within it. Once initial categories and sub-categories were produced, this analysis moved to group the data into themes. That is, similar properties of categories were grouped together to form a theme (Table 6.4, pp. 109–110). Such an axial coding process was used to organize and identify the interrelationships between categories and sub-categories.
Following a general classification scheme of (T1) social practice for maintaining quality of life, (T2) local context, (T3) travel activity adaptation, (T4) vehicle meaning, and (T5) vehicle property was established, this study moved to understanding the connections between different themes. In this second step of data analysis, themes and categories were related to their subcategories to form more precise explanations about travel phenomena. The structure analysis paradigm was based on the coding system by thinking about every category’s properties and dimensional qualifiers.

- Through structure codes to find conditions – answer the ‘why’ question;
- Through locating the actions related to the vehicle using process to define the activity – answer the ‘how’ question;
- To determine the consequence – answer what happens as a result of these actions from a design perspective.

Such structural analysis helped to develop the conditional/consequential matrix (Figure 7.1, p. 114) which was used as a tool to guide further analysis. Moreover, this study was designed to rate the themes from the point of view of frequency, and so identify the significant themes. This analysis was done because it helped to build a systematic, logical, and integrated account, which included specifying the nature of relationships between substantial travel-related phenomena.

In order to re-examine the data to establish a more detailed descriptive model on the relationship among categories, the third step of analysis moved to cross-age comparisons and analysis at category, sub-category and conceptual levels. This analysis started with rating the categories and sub-categories from the point of view of frequency so as to identify the significant categories and concepts. Frequencies of categories and sub-categories were compared across four participant groups (Figure 1.1, p. 3):

- Between middle-aged vehicle users’ current travel actives and older vehicle users’ current activities;
- Between middle-aged vehicle users’ future travel actives (future younger-old users) and older vehicle users’ future activities (future older-old users);
Between middle-aged vehicle users’ present travel activities and their future travel activities (future younger-old users).

These comparisons were necessary because they helped to recognize the key factors that influence the needs of future older Chinese vehicle users. That is, through such integrated comparisons between two age cohorts, the significance of categories and sub-categories within the specific theme were identified by a higher relative count. Once the key factors emerged, they were put into a conditional/consequential matrix to map out the connection between them during the third data analysis step. In order to answer the research question, this analysis step focussed on producing an interpretation of these interrelationships and building a theoretical model to identify future travel needs for Chinese new aging generations.

Current travel activities were used as a reference framework for comparison, because seeing into the future is easier if researchers have a clear view of the current situation (Press and Cooper 2003). Future need is an abstract concept through which human beings bring symbolic order to the present, and meaning to past endeavours. Human coping strategies are often centred on the organization of present activities in the context of both experiences and future goals (Weingand 1995). It was envisaged that the findings from comparisons might help to predict and identify the future aging generation’s travel needs and activities (Figure 6.4).

Figure 6.4: Comparisons and prediction of future older vehicle users’ travel needs
The findings from the above analysis assisted (i) to identify the future elderly vehicle users’ travel needs categories and (ii) to structure the interrelationship between these needs categories. In the fourth analysis process, selective coding was conducted to (i) synthesize users’ needs influencing categories and (ii) to identify central categories about elderly vehicle users’ needs. According to grounded theory, as the concept is refined analytically through integration with other concepts, the theory grows in depth and explanatory power. A central category has analytic power, which pulls the existing categories together to form an explanatory whole (Strauss and Corbin 1998). The conceptual model for the identification of older users’ needs (Figure 8.3, p. 166), which was developed previously, was employed as a tool to incorporate various factors that influence travel needs. The selective coding was based on analysis of paragraphs of data (rather than sentence by sentence) to infer the general level of older vehicle users’ travel needs from the vehicle design point of view. Moreover, this study integrated cross-age comparisons of these central categories by calculating the proportion of participants mentioning the various travel-related needs. Through integrated comparisons and interpretations of overall categories between two age cohorts, the different meanings of travel needs between the two age cohorts emerged. The theoretical model about older vehicle users’ needs was built, based on integrated descriptions and conceptualization (Strauss and Corbin 1998).

6.4.1 Coding System

The coding procedures were useful to establish both descriptions of the users’ experiences with vehicles and to develop a framework for further vehicle design. In order to move from specific descriptions to more general level theoretical findings, grounded theory (Strauss and Corbin 1998) requires constant comparison of data and findings. It needs back-and-forth movement between concepts and raw data, across different types of evidence, cases and vehicle properties. Therefore, by analysing the travel activities of two age cohorts in their daily lives and comparing these data, patterns about future older vehicle users’ travelling needs emerged. In each section of the experiments, middle-aged and older vehicle users’ experimental outcomes were compared in order to infer their differences and nature. Moreover, by comparing the two sets of findings, differences between current and perceived future trends might
emerge. Therefore, results from the comparative analysis and well-established patterns of association between concepts (Blaikie 2000) helped to predict and identify the future aging generation’s travel needs.

As mentioned earlier in this section, the analysis started with the open coding of the co-discovery, interview and logbook transcriptions on a case-by-case basis. This was essentially a detailed examination of the data for identifying, naming, categorizing and describing patterns in the text. This provided a starting point for analysing the experiment, and produced the description of (T1) social practice for maintaining quality of life, (T2) local context, (T3) travel activity adaptation, (T4) vehicle meaning for users and (T5) vehicle property of users aspirations involved. From these five themes, 17 codes were generated; that is, social activity for maintaining daily lifestyle, social role adaptation, social acceptability, social accessibility, socio-economic factors, local geography, local customs, travel patterns, driving behaviour, social meaning, practical meaning, cultural meaning, economy, structure, function, technology, and aesthetics (Table 6.4). Atlas.ti was used in the coding and data analysis (Appendix 6).

Potential concepts and their properties were described on the coding notes, and tagged with key words. According to grounded theory, these concepts are the basic units of analysis. Concepts are the first step of moving from data to more abstract level explanations. Sub-categories and categories are higher in level and more abstract than the concepts they represent. When a similar set of categories, sub-categories or concepts started to emerge, they were sorted by recurring themes. Also defined as axial coding (Figures 7.4, 7.7, 7.10, 7.12 and 7.20), this analysis process involved putting data back together in a new way by making connections between concepts.

It is worth noting that the data was analysed based on the sentence during the coding framework development (open coding). It was further decomposed into segments. A segment is defined as a specific thought unit that conveys an idea or theme (Weber 1990). This technique was particularly valuable because it enables the analyst to raise questions about possible meanings (Strauss and Corbin 1998). In the textual data that was transcribed from the verbal data such as co-discovery and interviews, where
sentence related to a single factor influencing the travel needs of older people, that sentence would carry one code. For example in this co-discovery excerpt; ‘*there are some works I need to do, for instance part-time working and teaching.*’ This sentence relates to a single travel-needs-influencing factor, and it was coded once because it makes reference to ‘maintaining work’, which is a ‘social activity for maintaining daily lifestyle’; therefore it was coded (SAL). Moreover, some sentences contained multiple travel-needs-influencing factors. In such cases, these data segments were coded by the number of categories. For instance, the following sentence was coded three times: ‘*in case of some special situations such as illness or somewhere public transportation can not reach, I think that I will drive vehicle to there.*’ The first code was on ‘illness’ which is ‘social activity for maintaining health condition’; it was coded (SAL). The second code was on ‘travel modes selection’ such as ‘public transportation’ and ‘drive vehicle’ which is ‘travel patterns’; this was coded (TPT). When combining ‘special situation’ and ‘drive vehicle’, it is clear that the participant looks on the vehicle as a ‘tool for emergency support’. This sentence could be coded as ‘vehicle’s practical meaning’, so the third code (PMN) emerged.

In addition, all sketches and photographs were coded using the same coding system (Table 6.4). Visual data (sketches drawn by users, photographs shot in the vehicle) were used to back up textual data. The information from visual data assisted in analysis of (i) which particular vehicle properties were preferred by participants in their prototypes, (ii) how participants interpreted and transformed their current and future vehicle properties into particular meanings, and (iii) whether the categories emerging in the visual data could be linked to the elderly vehicle users’ needs. The examples of visual data analysis were presented in Figures 7.15 (p. 142), 7.16 (p. 145), 7.17 (p. 148), 7.18 (p. 149), 7.21 (p. 155), 8.6 (p. 173) and 8.7 (p. 182).
<table>
<thead>
<tr>
<th>Theme</th>
<th>Property</th>
<th>Code</th>
<th>Example</th>
<th>Interpretation parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social practice for maintaining quality of life (T1)</td>
<td>Social activity for maintaining daily lifestyle</td>
<td>SAL</td>
<td>‘When I am retired, the family will be the centre for my life…travel relates to go to hospital, shopping centre and my child's apartment…’</td>
<td>Regular patterns of activities that represent habitual or customary behaviour and social affinities in daily life</td>
</tr>
<tr>
<td></td>
<td>Social role adaptation</td>
<td>SRA</td>
<td>‘When we retired, we probably will get the grandsons. So, we will look after and carry our grandchildren to enjoy the leisure travel when we drive the car.’</td>
<td>Social position and responsibility adjustment or change combining aging process</td>
</tr>
<tr>
<td></td>
<td>Social acceptability</td>
<td>SAP</td>
<td>‘When we become older in the next decade, our cohort’s attitude must be different from current 60’s older people. We are more active than current old generation.’</td>
<td>Identification of the social group membership</td>
</tr>
<tr>
<td></td>
<td>Social accessibility</td>
<td>SAS</td>
<td>‘Maybe older guy will be suddenly ill and cannot move after he buys this car.’</td>
<td>Aging related cognitive and physical capability</td>
</tr>
<tr>
<td>Local context (T2)</td>
<td>Socio-economic factors</td>
<td>SEF</td>
<td>‘I think that Chinese society and economy develop fast.’</td>
<td>Background and environment that related to local trade, industry, policy and so on</td>
</tr>
<tr>
<td></td>
<td>Local geography</td>
<td>LGF</td>
<td>‘There are lots of problems such as traffic jam and no parking areas in the city centre.’</td>
<td>Local nature features that affect the transportation conditions</td>
</tr>
<tr>
<td></td>
<td>Local customs</td>
<td>LCT</td>
<td>‘I need a water heater in the car because Chinese people would like drink hot water and tea during the journey.’</td>
<td>The Chinese habitual practice, philosophy, and ritual which affect people’s travel-related activities</td>
</tr>
<tr>
<td>Travel activity adaptation (T3)</td>
<td>Travel patterns</td>
<td>TPT</td>
<td>‘…it is possible to take subway. It probably takes 40 minutes or one hour.’</td>
<td>Reliable samples of traits, actions, tendencies, models or other observable characteristics of vehicle user’s travel activities</td>
</tr>
<tr>
<td></td>
<td>Driving behaviour</td>
<td>DBV</td>
<td>‘Older people need steadily operate during the driving … they will drive slowly comparing with young guys.’</td>
<td>The driving-related action and reaction when particular groups of people use the vehicle</td>
</tr>
<tr>
<td>Theme</td>
<td>Property</td>
<td>Code</td>
<td>Example</td>
<td>Interpretation parameters</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------</td>
<td>------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Vehicle meaning for users</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practical meaning</td>
<td>PMN</td>
<td>‘Vehicle just likes a house or container which can carry a lot of necessary stuff.’</td>
<td>Functional and physical significances that relate to artefact (vehicle) benefits and values</td>
</tr>
<tr>
<td></td>
<td>Social meaning</td>
<td>SMN</td>
<td>‘I think that older people does not think a lot of status or class which is showed by his car when he retires.’</td>
<td>Psychosocial significances incorporating embodied user experience, emotion, identity building and social display when humans interact with an artefact (vehicle)</td>
</tr>
<tr>
<td></td>
<td>Cultural meaning</td>
<td>CMN</td>
<td>‘I would like hang a lucky symbol below the rear mirror … it may be a photo of Chairman Mao or Chinese luck knot … I will feel safety and comfort if there are these kinds of decorations in my car.’</td>
<td>Sense and value coming together of the users and artefact (vehicle) in the particular cultural context</td>
</tr>
<tr>
<td></td>
<td>Economic</td>
<td>ECM</td>
<td>‘…its using cost should be low; it should consume less gasoline.’</td>
<td>Vehicle properties that related to environmental sustainability, cheap and efficient use/purchase</td>
</tr>
<tr>
<td></td>
<td>Structural</td>
<td>STT</td>
<td>‘So, there should be proper space in this vehicle not only for the passenger’s areas but also for boot space.’</td>
<td>Physical vehicle properties with construction, configuration and interface</td>
</tr>
<tr>
<td></td>
<td>Functional</td>
<td>FCT</td>
<td>‘It must be have auto transmission; older driver do not like to operation troublesomely.’</td>
<td>Vehicle properties that enhance and benefit the physical action of its users</td>
</tr>
<tr>
<td></td>
<td>Technology / quality</td>
<td>TNG</td>
<td>‘Some kinds of smart and electronic devices might assist older people drive safely.’</td>
<td>The technological and essential invention, method, characteristics, and attributes of vehicle that benefit the vehicle users</td>
</tr>
<tr>
<td></td>
<td>Aesthetics</td>
<td>ATS</td>
<td>‘We would like to select simple style car.’</td>
<td>Emotional factors that induce appreciation of beauty with vehicle properties and driving interactions</td>
</tr>
</tbody>
</table>

**Key Abbreviations:**

- **SAL** -- Social activity for maintaining daily lifestyle
- **SAP** -- Social acceptability
- **SEF** -- Socio-economic factors
- **LCT** -- Local customs
- **DBV** -- Driving behaviour
- **SMN** -- Social meaning
- **ECM** -- Economy
- **FCT** -- Function
- **ATS** -- Aesthetics
- **SRA** -- Social role adaptation
- **SAS** -- Social accessibility
- **LGF** -- Local geography
- **TPT** -- Travel patterns
- **PMN** -- Practical meaning
- **CMN** -- Cultural meaning
- **STT** -- Structure
- **TNG** -- Technology / quality
6.4.2 Pilot Study and Research Methods Validity

The pilot study was conducted to ensure the validity of the research methodology. The methods conducted in the pilot study not only involved the co-discovery, interviews, and logbook, but also included observations that were made inside and outside the participants’ private cars. During the 40-minute observations, each participant was asked to perform specific tasks which involved using the controls, seeing parking, using the boot, and so on. The DV camera was used to collect the observation data. There were six participants involved in the pilot study.

The pilot study analysis started to code the verbal data and developed an initial coding frame. However, when using the same coding framework to analyse visual data generated by the observation method, this study found that the observation data could not convey enough useful information to answer the research questions. For example, all participants exhibited similar driving behaviours during the pilot experiment, and most behaviours could only be coded as ‘physical accessibility’. According to ethnographies, observational work in particular settings needs researchers to take time to enter into a community, gain acceptance, and understand a group of people. That is, researchers must engage in an extended period of observation (Silverman 2000) to ensure immersion into local culture and to gain the contextual and comprehensive information of daily life. In studies such as this, social and individual activities related to vehicle use are difficult to capture from only one observational visit; there are insufficient examples of daily activities in the context. This research method evaluation demonstrated that it would be necessary to revise the research methods for the main experiment. Therefore, to ensure research reliability and validity, the revised research methodology and approach were developed (Section 6.2.2).

6.5 Summary

This chapter described and discussed the methodological approaches of the study’s research design. The research design aims to identify the key factors which influence the needs of older Chinese vehicle users and establish a theoretical travel needs model for future older Chinese vehicle users. The grounded theory approach assisted in developing this research foundation. A methodological triangulation approach
consisting of interview, logbook and co-discovery helped to collect multiple forms of visual and textual data to explore the research question. Methods and techniques were tested through a pilot study that was proposed to assess the experiment’s general criteria.

By utilizing grounded theory, this chapter developed a coding system that provided a starting point for analysing further main experiments. In order to develop a future younger-old vehicle users’ travel needs model, the analysis approaches involved comparing middle-aged and older vehicle users’ travel-needs-influencing factors in different category levels. The next chapter reports the details about data analysis and interpretations.
7.1 Introduction

In order to gain an insightful understanding of the future older Chinese vehicle users’ travel needs, this empirical study goes beyond a simple categorization of the physical properties served by the vehicles; it also deals with the dynamics that give rise to the overall structure of user-vehicle relations. The analysis process focuses on exploring the nature of elderly user-vehicle interactions, and the fundamental components of the various elderly user-vehicle relations. These efforts will be helpful to answer the following question: How do these different dimensions interact to determine the vehicle related travel needs?

7.2 Interrelating the Themes

Central to the analysis of the data in this study has been the identification of the factors influencing the needs of older Chinese vehicle users, and how the future older drivers’ travel needs are constructed and shaped through interaction with vehicles. The term needs was previously defined as the state of drive or arousal that impels users’ activities towards certain lifestyles or experiences (Section 5.2). The ways in which users defined and redefined their needs and lifestyles shape the decisions of each user’s role (Sheth, Mittal and Newman 1999). Therefore, the emphasis of this study was on (i) drivers’ travel activities and experiences with the vehicle, (ii) observed consequences provided by the interaction with the vehicle and participants’ subjective interpretations of what constitutes users’ needs, rather than the marketers’ perspective. Therefore, the following analysis of needs is based on the vehicle users’ lifestyle and user–vehicle interaction.
As previously presented in the coding framework (Table 6.4, pp. 109–110), the data suggest the existence of five major travel-needs-influencing themes present in the vehicle users’ lifestyle and user-vehicle interactions. These include (T1) social practice for maintaining quality of life, (T2) local context, (T3) travel activity adaptation, (T4) vehicle meaning for users and (T5) vehicle property related to users’ aspirations.

In order to build the theoretical model, the findings should be presented as a set of interrelated concepts. The grounded theory suggests that researchers should locate a phenomenon within the full range of macro and micro conditions in which it is embedded, and trace out the relationships of subsequent interactions through to their consequences (Strauss and Corbin 1998). Therefore, this study builds a conditional/consequential matrix to explore interrelationships among five major themes that influence travel needs (Figure 7.1).

![Figure 7.1: Conditional/consequential matrix](image)

For current research purposes, *condition* can be understood as sets of events/lifestyle or circumstances pertaining to a phenomenon which will affect or relate to the older and middle-aged vehicle users’ travel activities and needs. It explains why and how older and middle-aged vehicle users respond to their current and future travel needs. Following the initial coding system, condition involves (T1) social practice and (T2) local context.

The term *activity* can be understood as older and middle-aged vehicle users’ activities responding to their travel needs. These may include strategic actions,
routine habits related to travel behaviours and travel patterns. The data suggest that social practice and local context variables affect the aging populations’ adoptions to their (T3) travel activities.

The term consequence can be defined as outcomes of activities related to travel behaviour and patterns. For the purposes of this research, consequences are represented by specific properties and vehicle-related meanings that can meet the vehicle users’ current and future travel needs. The raw data and coding system show that travel activity adaptation generates the particular travel needs which can be reflected by two kinds of consequential factors: (T5) vehicle property and (T4) vehicle meaning. Figure 7.1 illustrates this conditional/consequential matrix, which conveys the interrelationships among the five themes.

Figure 7.2 helps to identify the significant themes of the travel-needs-influencing factors through calculating the overall frequency counts of categories. Two age cohorts show a similar tendency across the five themes. Vehicle meaning (T4) is identified as the most significant theme for both age cohorts. Here, 33 per cent of older cohorts and 34 per cent of middle-aged cohorts mention the vehicle meaning. This demonstrates that vehicle meaning plays an important role in shaping vehicle users’ travel needs (both age cohorts). Therefore, in order to answer the research question, two factors have been central to exploring future older users’ travel needs: (i) the identification of how Chinese users define meaning for their vehicles and (ii) how meaning is constructed and shaped in their local context, social practice, travel activity adaptation and vehicle properties.
It is worth noting that middle-aged and older users mentioned the same frequency of local context (T2) (13 per cent). This shows that both age cohorts have similar attitudes towards the local context. Local context is a stable and consistent factor in shaping middle-aged and older vehicle users’ travel needs because both age cohorts use the vehicle within the same local context.

The data suggest that middle-aged users reveal more activity in their current and future life because they mentioned most of the five themes (T1, T3 and T4) more frequently than older users. The older cohort presented a higher frequency than the middle-aged cohort only in the vehicle property theme (T5) because they assume that tangible properties are going to benefit them in their age-related physical decline. Therefore, most vehicle properties can be linked with accessibility for the current older cohort (Figure 7.2).

![Figure 7.3: Integrated comparisons of travel-needs-influencing factors at the category level](image.png)

Although these travel-needs-influencing themes might be mentioned with similar frequencies to each other for both age cohorts, their interpretations within their own categories and sub-categories differ. Therefore, the next stage focuses on comparing the travel-needs-influencing factors at different levels. The summary of findings is illustrated in Figures 7.3, 7.5, 7.6, 7.8, 7.9, 7.11, 7.13, 7.14 and 7.19. In all these...
figures, the x-axis represents travel-need-influencing factors (at different levels) and the y-axis represents the percentage rate of occurrence of each travel-need-influencing factor. As can be seen from the figures, the pink curves show the fluctuation of older cohort’s travel-needs-influencing factors, and blue curves present the changeability of middle-aged cohort’s travel-needs-influencing factors. The dotted lines illustrate the participants’ current situation; the solid curves show their future situation.

Figure 7.3 shows the integrated comparisons of travel-needs-influencing factors between middle-aged and older drivers at the category level. There are five significant categories, in which all of the four curves exceed more than eight per cent (half of the peak). These are (i) social activity for maintaining daily lifestyle (SAL), (ii) practical meaning of vehicle (PMN), (iii) social meaning of vehicle (SMN), (iv) cultural meaning of vehicle (CMN) and (v) structure of vehicle property (STT). In general, the higher frequency rate of occurrence of a particular travel-need-influencing factor shows its significance to the Chinese vehicle users travel needs. In addition, these five core categories show strong linkages in the participants’ travel needs.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statement</th>
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<tbody>
<tr>
<td>Participant 12:</td>
<td>I don’t like a coupe because it’s an exclusive vehicle, which means it is impossible to sit three or more people in the small car. You know, older people need bigger space for their peers when they are travel together… we can look after each other while enjoying the journey.</td>
</tr>
</tbody>
</table>

The data show that constituents involved in the travel needs are closely related to the assignment of these five core categories. For instance, the data segment presented in Table 7.1 indicates that participant linked social activity for maintaining a leisurely lifestyle such as travelling by group (SAL) to the specific structure of vehicle property such as compatibility capacity (STT). It is observed that older vehicle users look on the vehicle as a tool for peer gatherings (PMN) — not only for sociability purposes, but also for showing concern for each other (SMN) during long-distance trips. In this context, leisure travelling can be defined as collective social activity in which the vehicle reflects interdependent cultural values in China (CMN).
These categories reflect the kinds of vehicles that users want in order to satisfy their future travel needs. By looking more closely at these categories, this study should be able to understand better the ties that bind elderly Chinese vehicle users to the material world around them, and the consequences of this relationship. Logically, the analysing begins with the condition themes and categories (Figure 7.1, p. 114).

7.3 Social Practice for Maintaining Quality of Life

Social practice plays an important role in explaining the investigated indicators of the aging population’s mobility (Scheiner and Kasper 2005). It has been defined as a condition for the Chinese vehicle users travel needs in this study (Figure 7.1, p. 114). Social practice for maintaining the quality-of-life theme (Figure 7.4) involved social activity for maintaining daily lifestyle (SAL), social role adaptation (SRA), social acceptability (SAP), and social accessibility (SAS) in this research. Figure 7.4 presents the categories of social practice for maintaining quality of life. This classification was constructed as a result of axial coding of the data and comparisons made across participants of different ages.

The categories of social practices (SAL, SRA, SAP and SAS) show different patterns between the two age cohorts (Figure 7.3, p. 116). The middle-aged cohorts mentioned the social activity category (SAL) more often than the elderly cohorts, both currently and in the future. This demonstrates that future younger-older vehicle users hope to spend their later years with activity involvement. Moreover, it is worth noting that four curves reach their bottom at the point of the social accessibility category (SAS), in which current middle-aged users are concerned about this point less than the elderly (current and future older users) (Figure 7.3, p. 116). Although current and future older users are a little more concerned with social accessibility than middle-aged users due to age-related physiological changes (Section 2.2), elderly Chinese vehicle users are less concerned with the accessibility factor than with other factors. This demonstrates that age-related lifestyle changes such as social acceptability (SAP) and social activity (SAL) are more important than physiological changes to shape the future older generations’ travel needs (Sections 2.3 and 2.4). Considerable differences emerged at the social acceptability category (SAP) between the two age cohorts. Future younger-old vehicle users (5 per cent) emphasized social
acceptability (SAP) more than current elderly and middle-aged people (3 per cent) did. Clearly, future Chinese younger-old users seek self-identity through using vehicles within the global markets (Zhao, Popovic, Ferreira and Lu 2007).

In order to gather more details about social practices of the Chinese vehicle users, this study compares the differences in social practice between two age cohorts at sub-category (Figure 7.5) and concept levels (Figure 7.6).

Figure 7.4: Social practice for maintaining quality of life categories
7.3.1 Social Activity for Maintaining Daily Lifestyle

Social activities for maintaining daily lifestyle encompass regular patterns of activity that represent habitual or customary behaviour and social affinities in daily life. The emphasis is on social activity in this research because travel results from the need to participate in social activities (Tindemans, Hofstraeten, Verhetsel and Witlox 2005).
The major sub-categories of social activity identified in the data are maintaining leisure lifestyle (SAL-1), maintaining health condition (SAL-2) and maintaining working (SAL-3) (Figure 7.4, p. 119).

Social activities undertaken to maintain leisurely lifestyle (SAL-1) are one of the most frequently occurring types of activity within the social-practice theme because both age cohorts emphasized this factor (Figure 7.5). Moreover, two age cohorts mentioned future leisurely lifestyle more often than they did current lifestyle. In the near future, the new older generation will retire and spend their savings on having a good time, which involves maintaining leisure pursuits such as shopping, hobbies, entertainment and travel (Figure 7.4, p. 119).

This study examines social activity in more detail, by comparing differences between two age cohorts at the concept level. Figure 7.6 shows that both age cohorts present a similar tendency in most of the concepts within the future social activity category because two solid curves illustrate analogous patterns. The social activity for maintaining leisure hobby (SAL-1.2) and maintaining leisure travel (SAL-1.4) are two significant concepts for both age cohorts’ future lifestyle because these two factors are mentioned with a frequency of more than ten per cent (Figure 7.6).

There are, however, many differences that show skewed distributions by age at the concept level of social activity for maintaining a leisurely lifestyle (Figure 7.6). The aging populations (both current and future older people) mention maintaining a leisure hobby (SAL-1.2) significantly more often than current middle-aged people (14 per cent of future older-old users and 12 per cent of future younger-old users versus 4 per cent of current middle-aged users).

In addition, the social activity for maintaining leisure travel (SAL-1.4) has been identified as one of the most significant concepts for the current and future aging population. They (17 per cent of future younger-old users, 14 per cent of current older users and 12 per cent of future older-old users) mention this factor obviously more often than the current middle-aged users (8 per cent). This challenges previous research (Burkhardt 2000; Kasper and Scheiner 2005) conducted in Western
countries, which indicated that mobility of elderly people is regarded as limited, and less frequently in comparison to other age groups.

These differences are extremely significant, and might reflect the lifestyle changes between middle-aged and aging vehicle users. Data suggests that future elderly Chinese vehicle users might travel more miles for maintaining their hobby due to lifestyle changes such as being retired from a full time job (Section 2.3). Travel to a leisure destination implies the transport of luggage and recreational equipment such as fishing tackle, camping equipment, pets and items for picnics. Such activities can be easily linked to the proper vehicle meanings such as the vehicle as a tool for carrying material objects (PMN-1.1) and a tool for exploring (PMN-1.7). Designers can also predict details of vehicle properties such as compatibility of vehicle capacity (STT-1.1) and food preparation accessories (STT-2.11) based on analysing users’ activities and vehicle meanings.

The above results also can be seen by the different patterns emerged at the maintaining working factor. Figure 7.5 (p. 120) shows that there are significant differences emerged among the four curves at the sub-category of social activity for maintaining working (SAL-3). It is clear that current middle-aged users (19 per cent) highlight this point more significantly than the older users (both current and future elderly). Future younger-old users mention this sub-category least frequently (7 per cent). Moreover, at the concept level of social activity for maintaining working (Figure 7.6, p. 120), there are large differences between current middle-aged users and older users (future younger-old users, future older-old users and current older users). Contemporary middle-aged generations highlight maintaining full-time work (SAL-3.1) currently (17 per cent), whereas they pay attention to part-time work (SAL-3.2) in the future (but only 6 per cent). Therefore, this findings show that future younger-old users are concerned more about leisure lifestyle than maintaining working. For the Chinese aging populations, it is conventional to think of lifestyles as a form of status that derives from a mastery of leisure time (Weber 1948). For example, most middle-aged users might have a lot of spare time to enjoy their leisure life and improve their quality of life after they retire from work.
Lifestyle can be utilized to provide a richer understanding of travel needs of unique sub-populations such as elderly vehicle users in China. Different lifestyle groups are symbolized by particular forms of travel activity and needs (Section 2.3.1) which can hint at details of vehicle meanings and properties to assist design innovation. The statements in Table 7.2 show that particular vehicle meaning and property can support Chinese older users’ leisure hobby.

Table 7.2: Statements on vehicle meaning and property supporting hobbies

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
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<tbody>
<tr>
<td>Participant 2:</td>
<td>My hobby is antique collecting. I would like to drive to the countryside or flea market to collect folk artworks and antiques when I am retired. So I need a vehicle which can not only carry these artworks but also protect these treasures when I am travelling in the countryside.</td>
</tr>
<tr>
<td>Participant 13:</td>
<td>I am going to make handicrafts and exhibit them in the art gallery in the next decade. So I need a big car to carry these things.</td>
</tr>
</tbody>
</table>

In addition, insofar as culture and sub-culture involve shared values and a shared way of life, they have much in common with some definitions of lifestyle. According to Scheys (1986), lifestyle is not just a matter of patterns of behaviour reflecting other social processes, but is also the very mechanism through which differential culture is wielded in society. Data suggest that most current or future elderly vehicle users share the same value to make long-distance leisure tours or hobby related travel. Clearly, similar lifestyles shape the sub-culture of retirement within the contemporary Chinese society.

7.3.2 Social Role Adaptation

Social role adaptation can be defined as social position and responsibility adjustment combined with the aging process. Social role adaptation for reinforcing family relationships (SRA-1) is one of the most significant sub-categories which follow the social activity for maintaining a leisurely lifestyle (SAL-1) (Figure 7.5, p. 120). Both age cohorts emphasize this point, not only currently but also in the future. On the other hand, both age cohorts mention the social role adaptation for maintaining social networks (SRA-2) with a similar frequency (from 7 to 10 per cent).

The significant difference between future and current travel needs for both age cohorts has been identified at the concept level of adaptation for reinforcing family
relationships (SRA-1) (Figure 7.6, p. 120). Middle-aged users in the present mention the nuclear family (SRA-1.1) significantly more often than themselves in the future (14 per cent versus 1 per cent). However, they emphasize the extended family (SRA-1.2) when they imagine their retired life (13 per cent). It is worth noting that both current and future aging generations pay more attention to the extended family (SRA-1.2) than the contemporary middle-aged people do. The data suggest that this is an adaptation process due to age-related family structure changes.

Table 7.3: Statements on social role adaptation

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 13:</td>
<td>I take my child to school and carry her when I take part in some community activity such as tree planting. She would like to sleep in the back seat during the journey. It is dangerous because she does not like to wear the safety belt.</td>
</tr>
<tr>
<td>Participant 14:</td>
<td>In the next decade, our children may be married. I probably will get a grandson. It would be great that my wife and I will use the car to carry our grandson to visit the museum and zoo.</td>
</tr>
<tr>
<td>Participant 3:</td>
<td>When I retire, I will focus on my big family. I will use a car to keep contact with relatives and to take care of my oldest parents. I think a car is useful when my oldest parents are sick, especially when they have some emergency health problems.</td>
</tr>
</tbody>
</table>

The current middle-aged users need a vehicle to reinforce nuclear family relationships, which are related to driving a private car (TMD) for escorting children (SMN). Therefore, the vehicle might be designed to include appropriate in-vehicle child safety facilities (Table 7.3: Participant 13). On the other hand, some vehicles are used to maintain extended family relationships for the future Chinese younger-old users. They will use vehicles to look after extended family members, who include grandchildren, oldest-old parents and other relatives (Table 7.3: Participants 14 and 3).

In the traditional culture, China had many households with three and four generations living together. Although most young generations’ households today comprise only the immediate family members with parents and children, elderly Chinese people still believe that it is good to have such a large extended family living under the same roof as it means the family is flourishing and harmonious (Section 3.5). Clearly, the older Chinese generation tends to hold on to lasting habits, and their behaviors are often influenced by traditional cultural values, even while using modern artifacts (motor vehicle). The family is a source which constantly diffuses cultural influences.
on Chinese individuals throughout their lives. Even though Chinese people might deviate from the traditional value orientations at some point in life, they would be assimilated again by their culture and their social status as they became old (Yau 1994).

It is clear that the concept of the extended family is important to vehicle design for the elderly Chinese vehicle users. The elderly Chinese users believe that society benefits when people discipline themselves and consider the needs of others (Kluckhohn and Strodtbeck 1961). The needs of extended family members such as grandchildren, oldest-old parents and distant relatives should be considered in the vehicle design stage. For instance, from a design point of view, using a vehicle to reinforce extended family relationships can be interpreted as tangible vehicle properties such as compatibility capacity for a gathering of relatives, childcare facility for grandchildren’s safety, and emergency support accessories for oldest-elderly health care. Clearly, although culture as an intangible element in shaping the future aging generations’ travel needs, it can be decoded as particular vehicle meanings and properties to support future aging generation’s travel activities (Section 5.4.1).

7.3.3 Social Acceptability

The term social acceptability refers to the socially oriented benefits attained through ownership and experience with artefacts (vehicle). The data from the present study suggest that social acceptability (SAP) is a significant category within the social practice theme due to considerably different patterns emerging between the two age cohorts (Figure 7.3, p. 116). Figure 7.5 (p. 120) shows that future younger-old users are concerned more about social acceptability factors than others. This can be confirmed by the fluctuation of social acceptability curves at the concept level (Figure 7.6, p. 120). It is clear that the middle-aged cohort mentioned most concepts of social acceptability more often than the older cohort when they talked about the future.

Future younger-old populations need multiple status identity through interaction with personal cars within the global market context. Personal vehicles are important
shapers of the self-identity in middle-age, and continue in later life as symbols of social acceptability for the future younger-old users. The middle-aged vehicle users express their identity as a certain generation, class, group, gender or individual by the use of a personal car (Figure 7.4, p. 119). Identity is constructed, reconstructed, or socially co-constructed through a particular local culture (Section 5.4). Therefore, local cultural elements play important roles in inspiring vehicle innovation by the use of appropriate form, colour, structure and function, in which multiple-status identity could be achieved.

This study shows that future elderly vehicle users are concerned about cohort identity (SAP-1) more frequently than they are at middle age (Figure 7.5, p. 120), especially in the concept of generation identity (SAP-1.1) (Figure 7.6, p. 120). The Chinese users are group-oriented towards the social units with which interactions have been found (Yau 1994). Although the Chinese middle-aged cohort is influenced by contemporary Western culture which pursues the values of the individual (SAP-3.2), they follow the appropriate social norms from the generation or group point of view, regardless of their own private views when they become old (Section 3.5). The need for cohort identity suggests that vehicle designing for older users’ experience might be a main agenda item in vehicle design practice because the cohort effect is closely related to each generation’s experience (Sections 2.3.3 and 5.4.2).

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
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<tbody>
<tr>
<td>Participant 5: I will join a group composed of our generation when I retire. Members of such a group must have similar experiences, hobbies and income. We will drive our personal car and travel together.</td>
<td></td>
</tr>
<tr>
<td>Participant 12: When we become older in the next decade, our cohort’s attitude must be different from the current 60’s older people. We are more active than the current old generation.</td>
<td></td>
</tr>
<tr>
<td>Participant 4: I enjoy being in a private car by myself. For my personality, I like to stay in a quiet and peaceful environment. This space is owned by myself. Nobody can disturb me when I sit in such a personal and independent small space.</td>
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</tbody>
</table>

Participant 5 in Table 7.4 shows that older Chinese people would like to take part in leisure activities by a particular group which is based on a similar hobby, early life experience and age cohort. Therefore, social acceptability can be linked with social activity such as maintaining a leisure lifestyle. Weber (1948) argues that a ‘status group’ is distinguished by the honour accorded to it by the rest of society, but also by
its particular style of life. The lifestyle adopted by a status group serves to mark the boundaries of the group and to reinforce the honour system which underpins the group’s status. In addition, Chinese current and future elderly vehicle users prefer identifying their status from a collective point of view rather than from an individual perspective. They prefer using ‘we’ rather than ‘I’ to describe the concept of self when they become old (Table 7.4: Participants 5 and 12), compared with using ‘I’ to emphasis personality during middle age (Table 7.4: Participant 4). The elderly Chinese vehicle users related themselves to other persons by bonds of interaction. They defined and cultivated their individuality by using the personal vehicles that enable them to exist among certain groups. This change with age, from self-identity to group-identity, matches different patterns between modern and traditional cultural values, which are hybrid within contemporary Chinese society. Modern culture emphasizes self-experience in terms of personal goals which, compared with traditional culture, highlight the users’ goals which are shared with others (Csikszentmihalyi and Rochberg-Halton 1981).

Table 7.5: Statements on social acceptability of gender identity

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 7:</td>
<td>As a woman, I pay more attention to the details in my personal car, which include a nice colour and personal in-vehicle facilities. I need a small cabinet which is designed in a hidden place to deposit my bag and shoes. Women usually have lots of beautiful bags and shoes. I would like to have sneakers when I am driving and high-heeled shoes when I get out of the car.</td>
</tr>
<tr>
<td>Participant 20:</td>
<td>I need a small shoe cabinet which is designed below the seat. I need to have sneakers when I am walking in the countryside. But sneaker’s soles are too thick for elderly drivers because my feet have problems sensing the [foot controls]. To ensure safe driving, I would like to change into thin and soft soled shoes when I am driving. Such an in-vehicle shoes cabinet would be convenient, it would make the vehicle interior more neat, and would give a good image for other people who might use my car.</td>
</tr>
</tbody>
</table>

In addition, both age cohorts mention similar frequency of social acceptability for gender identity (SAP-2) (Figure 7.5, p. 120). It is interesting that the interpretations show that feminization trends emerged not only in the older female users’ statement (Table 7.5: Participant 7), but also in the older male users’ conversation (Table 7.5: Participant 20). Data suggest that the future female aging population will seek new factors such as colours and functions that will help them to define who they are from interactions with traditional masculinity objects such as vehicles. Meanwhile, future older male users need detailed and feminized in-vehicle facilities to take care of
themselves (SMN-2.7) and to save face (CMN-1.5). It is clear that feminization trends in product design will emerge in the 21st century (Jordan 2000b), which will affect both male and female older users’ needs. The designers should focus on employing proper details and colour to build the feminization style. Moreover, such vehicle properties can construct particular cultural meaning so that vehicle users’ can save face. The literature (Section 2.3.2) also demonstrates that there are few gender-related differences for the new generations as they reach older age.

7.3.4 Social Accessibility

The data presented in this study suggest that social accessibility categories show the most skewed distributions by age (Figure 7.3, 7.5 and 7.6). The current and future elderly vehicle users’ express concern about their health condition (SAS-1) significantly more often than the current middle-aged users, due to age-related physiological changes (Section 2.2). These findings call designers to pay more attention to barrier-free design principles such as low-floor vehicles. However, the future younger-old vehicle users mention social accessibility of general health attributes (SAS-1.0) less than the current elderly users (Figure 7.6, p. 120). They demonstrate that continuing driving in older age represented a significant way to ward off an ‘old age identity’. Clearly, driving symbolised for the future Chinese younger-old users a positive and vital status. The data suggest that future new aging generations show more concern about their age-related differences from social, economic and culture perspectives than from a physical accessibility perspective. This challenges earlier road safety research (Section 2.2) which highlights the age-related sensory and cognitive differences.

7.4 Local Context

The local context theme includes socio-economic factors (SEF), local geography (LGF) and local customs (LCT) (Figure 7.7). Under socio-economic factors, this study groups general economy factors and national regulation factors. Under local geography are grouped residential patterns, travel resource and local climate. The local customs category comprises beliefs/philosophy and social ritual sub-categories. Compared with the social practice theme, which constructs Chinese subjective
culture, local context shapes Chinese objective culture (Gould 2005; Stewart and Bennett 1991) (Section 3.5.1).

<table>
<thead>
<tr>
<th>Theme</th>
<th>Categories</th>
<th>Sub-categories</th>
<th>Concepts</th>
</tr>
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<tbody>
<tr>
<td>T2. Local context</td>
<td>LGF. Local geography</td>
<td>LGF-1 Residential patterns</td>
<td>LGF-2.1 Travel infrastructure/service</td>
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<td></td>
<td></td>
<td>LGF-2 Travel resource</td>
<td>LGF-2.2 Scenery/heritage</td>
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<td></td>
<td>LGF-3 Local climate</td>
<td>LGF-2.3 Traffic condition</td>
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<tr>
<td></td>
<td>LCT. Local customs</td>
<td>LCT-1 Beliefs/philosophy</td>
<td>LCT-1.1 Visual convention</td>
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<td></td>
<td></td>
<td>LCT-2 Social ritual</td>
<td>LCT-1.2 Social ethics/responsibility</td>
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<td>LCT-1.3 Environmental belief</td>
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<td>LCT-2.1 Festival</td>
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<td>LCT-2.2 Food/beverages</td>
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<td>LCT-2.3 Etiquette</td>
</tr>
<tr>
<td>SEF. Socio-economic factors</td>
<td>SEF-1 General economy</td>
<td>SEF-1.1 National GDP</td>
<td></td>
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<td></td>
<td></td>
<td>SEF-2 National regulation</td>
<td>SEF-1.2 Local vehicle industry/market</td>
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<td>SEF-1.3 Personal income</td>
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<td></td>
<td>LGF. Local geography</td>
<td>LGF-1 Residential patterns</td>
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<td></td>
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<td>LGF-2 Travel resource</td>
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<td>LGF-3 Local climate</td>
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<td></td>
<td>LCT. Local customs</td>
<td>LCT-1 Beliefs/philosophy</td>
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<td></td>
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<td>LCT-2 Social ritual</td>
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</tbody>
</table>

Figure 7.7: Local context categories

Everyone in the Chinese cultural context shares the same objective cultural orientation. Therefore, middle-aged and elderly cohorts present similar frequency among the local context categories and sub-categories. As objective culture, local context shows stable and constant characteristics due to similar trends emerging among the four curves — not only at the themes level (Figure 7.2, p. 115), but also at the categories and sub-categories levels (Figures 7.3 and 7.8).
7.4.1 Socio-economic Factors

Older vehicle users’ travel needs are affected by socio-economic factors, not only at the macro-level such as local policies (SEF-1), but also at micro-levels such as personal incomes (SEF-2). Global evidence suggests that income is the most powerful determinant of personal car ownership (Ingram and Liu 1999). This study revealed that aging populations (both currently and in the future) are concerned more
about the personal income factor (SEF-1.3) than contemporary middle-aged vehicle users (Figure 7.9). Age-related income decline is the condition factor that affects economic vehicle properties such as low energy consumption, durability quality and ease of maintenance.

7.4.2 Local Geography

The local geography is an important category which involves residential patterns (LGF-1), travel resource (LGF-2) and local climate (LGF-3) sub-categories (Figure 7.7, p. 129). All four curves describe similar trends within the local context categories in which both age cohorts highlight the local geography category (LGF), not only currently but also in the future (Figure 7.3, p. 116). When compared at the sub-category level, Figure 7.8 shows that the travel resource (LGF-2) is one of the most significant factors for both age cohorts’ travel needs, because four curves reach their peak at this point. Although both age cohorts mention travel resource (LGF-2) with similar frequency, the concepts and interpretations of this sub-category show different patterns between current and future travel needs. Both age cohorts highlight the concept of traffic condition (LGF-2.3) currently, whereas they emphasize the concept of scenery/heritage (LGF-2.2) in the future (Figure 7.9). These different patterns emerged in the experiment in that both age cohorts wished to drive for leisure travelling (SAL-1.4) to the countryside (LGF-2.2) in the future, while they currently drive in the dense city centre (LGF-2.3) for business (SAL-3). The data suggest that most leisure travel demands rest on underlying perceptions and cultural tensions, particularly where the countryside and heritage are concerned by elderly vehicle users. Therefore, considering the traffic infrastructure and road conditions in the Chinese countryside, future older users’ vehicles might have reliable quality, solid form, and off-road functions to support leisure travelling to the countryside. The biggest challenge for the designer is how to integrate these factors into accessibility and usability design principles (Sections 4.2 and 4.3).

The data also show that elderly vehicle users generally try to avoid driving under poor weather conditions, at dusk or at night, and during rush hours. These findings verify earlier research (Hakamies-Blomqvist, Siren and Davidse 2004; OECD 2001) conducted in Western countries (Section 2.2.4). In summary, as a tangible cultural
element, local geography (LGF) is a part of the preconditions for changing older vehicle users’ driving behaviour (DBV).

7.4.3 Local Customs

Local custom (LCT) is a stable category because three curves (future younger-old users, future older-old users, and current middle-aged users) cross at the point of three per cent and the forth one (current elderly users) is also close to this cross point (4 per cent) in Figure 7.3 (p. 116). Moreover, at the sub-category and concept levels (Figures 7.8 and 7.9) of local customs, four curves present similar tendencies.

Table 7.6: Statements on local customs

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 23:</td>
<td>All of my family members are living in Beijing. So I bought this car to maintain good relationships with them. Especially, I take responsibility to look after my oldest-old mother and this car is very helpful to do such things.</td>
</tr>
<tr>
<td>Participant 19:</td>
<td>I would like to be the driver for taking all of my family members to the graveyard during the Qingming Festival (Traditional Tomb-sweeping Day). It is a big day to worship my family’s ancestors. So we need a big car to include all of the family members.</td>
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</tbody>
</table>

The beliefs/philosophy sub-category (LCT-1) has been identified as one of the most significant sub-categories within the local customs category because both age cohorts mention it frequently (Figure 7.8, p. 130). When comparing concepts of beliefs/philosophy (Figure 7.9, p. 130), both age cohorts highlight the social ethics factor (LCT-1.2), which has been defined as a central theme in Chinese traditional philosophy (Hsieh 1967). The data suggest that the concept of social ethics (LCT-1.2) can be easily linked to social role adaptation for reinforcing the family relationship category (SRA-1). For example, the filial piety doctrine, which is primary a Chinese ethical principle, drives Participant 23 (Table 7.6) to use a car to take care the oldest-old parents.

In addition, three curves cross at the visual convention concept (LCT-1.1). Visual convention includes traditional auspicious factors, colour, features, symbols, materials and language. These factors are associated with different vehicle meanings such as metaphors of luck (SMN-2.1) and tools for safety (PMN-1.3). The interrelationships among these concepts will be discussed later. Here, it is worth noting that the Chinese elderly vehicle users appreciate being communicated with, in
their own language. However, the problematic in-vehicle interface elements include English characters based on different norms of icons that not only violate national conventions, but also affect the correctness of driving decision-making.

Social ritual (LCT-2) is a kind of social action devoted to the manipulation of cultural meaning for purposes of collective and individual communication and categorization, which is an opportunity to affirm, evoke, or assign the conventional symbols and meanings of the cultural order (McCracken 1986). It is clear that social ritual is rooted in cultural tradition. The data presented in this study suggest that Chinese rituals involve festival, food and etiquette traditions. It is interesting that current and future elderly vehicle users mention festival with the same frequency (LCT-2.1). The festivals in China strengthen familial bonds which involve family reunions and ancestral worship. Chinese festivals embody the cultural characteristics and spirit of the nation. Chinese people, especially the elderly, organize various travel-related activities to celebrate festivals to help younger generations gain a deeper understanding of their own roots. Therefore, they look on the personal car as a tool to gather the family members (PMN-1.6) within this cultural context (LCT-2.1) (Table 7.6: Participant 19). From a design point of view, compatible and capacious in-vehicle space and framework (STT-1.1) can be the solutions to gathering extended family members.

7.5 Travel Activity Adaptation

The travel activity adaptation theme comprises two categories: travel patterns (TPT) and driving behaviour (DBV) (Figure 7.10). The travel activity model that has been developed so far shows the necessity of integrating behavioural and social science elements into the model (Stern and Richardson 2005). Some of the travel activity research projects were generated on the basis of the activity-based choice paradigm, actually rooted in the space-time geographical studies (Section 2.3). Most travel activity models (Dijst and Vidakovic 1997; Timmermans, Arentze and Joh 2002) — which concentrate only on time-space, a facet that includes trip chaining and driving decision making — lack the necessary context mechanisms to predict adjustment behaviour of individual drivers (Stern and Richardson 2005).
This study supports the above idea, which emphasises using context-dependent heuristics to explore the travel activity and travel needs. Figure 7.2 (p. 115) illustrates that both age cohorts mentioned the travel activity adaptation theme (T3) least frequently comparing with other themes. This finding demonstrates that there are considerable limitations if research only focuses on the travel behaviour per se. Vehicle design research should look into travel activities that relate to conditions such as social practice and local context, and to consequences such as vehicle meanings and properties (Figure 7.1, p. 114).

<table>
<thead>
<tr>
<th>Theme</th>
<th>Categories</th>
<th>Sub-categories</th>
<th>Concepts</th>
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<tbody>
<tr>
<td>T3. Travel activity adaptation</td>
<td>TPT. Travel patterns</td>
<td>TPT-1 Travel modes</td>
<td>TPT-1.1 Public transportation</td>
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<td>TPT-1.2 Personal car</td>
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<td>TPT-1.3 Alternative transport</td>
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<td></td>
<td></td>
<td>TPT-2 Travel duration</td>
<td>TPT-2.1 Distance of travel</td>
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<td>TPT-2.2 Time of travel</td>
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<td>TPT-2.3 Frequency of travel</td>
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<td>TPT-3.1 Organization of travel</td>
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<td>TPT-3.2 Course of travel</td>
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<td>TPT-3-Travel route</td>
<td>DBV-1 Driving style</td>
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<td>DBV-1.1 Simultaneous activity avoidance</td>
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<td>DBV-1.2 Calm driving</td>
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<td>DBV-2 Driving decision-making</td>
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</tbody>
</table>

Figure 7.10: Travel activity adaptation categories

Figure 7.11: Integrated comparisons of travel activity adaptation at sub-category level
7.5.1 Travel Patterns

Travel patterns refer to the various choices facing the drivers as regards to the choice of destination, route, departure time, and mode. This category reflects the spatiotemporal patterns and the volumes of the various modes (Stern and Richardson 2005). This study shows that both age cohorts highlighted the travel pattern categories and the middle-aged cohort emphasized this factor more than elderly cohorts (Figure 7.3, p. 116). This finding supports the prior idea (Section 2.3) that current middle-aged and future younger-old users concentrate on the active lifestyle, compared with current elderly and future older-old users.

Travel mode (TPT-1) is a significant sub-category for both age cohorts (Figure 7.11). Both cohorts emphasized travelling by private car (TPT-1.2), and the middle-aged cohort mentioned this concept more frequently than the elderly one — not only currently, but in the future (Appendix 7). This demonstrates that car dependence is a significant characteristic of the future younger-old generation. The data suggest that elderly people reliant on public transport have considerable difficulties accessing facilities and maintaining social contacts. Regular public transport services in China are of limited utility: taking a bus may require a long walk to or from the transit stop, inner bus conditions are usually crowded, and vehicles are difficult to board and alight from. Pedestrian barriers such as wide streets and exposed bus stops also add to difficulties. Therefore, most elderly people would like to continue driving if it is practically feasible (Sections 2.3.1 and 4.4.1).

The distance of travel (TPT-2.1) is another important concept within the travel pattern category (Appendix 7). Both age cohorts emphasised this concept to be more important in the future than currently. There are a significant number of long distance trips to outside the urban area that will be conducted by the future elderly vehicle users. Since future older generations often leave the city centre for leisure purposes (SAL-1), the vehicle is a frequently used means of exploring (PMN-1.7). Therefore, travel patterns (TPT) have close relationships with social activity (SAT) to shape a vehicle’s practical meaning (PMN). In this context, the vehicle should be designed to afford long-distance and long-time journeys for the elderly users. In
order to achieve this aim, designers need not only to understand the users’ age-related cognitive and physical changes, but also to research older users’ trip-related activities and contexts.

Table 7.7: Statement on travel organization

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
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<tbody>
<tr>
<td>Participant 5:</td>
<td>I will travel with a few friends or relatives in the future. We will drive five or six cars travelling together, have dinner together and enjoy the journey together. On the other hand, an elderly group can help each other if there is some emergency during the trip. For example, every car needs a walkie-talkie and rescue facility. As elderly people, we need these to ensure our safety during the journey.</td>
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</table>

The concept of travel organization (TPT-3.1) shows different patterns between current and future travel activities (Appendix 7). Both age cohorts were concerned about this concept more in the future and less currently. The elderly vehicle users travel in groups not only to maintain social networks, but also to ensure travel safety (Table 7.7: Participant 5). In this process, a vehicle can be interpreted as a reflector of interdependence (CMN-1.3), a tool for safety (PMN-1.3), and a metaphor of pleasure (SMN-2.6). Designers can transfer these intangible vehicle meanings, generated from users’ verbal protocols, to tangible design elements such as in-vehicle communication support accessories and emergency support facilities.

7.5.2 Driving Behaviour

Driving behaviour deals with the vehicle users’ overall actions while driving. These are responses to other drivers, environmental conditions, and vehicles’ tangible properties, both objective and subjectively perceived. This study shows that four curves bottomed out in the driving behaviour category (DBV) (Figure 7.3, p. 116). This demonstrates that driving behaviour is not an important factor influencing elderly Chinese vehicle users’ travel needs. This finding challenges the earlier research, which emphasis older drivers’ conservative driving behaviours (Hakamies-Blomqvist, Siren and Davidse 2004; OECD 2001) (Section 2.2).

At the sub-category level of driving behaviour (Figure 7.11, p. 134), driving style (DBV-1) and driving decision-making (DBV-2) present different patterns between middle-aged and elderly cohorts. The current elderly cohort mentioned these sub-categories more frequently than the middle-aged cohort did. This trend might reflect
in part a cohort difference (SAP-1) in exposure. Private vehicles became widely available for the Chinese family only after persons of the current elderly generation grew to old adults, and thus they might be novice drivers and have had driving licences for just a short time (Section 3.4.2). Therefore, the contemporary elderly drivers mentioned the vehicle as a metaphor of skill/challenge (SMN-2.4) more frequently than the middle-aged generation. For instance, the data suggest that social accessibility (SAS) and social acceptability (SAP) are conditions to affect driving style (DBV). The vehicle meanings such as the vehicle as a tool for safety (PMN-1.3), the vehicle as a metaphor of skill/challenge (SMN-2.4) and the vehicle as a reflector of traditional neutral attitudes (CMN-1.2) can be generated within such contexts.

All in all, the above analysis suggests that transport cannot be properly analysed in isolation from its context (Geenhuizen, Nijkamp and Black 2002); on the contrary, the elderly vehicle users’ mobility is a direct result of broader practical, social, cultural, and technological developments.

7.6 Vehicle Meaning

Vehicle meaning allows designers to explore the manner and extent to which Chinese middle-aged and older vehicle users’ past experience biases future use interactions. Vehicle meaning reflects the detail of elderly users’ needs (Section 5.6). This study shows that vehicle meaning is one of the most significant categories (Figure 7.2, p. 115). There are a total of 27 meanings given by Chinese vehicle users related to their current and future travel needs. These are categorized in three core groups: practical meaning, social meaning and cultural meaning. Figure 7.12 shows the detailed structure of vehicle meaning.

Significant differences between the two age cohorts emerged at practical and social meanings (Figure 7.3, p. 116). Especially when they talked about the future travel needs, the Chinese middle-aged cohort was concerned more with social meaning (SMN) and less with practical meaning (PMN) than was the older cohort. However, both age cohorts present similar frequency of cultural meaning (CMN), not only currently but also in the future. It is clear that cultural values are the stable and
constant factors rooted in each generation’s current travel activities and influencing their future travel needs (Zhao et al. 2007).

<table>
<thead>
<tr>
<th>Theme</th>
<th>Categories</th>
<th>Sub-categories</th>
<th>Concepts</th>
</tr>
</thead>
</table>
|                              | PMN. Practical meaning |                | PMN-1 Vehicle as tool  
| T4.                           | PMN-1.1 Tool for carrying objects  
| Vehicle meaning for the users | PMN-1.2 Tool for mobility/commuting  
|                               | PMN-1.3 Tool for safety/health care  
|                               | PMN-1.4 Tool for relaxation/coziness  
|                               | PMN-1.5 Tool for time management  
|                               | PMN-1.6 Tool for gatherings  
|                               | PMN-1.7 Tool for exploring/view  
|                               | PMN-2 Vehicle as place/space  
|                               | PMN-2.1 Vehicle as home/shelter  
|                               | PMN-2.2 Vehicle as work studio  
|                               | SMN. Social meaning | SMN-1 Vehicle as event  
|                               | SMN-1.1 Event of expectation  
|                               | SMN-1.2 Event of memory  
|                               | SMN-2 Vehicle as medium/symbol  
|                               | SMN-2.1 Metaphor of luck  
|                               | SMN-2.2 Metaphor of freedom  
|                               | SMN-2.3 Metaphor of status  
|                               | SMN-2.4 Metaphor of skill/challenge  
|                               | SMN-2.5 Metaphor of personality  
|                               | SMN-2.6 Metaphor of affection/pleasure  
|                               | SMN-2.7 Metaphor of concern  
|                               | CMN. Cultural meaning | CMN-1 Vehicle as reflector of traditional cultural value  
|                               | CMN-1.1 Harmony with nature  
|                               | CMN-1.2 Neutral attitude  
|                               | CMN-1.3 Collective/interdependence  
|                               | CMN-1.4 Conventional custom/wisdom  
|                               | CMN-1.5 Face saving  
|                               | CMN-2 Vehicle as reflector of contemporary cultural value  
|                               | CMN-2.1 Efficiency with technology  
|                               | CMN-2.2 Expressive style  
|                               | CMN-2.3 Individual/independence  
|                               | CMN-2.4 Contemporary custom/wisdom  

Figure 7.12: Vehicle meaning categories
Figure 7.13: Integrated comparisons of vehicle meaning at sub-category level

Figure 7.14: Integrated comparisons of vehicle meaning at concept level
7.6.1 Practical Meaning

The practical meaning is the most important category for the Chinese user’s vehicle. It is intimately tied to the product’s physical attributes and benefits, and the inherent need satisfaction these provide (Fournier 1991). At the point of practical meaning (PMN), current middle-aged users reached their peak frequency of 17 per cent (Figure 7.3, p. 116). The middle-aged cohort was concerned about practical meaning more currently and less in the future than the elderly cohort was. Future younger-old users mentioned the practical meaning least frequently (11 per cent).

This study suggests that practical meaning can be divided into two sub-categories: vehicle as tool (PMN-1) and vehicle as activity place (PMN-2). Figure 7.13 shows that the vehicle as a tool (PMN-1) is most frequently mentioned by both age cohorts. The future younger-old users were concerned about this sub-category less than others. Moreover, although both age cohorts mentioned vehicle as space (PMN-2) least frequently, they had similar attitudes to this sub-category not only currently but also in the future, where both cohorts look on the vehicle as the home or shelter (PMN-2.1) due to pursuing a leisurely travelling to the countryside (SAL-1) when they retire.

There are many differences between middle-aged and elderly cohorts at the concept level of vehicle meaning (Figure 7.14). Here, eight per cent of contemporary older users mentioned the vehicle as a tool for carrying objects (PMN-1.1), as often as contemporary middle-aged users. However, for the future, they highlighted this point more frequently than the middle-aged users.

The concept of vehicle as tool for mobility/commuting (PMN-1.2) illustrated different patterns between middle-aged and elderly cohorts (Figure 7.14). Contemporary middle-aged users mentioned it significantly more often than the elderly users (both current and future elderly). Ten per cent of contemporary middle-aged users mentioned this concept, versus six per cent of current older and future older-old users, and only three per cent of future younger-old users. Data suggest that current middle-aged users need a vehicle to maintain regular work-related commuting between home and office during workdays.
Table 7.8: Statement on practical meaning

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 12:</td>
<td>I need to drive to take my son to study karate on Thursday evenings. I have to wait for him in the car for two hours when he is practicing in the gymnasium. It is so boring and wastes time. So, I listen to the radio, read a book or keep working in the car. Actually, it is hard to keep reading due to the weak light in the car. It is also hard to use a laptop in my car, due to the small space and inadequate in-vehicle accessories... So, I drive to the bookshop or supermarket when he is practicing and drive back when he is finished. My next car should solve these problems because I will escort my grandson to school as well when I retire.</td>
</tr>
<tr>
<td>Participant 7:</td>
<td>I will have a good view if the car has a wide windshield. Moreover, the A pillar should be narrow to ensure driving safety, especially during a traffic jam.</td>
</tr>
<tr>
<td>Participant 29:</td>
<td>The steel bars should be designed within both doors. The bumper should be solid. I feel safe if the car has these things. I do not like the small cars such as QQ because they are not safe. Its fibre glass bumper is easily broken... I am old and have a bad memory, so I do need an automatic lock to avoid forgetting to lock the door.</td>
</tr>
<tr>
<td>Participant 11:</td>
<td>It is safer if there is a medicine-chest in my car. Maybe I will have some health problems when I become old.</td>
</tr>
<tr>
<td>Participant 32:</td>
<td>It is so dangerous if a tyre is broken during the journey. So I think that a compact tyre air-pressure meter and air pump are useful for the elderly driver.</td>
</tr>
<tr>
<td>Participant 5:</td>
<td>I need a walkie-talkie device in my future car. If my car breaks down on the freeway, I can call the emergency number and get help... It is also useful when a few of the cars of my extended family travel together.</td>
</tr>
</tbody>
</table>

The patterns that emerged at the concept of vehicle as tool for time management (PMN-1.5) support the above findings (Figure 7.14, p. 139). Both age cohorts mentioned with similar frequencies the vehicle as a time management tool (PMN-1.5) when they imagined their future life (only two per cent) versus contemporary middle-aged users, who highlighted it at seven per cent. The data suggest that the vehicle as a tool for time management had different meanings, which include the efficient use of time, saving time, reordering time and killing time. The current middle-aged users often described their private vehicle as being a time saver, not only during the interview, but also in the travel diary. They clearly expressed a sense of hurriedness and perceived that they were short of time during their daily life, which can be linked to their maintaining full-time work (SAL-3.1). In some specific social and cultural contexts, the vehicle also has been described being used as a tool for killing and reordering time by the middle-aged cohort. For example, the vehicle as time management was often related to the efficient use of time by switching a time consuming or boring activity to a different meaningful activity niche (Table 7.8: Participant 12). It is clear that reinforcing family relationships (SRA-1) is an important condition for leading Chinese future older generations to adapt their travel activities (child education escort). This particular activity was based on the Chinese collective (family) cultural value, and generated the specific vehicle meaning (tool
for time management), which might guide the design of new vehicle properties such as entertainment support accessories (STT-2.1) and working support facilities (STT-2.12).

Figure 7.15: Participants’ sketches on the vehicle as tool for safety

Compared with current middle-aged users, who highlighted the vehicle as tool for mobility and time management, elderly users (both current and future elderly) emphasized the vehicle as tool for safety/health care (PMN-1.3). Moreover, this concept shows skewed distributions by age. The future older-old users were concerned about this concept slightly more than the future younger-old users (13 per cent versus 10 per cent), compared with only seven per cent of current middle-aged users. It is worth noting that elderly vehicle users interpreted safety meanings differently, due to different contexts. Firstly, the vehicle as a safety tool was related to relying on the absence of blind spots to guarantee driving safety (Table 7.8: Participant 7). The left-hand sketch in Figure 7.15 illustrates concrete shapes to interpret this from the user’s point of view, in which the vehicle has a narrow A pillar that is set to stand well back, and a big windshield and windows to achieve characteristics that avoid blind spots. Secondly, the safety meaning was interpreted as using solid materials and accessories to protect elderly users, and using smart technology to ensure the vehicle’s security (Table 7.8: Participant 29). These attributes can be easily identified from the participant’s sketch (the right-hand sketch in Figure 7.15). Thirdly, the elderly user emphasized the vehicle’s safety meaning by depending on the health emergency support facility to remedy age-related capability decline (Table 7.8: Participant 11). Fourthly, an urgent maintenance support device can be used to enhance the driving safety on the freeway (Table 7.8: Participant 32). Lastly, the vehicle as a safety tool was defined as using a communication device in case of an emergency or accident during long-distance travel (Table 7.8: Participant 32).
5). From a design perspective, all these interpretations of the vehicle as a safety tool comprise the implicit or explicit physical vehicle parameters required to fulfil vehicle users’ multiple-safety needs.

Both age cohorts had similar attitudes toward the vehicle as a tool for social gatherings (PMN-1.6) (Figure 7.14, p. 139). This attitude is rooted in Chinese collective culture values (cultural meaning) and associates with social role adaptations (maintaining social network), local customs (social ritual), travel patterns (travel by group), social meanings (metaphor of concern), and vehicle framework (compatibility capacity). The vehicle as a tool for exploring (PMN-1.7) is another concept which was mentioned frequently by the future elderly population (Figure 7.14, p. 139). Driving a vehicle to explore the countryside, culture heritage and famous scenery (LGF) contributed to primary leisure lifestyle and activity (SAL) when Chinese vehicle users retire. The vehicle should have not only durable qualities but also multiple functions to support exploring travel.

7.6.2 Social Meaning

Artefacts can be defined as social agents in the limited sense that they extend user activity and mediate meanings between users (Dant 1999). In this study, a vehicle’s social meaning involved two categories: vehicle as event (SMN-1) and vehicle as medium/symbol (SMN-2) (Figure 7.12, p. 138). Note that the social meaning (SMN) category shows one of the most skewed distributions by age. Figure 7.3 (p. 116) illustrates that 13 per cent of current middle-aged users mentioned social meaning versus 10 per cent of future younger-old users and only 6 per cent of future older-old users. It is clear that future new aging generations (current middle-aged) highlighted social meaning significantly more often than the current elderly.

Figure 7.13 (p. 139) illustrates that the vehicle as medium/symbol (SMN-2) was considered as more important than the vehicle as event (SMN-1) for both age cohorts. The sub-category of the vehicle as medium/symbol (SMN-2) shows different patterns between middle-aged and elderly cohorts. The middle-aged cohort mentioned this factor more often than the elderly cohort, not only currently but in the future. Here 26 per cent of the future younger-old users mentioned the vehicle as
medium/symbol (SMN-2) versus 19 per cent of the future older-old users. This suggests the vehicle’s symbolic meaning declines from the middle-aged cohort to the older cohort. The vehicle’s symbolic meaning assisted the Chinese vehicle users in the expression of their attitudes, beliefs, emotions and superstition. Within a specific social and cultural context, users can express an attitude, emotion or belief with an object that conveys meaning both about that artefact and about oneself (Shavitt 1989). The data show that both age cohorts interacted with their vehicles in a way that not only leads to the achievement of some specific task to express practical meaning, but that also signals something about one’s personal emotions, beliefs and attitude systems. Such behaviour then becomes expressed as users’ needs (Sections 5.4 and 5.6).

The concept of the vehicle as event of expectation (SMN-1.1) shows a significant difference between middle-aged and older cohorts when they imagine their future. Future younger-old users emphasized this concept more frequently than future older-old users (Figure 7.14, p. 139). Contrary to the concept of the vehicle as expectation event, this study shows that meaning referring to the past (SMN-1.2) increases from the middle-aged to the elderly. Older people (both current and future elderly) prefer seeing their private vehicle as extensions of themselves or as a personal record of their memories and experience. This point can be supported by the findings that three curves (current older users, future younger-old users, and future older-old users) cross at the concept of vehicle as memory event (SMN-1.2). For an older vehicle user, artefacts (vehicle) serve the purpose of maintaining the continuity of the self as it expands through time (Csikszentmihalyi and Rochberg-Halton 1981). The vehicle is a sign of past events, of ties to family, to other people and to emotional experiences. On the other hand, users always evaluate the appearance and styling of a vehicle with their past as a reference. This means that vehicle designers have to know the history and past experience of the future younger-old users. The statement in Table 7.9 gives an example to support this point. Here, the vehicle’s social meanings derive from the user’s memories of the occasions on which the vehicle was a tool for personal mobility (PMN-1.2), the metaphor of concern in a social network (SMN-2.7), the moment of intimacy over the years in which one may have expressed to a friend, one’s appreciation of this object. According to Csikszentmihalyi and Rochberg-Halton (1981), the value and meaning of the artefact is ‘cultivated’ over
time and emanates from the psychic energy invested in it and experiences relating to it. For these reasons, the vehicle as event is closely associated with the vehicle as metaphor of affection. The design features such as shape and colour serve the physical medium to contain or express these kinds of meanings.

Table 7.9: Statement on vehicle as event of memory

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 4:</td>
<td>I remember how hard it was when I sold my old car. I felt so depressed when I had to give the car’s keys to other people. You know, it was like my kid, and it had been with me for six years. I drove it and carried my family and friends. It contains a lot of stories and memories. For a man, his car contains a particular affection.</td>
</tr>
</tbody>
</table>

It is interesting that the middle-aged cohort mentioned the vehicle as metaphor of luck (SMN-2.1) as often as the elderly cohort, not only currently but in the future. Therefore, this sub-category is identified as a stable concept for the both age cohorts. The representative examples of the luck metaphor are the decorations of auspicious symbols that are placed in different parts of the vehicle space. The location of such lucky symbols is based on traditional Chinese rituals and beliefs (LCT-1 and LCT-2). For example, the right-hand picture in the Figure 7.16 illustrates the typical location of lucky symbols, which are usually hung below the inner rear mirror. Some vehicle users put a traditional talisman, such as a tiger, in the back of the vehicle to avoid a rear-end crash (the left-hand picture in Figure 7.16). Such auspicious symbols involve not only traditional fortunate figures such as lucky nodes but also particular political leaders such as Chairman Mao. Relying on superstitious power for protection is rooted in traditional Chinese cultural values. This kind of social meaning is closely associated with elderly users safety needs from the spiritual
perspective. From the design point of view, designing vehicles for the safety need is related not only to the use of technology to extend elderly drivers’ physical capabilities, but also to the employment of proper lucky symbols to reinforce older people’s safety-related spirituality and confidence. In some contexts, the latter factor is more important than the former for driving safety.

Future younger-old users were more concerned about the vehicle as a metaphor of status (SMN-2.3) than were the future older-old users. Social motives of belongingness are evident when users want to buy vehicles that are well regarded by others, so that the use of a vehicle brings peer approval, their affection, and a sense of belonging. In Chinese culture, a vehicle is bought specially to promote relationships within the group. Middle-aged vehicle users therefore prefer to drive cars that reflect who they are, not only currently but also when they are retired. For example, the future younger-old users believed that a vehicle’s model and brand can reflect the users’ taste and status, which can help to construct class, generation and gender identity (Table 7.10). In addition, the vehicle as a metaphor of status (SMN-2.3) was closely associated with the vehicle as a metaphor of personality (SMN-2.5) (Table 7.10: Participant 18). The future younger-old users were concerned more about the vehicle as metaphor of personality (SMN-2.5) than the current elderly. Such social meanings have roots in contemporary cultural values, which emphasize expressive attitudes (CMN-2.2).

Table 7.10: Statement on vehicle as metaphor of status

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 25:</td>
<td>I won’t buy a sedan. I think that the sedan has a strong official characteristic. I am a teacher. My colleagues and I prefer to buy a hatch back.</td>
</tr>
<tr>
<td>Participant 18:</td>
<td>For me, a personal car is an item that displays my taste and personality. It is like clothes that can express everybody’s status. So I need a unique style of car to display my personality.</td>
</tr>
</tbody>
</table>

The vehicle as metaphor of affection/pleasure (SMN-2.6) has been identified as one of the most significant concepts within the vehicle-meaning theme because both age cohorts emphasized this point considerably, not only currently but also in the future (Figure 7.14, p. 139). This concept shows the skewed distributions by age. That is, the middle-aged cohort highlighted this concept more frequently than the older cohort did (Figure 7.14, p. 139). The data suggest that the vehicle as a metaphor of
affection/pleasure is broadly related to other categories. For example, Participant 23 (Table 7.11) claimed that the vehicle model plays an important role in shaping the female users’ gender identity (SAP-2.1) and further influences her affection (SMN-2.6). On the other hand, the vehicle’s material and immaterial properties, which contain memory and experience symbols (SMN-1.2), strongly affect Chinese vehicle users’ emotions (Table 7.11: Participant 4). The vehicle evokes a specific range of emotions, thoughts and affections, and transmits its values to other objects, behaviours, or persons with which it is associated (Csikszentmihalyi and Rochberg-Halton 1981). Moreover, for many middle-aged users, a private vehicle is the means through which they can relax or refresh their body and mind. Thus, a vehicle is much more actively related to a person’s emotions. When depressed or overwhelmed with responsibilities, those of the middle-aged generation would retire to their private car and seek refreshment and pleasure through driving and ‘catching the wind’ (Table 7.11: Participant 2). Here, the practical meaning (vehicle as tool for relaxation) and social meaning (vehicle as metaphor of pleasure) were interrelated to shape the vehicle users’ emotional needs.

Table 7.11: Statement on vehicle as metaphor of affection

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 23:</td>
<td>I love the streamlined model. It is so beautiful. As a woman, I like a car that is fashionable and beautiful.</td>
</tr>
<tr>
<td>Participant 4:</td>
<td>I have such a complicated feeling for my car because I have already driven it for ten years. Although this car becomes dated, I still love everything within it, including the sound of closing the door.</td>
</tr>
<tr>
<td>Participant 2:</td>
<td>When I feel depressed, I like driving my car, listening to music and catching the wind on the freeway.</td>
</tr>
</tbody>
</table>

Following on from the vehicle as a metaphor of pleasure/affection, another important social meaning is the vehicle as a metaphor of concern (SMN-2.7) (Figure 7.14, p. 139). Caring for people and preserving and nurturing relationships are important tasks that are most valued by the Chinese vehicle users, especially elderly users. Therefore, they prefer to interact with a vehicle that acts as a tool for carrying out such activities. For instant, some participants mentioned that they use a vehicle to help their colleagues carry heavy materials (vehicle as tool for carrying objects) or to escort members of the extended family. The data suggest that references to extended family and kin increase with age. The future Chinese aging generation took responsibility for looking after the extended family members (SRA-1.2) which is
based on traditional collective cultural values (CMN-1.3). Figure 7.17 illustrates that the vehicle plays an important role for the elderly users to escort grandchildren, in that it becomes a tool for carrying childcare facilities (PMN-1.1). In this context, the vehicle should have the capacity to fulfil social networking tasks.

![Vehicle as tool for escorting grandchildren and carrying childcare facilities](image)

**Figure 7.17: Vehicle as tool for escorting grandchildren and carrying childcare facilities**

### 7.6.3 Cultural Meaning

Vehicles have a significance that goes beyond their functional character and social value. This significance has its roots largely in their ability to carry and communicate cultural meanings (Douglas and Isherwood 1978; McCracken 1986). Although culture is an intangible element, cultural meanings are not only in people’s heads: rather they are ideas that are shared by social actors. ‘Cultural meanings have some public manifestations and therefore must be somewhat observable’ (Trice and Beyer 1993, p. 43). The cultural meaning is made a visible, demonstrable part of the material world through interactions between users and vehicles (Section 5.4). The data suggest the duality of dimensions of cultural meaning, which comprises traditional and contemporary sub-categories and concepts (Figure 7.12, p. 138). In addition, compared with practical and social meanings, cultural meaning present a more-stable pattern than the others, because four curves just slightly fluctuate around nine per cent (Figure 7.3, p. 116).

The vehicle as a reflector of traditional cultural values (CMN-1) has been identified as one of the most significant sub-categories because the major tendency of the curves is to fall by about 20 per cent from the traditional cultural value (CMN-1) to
the contemporary cultural value (CMN-2) (Figure 7.13, p. 139). Moreover, the traditional cultural value (CMN-1) shows one of the most skewed distributions by age. The aging population (both current and future elderly) are concerned about traditional cultural values more than the current middle-aged users. They also mention this sub-category with similar frequency. These findings can be supported by the prior analysis of many other categories such as social role adaptation (SRA), in which elderly people presented traditional culture-related activity more frequently than current middle-aged people. ‘Traditional culture is presented as integrated, normative and involving inflexible social bonds and belief system’ (Featherstone 2007, p. 153).

Both age cohorts mentioned harmony with nature (CMN-1.1) more frequently in the future than currently. Such a traditional cultural value can be interpreted by the sustainable transport demands and environmentally ‘green’ travel behaviour. The future Chinese younger-old users rely on the technology (TNG) to achieve sustainable mobility. The new technology is not only assisting elderly users to reduce petrol consumption (ECM-1), but is also reshaping the vehicle’s appearance. For example, in the left-hand picture of Figure 7.18, the elderly user has drawn a large sustainable-technology device (a solar panel on top) which dominates the profile of his new vehicle. Such original sketches (as Figure 7.18) generated by elderly users can give designers valuable inspiration in designing the next generation of sustainable transportation for the future aging population.

Figure 7.18: Participants’ sketches of vehicles as a reflector of harmony with nature
Compared with current middle-aged users, who highlighted the expressive attitude (CMN-2.2), older users (current older, future younger-old and future older-old users) emphasized the neutral attitude to cultural values (CMN-1.2) (Figure 7.14, p. 139). It is worth noting that the vehicle as a reflector of a neutral attitude to cultural values (CMN-1.2) showed a stable characteristic for the elderly users because three curves — which present both contemporary and future elderly users’ vehicle meaning concepts — cross at the one point. The data suggest that the neutral attitude (CMN-1.2) is usually associated with calm driving behaviour (DBV-1.2) and a plain vehicle model (ATS-1.2) to identity age related status (SAP-1).

Individualist and collectivist cultural dimensions have been identified as important value orientations in many cultural studies (Hofstede 1997; Kluckhohn and Strodbeck 1961) (Section 3.5.1). The vehicle as a reflector of collective/interdependence cultural values (CMN-1.3) has been identified as one of the most significant concepts within the vehicle-meaning theme because both age cohorts emphasized this point, not only currently but also in the future (Figure 7.14, p. 139). Moreover, the aging populations (current elderly, future younger-old and future older-old users) paid more attention to this concept than the current middle-aged people. It is the cultural peculiarities and collective consciousness that define what middle-aged and elderly vehicle users are. Chinese cultural values are largely formed and created from inter-personal relationships and social orientations. This can be revealed by the work of Confucius, whose doctrine is still a basic pillar of Chinese life today (Yau 1994). The data suggest that the vehicle’s collectivistic nature is reflected not only in the Chinese family and kinship system, but also in the social network and friendship system. In Chinese society, people are integrated into strong cohesive in-groups and individuals act predominantly as members of a group (Sections 3.5 and 5.4).

On the one hand, while the ways in which users interact with vehicles have changed, users still interact with them as reflections or extensions of themselves and other people. For example, the first data segment of Participant 25 (Table 7.12; top entry) shows that the older driver looks on his car as a symbol to identify himself as a member of the particular collective (SMN-2.3). Meanwhile, the same elderly participant extended the meaning of his car to concerning others (SMN-2.7) (Table
Although he uses the vehicle in the different ways, both of these activities reflect a strong collective consciousness. The vehicles’ properties for many different usages means that they cannot only be reduced to function-related practical meaning and aesthetic-related social meaning.

On the other hand, collective cultural meaning is broadly embedded in other major themes such as social practice, travel activity and local context. The data (Table 7.12: Participants 34 and 12) show that collective cultural meaning can be observed by older people’s activities such as gatherings of extended family members and social networks (SRA and PMN), celebrating traditional festivals (LCT) and travelling in groups (TPT). It also can be interpreted within the compatibility vehicle framework and food preparation accessories, which provide tangible properties to support vehicle users’ collective social activities within the Chinese cultural context.

From the design point of view, collective cultural meaning suggests that considering the effects of an application on social versus personal identity should become a new design heuristic (Gould 2005). Designing vehicles for the elderly users who emphasize the collective cultural value should focus on collaborative activity, should highlight reliability and quality, and should imagine groups of people using the vehicle.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
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<tbody>
<tr>
<td>Participant 25:</td>
<td>Because most of my relatives have cars, they always organize big family parties in the beautiful countryside which is far away from the city centre. If I have no car, my wife and I have to ask other relatives to drive and take us to the family party. So the initial motive of buying this car is to drive to the family party, which shows being consistent with other relative’s families.</td>
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<tr>
<td>Participant 25:</td>
<td>…But when I bought this car, I found that it was very useful to escort my friends, old classmates and relatives as well. For example, when they come and visit to Beijing, I am very happy to carry them from the airport, deliver their luggage and so on. It is beyond the initial needs I had when I bought the car…</td>
</tr>
<tr>
<td>Participant 34:</td>
<td>I enjoy organising an elderly Chinese opera club. The members of this club are elderly people like me. I use my car to carry these elderly fans and instruments to participate in some community performance, especially during the traditional festivals.</td>
</tr>
<tr>
<td>Participant 12:</td>
<td>I need a big camping car. A group of people… they probably drive several camping cars to travel together. At the destination, these camping cars make a circular space that looks like a Chinese yard. We can celebrate the Chinese new year in this yard, cooking and eating together, playing games together, and helping each other…you know, my family, my friends, a group of people…</td>
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</tbody>
</table>
7.7 Vehicle Property

The vehicle property theme refers to a vehicle’s physical attributes such as economy (ECM), structure (STT), function (FCT), technology (TNG) and aesthetics (ATS). Figure 7.20 illustrates the axial coding framework of vehicle property through comparisons across different concepts generated by different age cohorts. In order to show details on vehicle properties from the users’ perspective, Figure 7.19 illustrates integrated comparisons of vehicle properties at the sub-category level.

Designers of transportation need to have details about physical vehicle properties from users’ perspectives. However, this study found that vehicle users cannot exactly identify the kind of vehicle properties — such as form, colour and function — they want because they do not have professional design knowledge. They can only explain what kind of the lifestyle they want, how they perceive their vehicle, and how they want to use their personal vehicle in the future. Therefore, although overall statistics show that the vehicle property theme is mentioned by the participants frequently (Figure 7.2, p. 115), it is hard to get useful information to guide design innovation from the ambiguous and general verbal protocols. From a design point of view, vehicle innovation for the local elderly users might systematically study the user–vehicle interaction rather than focus on the products properties in isolation.
<table>
<thead>
<tr>
<th>Theme</th>
<th>Categories</th>
<th>Sub-categories</th>
<th>Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ECM. Economy</td>
<td>ECM-1 Use economy</td>
<td>ECM-1.1 Low energy consumption</td>
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<tr>
<td></td>
<td></td>
<td>ECM-2 Purchase economy</td>
<td>ECM-1.2 Low maintenance fee</td>
</tr>
<tr>
<td></td>
<td>STT. Structure</td>
<td>STT-1 Framework</td>
<td>STT-1.1 Compatibility capacity</td>
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<td></td>
<td></td>
<td>STT-2 Accessories/facilities</td>
<td>STT-1.2 Compact capacity</td>
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<td></td>
<td></td>
<td></td>
<td>STT-1.3 Package/layout</td>
</tr>
<tr>
<td>T5. Vehicle</td>
<td>FCT. Function</td>
<td>FCT-1 Performance</td>
<td>STT-2.1 Entertainment support</td>
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<tr>
<td>property of</td>
<td></td>
<td>FCT-2 Maintenance</td>
<td>STT-2.2 Rest support</td>
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<td>users</td>
<td></td>
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<td>STT-2.3 Habit/relief support</td>
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<td>aspiration</td>
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<td>STT-2.4 Protection/security support</td>
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<td>STT-2.5 Health emergency support</td>
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<td>STT-2.6 Urgent maintenance support</td>
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<td>STT-2.7 Guarantee support</td>
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<td>STT-2.8 Communication support</td>
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<td>STT-2.9 Image/sensory support</td>
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<td></td>
<td>STT-2.10 Air quality adjust</td>
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<td></td>
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<td></td>
<td>STT-2.11 Food preparation support</td>
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<td></td>
<td>STT-2.12 Working support</td>
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<tr>
<td></td>
<td>STT-3 Interface</td>
<td></td>
<td>STT-3.1 Language</td>
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<td>STT-3.2 Layout</td>
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<td></td>
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<td>STT-3.3 Visibility</td>
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<tr>
<td></td>
<td>FCT-1 Performance</td>
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<td>FCT-1.1 Powerful performance</td>
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<td>FCT-2 Maintenance</td>
<td>FCT-1.2 Ease/simple of use</td>
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<td>FCT-1.3 Off road performance</td>
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<td></td>
<td>FCT-2.1 Ease of reparation/maintenance</td>
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<td>FCT-2.2 Ease of cleaning</td>
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<td>TNG. Technology/quality</td>
<td>TNG-1 Reliability</td>
<td>ATS-1.1 Solid/stable form</td>
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<td></td>
<td>TNG-2 Durability</td>
<td>ATS-1.2 Plain/simple form</td>
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<td></td>
<td>ATS-1.3 Fashion/steam line form</td>
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<td></td>
<td></td>
<td>TNG-3 Smart</td>
<td>ATS-1.4 Beauty form</td>
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<tr>
<td></td>
<td>ATS. Aesthetics</td>
<td>ATS-1 Model/form</td>
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<td></td>
<td></td>
<td>ATS-2 Colour</td>
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<td></td>
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<td>ATS-3 Material</td>
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<td></td>
<td></td>
<td>ATS-4 Detail/decoration</td>
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</tbody>
</table>

Figure 7.20: Vehicle property categories
7.7.1 Economy

The economy of vehicle category (ECM) presents the stable characteristics in this study. Most participants report that they need an economic vehicle when they are retired due to age-related income decline. This can be confirmed by Figure 7.3 (p. 116) in which three curves (current elderly, future younger-old and future older-old users) cross at the economy factor (ECM). There are no significant differences between use economy (ECM-1) and purchase economy (ECM-2) (Figure 7.19, p. 152). This category provides a sustainable design principle to reconstruct the elderly users’ traditional cultural values such as harmony with nature. The economic vehicle can be attained through use of recycled materials, simple shapes, and alternative energy consuming techniques.

7.7.2 Structure

The vehicle structure (STT) is the most important category within the vehicle property theme. Both age cohorts highlighted vehicle structure (STT) and elderly users mentioned it more often than middle-aged drivers (Figure 7.3, p. 116). Within the vehicle structure category, vehicle framework (STT-1) and vehicle accessories/facilities (STT-2) can be identified as two significant sub-categories (Figure 7.19, p. 152) because two cohorts presented considerably different patterns between current and future vehicle properties. Both age cohorts were concerned about vehicle framework (STT-1) more in the future and less currently. However, they mentioned vehicle accessories/facility (STT-2) significantly more often currently than in the future. These findings demonstrate that current automobiles designed for universal global markets cannot fulfil the Chinese vehicle users’ culture-specific travel needs. Local users can only adapt their current personal vehicles through changing some minor accessories to fulfil the unmet needs because it is impossible to do the framework changes for their current cars by themselves. However, when local users talked about the next car they wanted to buy, they needed the new generation vehicles which will be designed totally based on their particular travel needs. That is, vehicle innovation is related to not only accessory adaptations, but also to revolutions in structure.
It is worth noting that although the findings do not highlight the interface element (STT-3) (Figure 7.19, p. 152), the interpretation of data suggests that interface will be an important element in influencing the other categories such as safety (PMN-1.3) and ease of use (FCT-1.2). It is also closely associated with age-related physical changes (SAS-1), local visual convention (LCT-1), and calm driving style (DBV-1). Interfaces need to be culturalized as well as translated; icons, graphics, rhetoric, and interaction style should suit the target users (Gould 2005).

Table 7.13: Statement on compatibility property

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 2:</td>
<td>I’ll probably have a pet when I become old because my child cannot always accompany me. This vehicle should have enough space for my pet. I also might use this car to carry some necessary things to picnics with my friends.</td>
</tr>
<tr>
<td>Participant 5:</td>
<td>Although a sedan looks bigger than a hatch back, I believe that the latter is more useful because its space is good for holding different sized things. For example, when delivered a TV set, the TV cannot be put into the boot of a sedan. But it is easy to put it inside the boot of a hatch back.</td>
</tr>
<tr>
<td>Participant 4:</td>
<td>I love hatch backs because they are compatible not only for carrying different sized objects, but also for escorting my disabled oldest-old mother. There is no way that I can put her in from the side door of sedan. She can only go inside from the back door of a hatch back.</td>
</tr>
</tbody>
</table>

Figure 7.21: Participants’ sketches on compatibility vehicle framework

At the concept level of vehicle structure (STT), both age cohorts highlight compatibility capacity vehicle framework (STT-1.1). The future younger-old users emphasize this vehicle property at a peak of 17 per cent (Appendix 7). The personal vehicles are meaningful only when considered within the interdependent web of users–objects–vehicles and as part of larger systems. The major elderly user’s consideration was the vehicle’s physical compatibility with different things stored inside and with different abilities of the people seated inside. For example (Table
7.13), compatibility of structure refers not simply to the large space, but it can be interpreted as flexible well-matched different size, shape and ability of peoples and objects. The appropriateness to elderly users’ activity such as adaptation social role (SRA-1) for caring of oldest-old parents (SMN-2), and transporting objects (PMN-1) for leisure lifestyle (SAL-1) emerges as another way of defining compatibility. In the users’ sketches, these factors become explicit by the tall vehicle roof, well-matched boot, flexible-adjustment seats, and travel-related devices (Figure 7.21). Clearly, not only the containing of size and shape of objects that go into the vehicle is at issue, but also the framework and package of vehicle (STT-1.3). The patterns that both age cohorts mention vehicle package concept (STT-1.3) more often in the future than currently support this finding in another way (Appendix 7).

Both age cohorts mentioned entertainment support accessories (STT-2.1) less often in the future than currently. The elderly vehicle users prefer a simple radio rather than a luxury stereo CD system. Moreover, both age cohorts were concerned about protection/security support accessories (STT-2.4) and guarantee support accessories (STT-2.7) not only currently but also in the future. These findings support the vehicle as a tool for safety (PMN-1) which has been reported before (Section 7.6.1). It is worth noting that the food preparation accessory (STT-2.11) is the stable concept for both age cohorts. The data suggest that the food preparation accessory is deeply rooted in the Chinese social ritual, such as food and beverage traditions (LCT-2). These two kinds of concepts present constant characteristics and associate with each other to reflect traditional Chinese cultural values (CMN-1). It is clear that any vehicle structure properties are associated with relevant vehicle meaning, which is constructed through user-vehicle interactions within the particular social and cultural context.

### 7.7.3 Function

A vehicle’s function not only relates to driving performance, but also involves maintenance tasks (Figure 7.20, p. 153). The elderly users (current older, future younger-old and future older-old users) emphasized the sub-category of performance (FCT-1) more frequently than contemporary middle-aged driver (14 per cent versus 9 per cent). The ease/simple of use performance (FCT-1.2) is one of the most
important concepts for both age cohorts. The aging population emphasized it slightly more often than current middle-aged users. For the elderly vehicle users, ease/simple use can be interpreted into different meanings, which include simplicity of control, ease of adjustment, effortlessness of access, and suitability of habit. The future younger-old vehicle users need ease of use to ensure travel safety (PMN-1.3) due to age-related physical changes (SAS-1). The ease of use can also be associated with the vehicle as a tool for relaxation (PMN-1.4), the vehicle as metaphor of affection (SMN-2.6), and efficiency with technology cultural values (CMN-2.1) together to support elderly users’ leisure travel (SAL-1). In addition, besides easy performance, both age cohorts were also concerned with the ease of repair (FCT-2.1) in that four curves cross at this point (Appendix 7). A new personal vehicle would get Chinese drivers where they need to be without the worry of mechanical troubles.

7.7.4 Technology/quality

The technology/quality category shows a constant characteristic. The middle-aged and elderly cohorts mentioned this with the same frequency both currently (1 per cent) and in the future (3 per cent) (Figure 7.3, p. 116). The future younger-old users emphasized the technology more than the current elderly users did, since future aging generations will have more experience with technologies (Section 4.2).

Within the technology category, the future younger-old users were more concerned about smart technology (TNG-3) than others (Figure 7.19, p. 152). The terminology of smart technology can be defined as using assistive devices of emerging technology to support elderly independence. Although prior research (Fisk et al. 2004; Helfenstein 2005) claims that old people were more ready to transfer their anxiousness to new technology, this study shows that the future younger-old generation wishes to use smart technology to extend their driving ability and to ensure their driving safety. The future elderly often mentioned assistive technology devices such as GPS, audio warning systems, auto transmissions, in-vehicle internet, automatic car locks and energy saving systems. Such smart technologies are closely related to the vehicle accessories adaptation (STT), and vehicle function innovations (FCT) to reshape a vehicle’s practical, social and cultural meanings (Sections 5.4 and 5.5). In addition, both age cohorts mentioned the sub-categories of
technology/quality similarly, especially at the point of durability (TNG-2). The Chinese users’ leisure travel activities (SAL), lower pensions (SEF), and local road conditions (LGF) determine that vehicles have to be of durable quality to fulfil the exploring task.

7.7.5 Aesthetics

The middle-aged cohorts presented different patterns in the aesthetics factor (ATS) between their current and future needs, whereas older cohorts showed a similar attitude at this point. As is shown by Figure 7.3 (p. 116), the middle-aged cohort was concerned more with the aesthetic factor currently than in the future. Moreover, both age cohorts mentioned the sub-categories of aesthetics similarly (ATS-1, ATS-2, ATS-3 and ATS-4) (Figure 7.19, p. 152). The material factor (ATS-3) is the catalyser to achieve other aesthetics due to four curves crossing at the material concept. It is important to note that the participants were more concerned about the model/form (ATS-1) factor than the other factors, in which simple and plain forms are the core terms which were often used to describe their future car. However, compared with current elderly users concerns about the solid appearance of vehicles, the middle-aged cohort emphasized the fashion model (ATS-1.3) more frequently, not only currently but also in the future.

The concept of detail/decoration (ATS-4.0) is another core factor affecting Chinese vehicle users’ needs. Without the detail of decoration such as traditional Chinese souvenirs, the vehicle would be naked and one would be ashamed to have visitors. These decorations could be seen in almost all of the participants’ personal vehicles. Although the methods, styles, and locations of decorations were different among the participants, Chinese middle-aged and older cohorts embedded deeply auspicious wishes and spirituality with the decorations to guard themselves and their family and to ensure safe travelling. Therefore, the decoration details were only within a pattern of cultural habits and expectations. User acceptance and social symbolic system conveyed by the design are enhanced when the aesthetics and the commonplace look of artefacts (vehicle) are given the same attention as their functional quality (Lawton 2001).
7.8 Summary

In this chapter, the travel-needs-influencing factors between middle-aged and elderly vehicle users are systematically compared. Vehicle meaning is identified as the most significant theme for both age cohorts. Meanwhile, local contexts show constant characteristics for the Chinese participants. Both age cohorts emphasized core categories such as social activity for maintaining daily lifestyle (SAL), practical meaning of vehicles (PMN), social meaning of vehicles (SMN), and cultural meaning of vehicles (CMN). Social acceptability (SAP), practical meaning (PMN) and social meaning (SMN) show significantly different patterns between the two age cohorts, compared with cultural meaning (CMN) presents constant characteristics between the two age cohorts.

It is important to note that the travel-needs-influencing themes might be mentioned with similar frequency by both age cohorts, but their interpretations within their own categories and sub-categories differ. Moreover, the analysis and interpretations of data show that many differences show skewed distributions by age at the sub-category and concept levels. The interpretations suggest that most categories have implicit or explicit relationships associated with others. Therefore, drawing from the data analysis and interpretation of this chapter, the next chapter explores the major findings of the study.
Chapter 8: 
Findings

8.1 Introduction

The questions posed for the experiment aimed to achieve understanding from the middle-aged vehicle users and from older vehicle users about differences between their current travel needs and future travel needs. This study might forecast future elderly Chinese vehicle users’ travel needs which can give designers new knowledge to assist their innovations. This chapter focuses on integrating the travel-needs-influencing elements that have been analyzed in the previous chapter. The future elderly vehicle users’ needs framework might be developed, based on the integration of description and analysis. The interrelationships between the different needs categories help in structuring design approaches in the future.

8.2 Integration of Travel-Needs-Influencing Factors

The data analysis demonstrates that most categories are correlated with others to shape the elderly vehicle users’ particular travel needs. The future younger-old generations’ travel needs might be identified among the interrelationships between these five themes (social practice, local context, travel activity adaptation, vehicle meaning, and vehicle property) within the Chinese cultural framework. In other words, if themes or categories are combined, the users’ social activities and local context are often found to link to travel activity adaptations that structure vehicle meanings and properties. For instance, the data segment presented in Table 8.1 can be coded as social practice (social activity and social role adaptation), local context (socio-economic factors and local customs), travel activity adaptation (travel patterns), and vehicle meaning (practical meaning, social meaning, and cultural meaning). Furthermore, designers can easily predict the details of vehicle properties.
Table 8.1: Statement on interrelating categories to shape utility need

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 12:</td>
<td>I might own a personal car if my pension can afford it when I retire. It is convenient because there are oldest-old parents and children in my family. If they are sick, I will carry them to hospital immediately. My family also need it to shopping. It is easy to buy lots of goods from the supermarket and put them into the boot. Of course, taking a bus is economic, but I cannot use that instead of a personal car because of my legs.</td>
</tr>
</tbody>
</table>

Based on such understanding, the themes and categories were entered into a conditional/consequential matrix (Figure 7.1, p. 114) to map out the connections among them. In the above case, social ethics such as family responsibility (LCT-1.2) and economic factors such as personal income (SEF-1.3) are preconditions to affecting the future younger-old user’s travel mode choice. Using a personal car (TPT-1.2) to help family members maintain health conditions (SRA-1.2 and SAL-2.2) generates a vehicle’s practical meaning, such as a tool for mobility and health care (PMN-1.2 and PMN-1.3), and social meaning such as a metaphor of concern (SMN-2.7). On the other hand, the future younger-old user needs a vehicle to carry goods (PMN-1.1) when he is shopping for the whole family (SAL-1.1). It is clear that all above factors can be built around the extended family foundation, which reflects collective and interdependent cultural value (CMN-1.3). Further, the relationships among these factors demonstrate that the future elderly vehicle user needs a utility vehicle to support his quality of life (Figure 8.1). According to
Popovic (2002), designers need to understand the knowledge structure domain that users have about social activity, products and their contextual environment, and how this knowledge is exchanged in order to support interactivity. Therefore, based on the better understanding of such a matrix (Figure 8.1), designers can easily predict the details of physical vehicle properties such as compatibility framework (STT-1.1), health emergency support accessories (STT-2.5) and low energy consumption (ECM-1.1) which the future younger-old vehicle user wants.

The data suggest that categories and concepts do not exist within one conditional/consequential matrix in isolation. They are implicitly or explicitly associated with different categories which are merged in other matrixes. For example, Participant 10 in Table 8.2 imagines that the future younger-old user needs a vehicle to identity the generation differences (SAP-1.1) which can be labeled as grandchild care activities. This particular cohort identity is embedded in traditional Chinese social ethics (LCT-1.2). A safety vehicle can be interpreted as a metaphor of concern (SMN-2.7) to fulfill such a task. These interrelationships suggest using the protect support facility to ensure child safety (STT-2.4). The left-hand conditional/consequential matrix in Figure 8.2 illustrates the relationships among these categories.

On the other hand, the data segment presented by Participant 12 (Table 8.2) shows that the future younger-old user needs a utility vehicle to support his leisure hobby activities (SAL-1.2), where the vehicle can be defined as a tool for carrying hobby-related objects (PMN-1.1). Therefore, such findings, illustrated in the right-hand matrix of Figure 8.2 suggest that a new vehicle should be designed by compatibility properties (STT-1.1) such as a large boot capacity, to fulfill the future younger-old user’s needs.

Although the above two data segments map out different conditional/consequential matrixes, the data examples, such as the statements of Participants 9 and 6 (Table 8.2) can link these two matrixes into an integrated system. Participant 9 indicates that social acceptability factors such as generation identity (SAP-1.1) are closely related to leisure activities such as hobby choices (SAL-1.2). Moreover, Participant 6 uses a vehicle to help others to carry objects. Therefore, the practical meaning of a vehicle
as a tool for carrying objects (PMN-1.1) can be defined as the condition factor to lead the social meaning such as vehicle as a metaphor of concern (SMN-2.7). Figure 8.2 maps the systematical interrelationships which emerged from the above examples (Table 8.2). It is clear that the travel-needs-influencing factors present an interactive circularity structure rather than a linear one.

Table 8.2: Statement on integrated relationship of categories

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 10:</td>
<td>It is a Chinese tradition that older people take care of the grandchildren. However, compared with the last older generation, our generation got a lot of knowledge about methods for educating children. We will use a car to carry our grandchildren to the museum, cinema, and zoo when we retire. Considering that little kids are seated in the car, this car must be safe.</td>
</tr>
<tr>
<td>Participant 12:</td>
<td>After I am retired, I would like to be a gardener because I like nature. Maybe I will possess a small garden in my house. I need a particular car to carry plants.</td>
</tr>
<tr>
<td>Participant 9:</td>
<td>When I am retired, my hobby will be affected by other elderly people who have similar status with me. I may change my old hobby, and then to join a fishing group, just because it is organized by my older colleagues. This is because the same age cohorts have similar experiences and they influence each other.</td>
</tr>
<tr>
<td>Participant 6:</td>
<td>The main reason I bought this car was to carry objects, not only for myself, but for my friends and relatives.</td>
</tr>
</tbody>
</table>

Figure 8.2: Interactive circularity relationship among the travel-needs-influencing factors
In summary, the present research suggests that the meaning that a user attributes to a particular artifact, such as a personal vehicle, not only coincides with one’s self-relevant knowledge (Fuhrer 2004), but is also accompanied by the specific need that the user attempts to fulfill. Furthermore, user’s needs influencing factors are much more dynamic than linear. It is worth noting that the cultural context in which a user acts also plays an important role in shaping his needs and vehicle meaning (Chapter 5).

Correlations among the five themes show that all vehicle meaning dimensions are associated with each other. For example, the data segment presented by Participant 13 (Table 8.3) suggests a strong association among practical meaning (tool for safety), social meaning (metaphor of status and skill) and cultural meaning (neutral attitude). In addition, the interactions between artifacts and users are always permeated by cultural meanings, both in their practical utility and in their social and commercial contexts (Sahlins 1976) (Section 5.4). This study found that cultural meanings always associate with practical and social meanings when elderly users interact with vehicles. That is, once practical or social meanings are embedded within the interactions between users and vehicles, the cultural meaning appears with them as well. For instance, vehicle as metaphor of concern (SMN-2.7) can be easily linked to the collective cultural value (CMN-1.3). In the Chinese culture, the egocentric attitude is replaced by a concern for other people such as one’s family or wider ethnic connections. There is an implicit sense of responsibility for maintaining a network of social ties embedded in a vehicle’s usage (Table 8.3: Participant 6).

It is apparent that multiple meanings exist in vehicles, depending on what kinds of travel needs a user has in a particular cultural context, and what kind of cultural values the user holds in a particular social circumstance (Section 5.4). According to Linton (1945), culture is the configuration of learned behaviour, and results of behaviour whose component elements are shared and transmitted by the members of a particular society. This definition emphasizes that culture is dynamic and transmissive. Its characteristics are shared by members of a given society. In this study, object culture, which is embedded in local context, and subject culture, which is embedded in the social practice, are interacting to shape the elderly Chinese vehicle users’ cultural values, which play a dynamic role to link social practices,
local contexts, travel activity adaptations, vehicle meanings and vehicle properties. The Chinese future younger-old vehicle users’ travel needs might be identified within this system.

Table 8.3: Statement on integrated vehicle meanings

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 13:</td>
<td>I do not want to buy a race car like young generations. The elderly driver would like to operate steadily and slowly to ensure driving safety. So the model of my car should not look like ambitious, luxury or speedy. That is not the proper style that our generations wanted.</td>
</tr>
<tr>
<td>Participant 6:</td>
<td>I felt so tired using a bike carrying coal when I was child. So I have a strong desire to buy a big car which can help my family and friends to carry lots of things.</td>
</tr>
</tbody>
</table>

Based on understanding the above, Figure 8.3 illustrates that older vehicle users’ social practice within particular local contexts generates social and cultural context in which older users emphasize high quality of life. Future younger-old vehicle users will maintain driving independently, in order to spend their later years filled with activity and meaningful involvement (Section 2.2, 2.3 and 2.4). During this process, vehicles serve to give a tangible expression through signs to users’ relationships, experiences and the activity of interactions. The future younger-old vehicle users’
travel-related needs might emerge among the travel activity adaptation, vehicle property and vehicle meaning interactions. Chinese traditional and contemporary culture performs a dynamic role in linking these factors and shaping older vehicle users’ travel needs. This model can be used to identify travel needs that are related to vehicle usage.

8.3 Travel Needs Identification

The travel needs identification concept model (Figure 8.3) can be used as a tool to explore the research questions (Section 1.3). The new abstract level of category, which is related to elderly vehicle users’ travel needs, has been identified as a central category because all other major categories can be related to it (Strauss and Corbin 1998). Therefore, the selective coding process was employed to integrate the travel-needs-influencing categories. In order to gain incorporated relationships among travel-needs-influencing factors, the selective coding analysis was based on paragraphs of data to infer the general level of elderly users’ travel needs. The aim of this process was to reconcile the dialectic of universality and individuality by searching for variations in design solutions in the context of individual needs, as exhibited within a common need structure.

Table 8.4: Integrated comparisons of different user groups’ travel needs categories

<table>
<thead>
<tr>
<th>Travel needs categories</th>
<th>Middle-aged cohort (N = 18)</th>
<th>Older cohort (N = 18)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current middle-aged users</td>
<td>Future younger-old users</td>
</tr>
<tr>
<td></td>
<td>Percentage mentioned</td>
<td>Percentage mentioned</td>
</tr>
<tr>
<td>N1-Safety</td>
<td>61%</td>
<td>72%</td>
</tr>
<tr>
<td>N2-Utility</td>
<td>94%</td>
<td>89%</td>
</tr>
<tr>
<td>N3-Comfort</td>
<td>78%</td>
<td>72%</td>
</tr>
<tr>
<td>N4-Identity</td>
<td>67%</td>
<td>78%</td>
</tr>
<tr>
<td>N5-Emotion</td>
<td>89%</td>
<td>61%</td>
</tr>
<tr>
<td>N6-Spirituality</td>
<td>56%</td>
<td>22%</td>
</tr>
</tbody>
</table>

The selective coding process identifies six travel-related users’ needs from a vehicle design point of view: (N1) safety, (N2) utility, (N3) comfort, (N4) identity, (N5) emotion, and (N6) spirituality. Table 8.4 shows the integrated comparisons of these users’ needs through calculating the proportion of participants mentioning the
various travel-related needs in the experiment. It is clear that although both age cohorts emphasized the safety (N1-safety) and utility (N2-utility) needs, the future younger-old users were concerned less about safety (N1-safety) and utility (N2-utility) needs than the future older-old users. However, a considerable change occurred from comfort needs (N3-comfort). The future younger-old users were concerned more about comfort (N3-comfort), identity (N4-identity) and emotion (N5-emotion) needs than the future older-old users.

### 8.3.1 Safety

Safety needs can be defined as security concerns about elderly vehicle users’ personal safety, availability of health care, accident minimization, provision of basic travel-related shelter and maintenance services. Compared with current middle-aged vehicle users, automobile safety is becoming a major concern for the both current and future elderly vehicle users (Table 8.4), reflected in the renewed emphasis on safety features and technology by vehicle designers.

In contrast with previous road safety research, which has emphasized conservative driving decision-making (Section 2.2), the findings of this study suggest that future younger-old vehicle users concerns for safety are not only from a driving behavior point of view, but also from the perspective of travel-related wellbeing. It is worth noting that most future elderly vehicle users wish to rely on technology to fulfill their different safety needs. For example, Participant 5 (Table 8.5) avoids simultaneous activities (DBV-1.1), such as taking a call during driving to ensure his safety (PMN-1.3 and CMN-1.2). However, an in-vehicle communication device (STT-2.8) is important for older users to reinforce their family relationships (SRA-1.2). Therefore, the category smart and freehand technology (TNG-3) plays an important role in ensuring the driving safety when older users try to maintain social networks while driving. If these categories are entered into the travel need identify mode (Figure 8.3, p. 166), the safety need is emerged among the interrelations of these elements (Figure 8.4). The dynamic blue circles in Figure 8.4 present technology factors which drive the innovation of vehicle properties to fulfill the future older users’ safety needs.
Table 8.5: Statement on safety need and technology factor

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 5:</td>
<td>From my experience, to ensure driving safety, elderly people won’t answer a phone call when they are driving. But if I had a call, it could be from my family and it would probably be important for me. So I need a smart phone in the car that I can easily use to answer the call hands-free.</td>
</tr>
<tr>
<td>Participant 23:</td>
<td>I need a small monitor on the dashboard which can display the conditions outside the car, especially a barrier behind the car. It would be useful for parking safely because my neck has problems. So it is hard for me to turn my neck and look back when I am going to park.</td>
</tr>
<tr>
<td>Participant 7:</td>
<td>I need some electronic alarm system to guarantee my car is in good condition. If there are some potential troubles such as lack of tyre air pressure, this system could give an alarm. It also could avoid the car being stolen.</td>
</tr>
<tr>
<td>Participant 12:</td>
<td>There should be some medical assisting device in the car. Older people will feel safe when they drive a car that has such facilities. In case of facing a health-related emergency, they can get some tools to solve it.</td>
</tr>
</tbody>
</table>

Figure 8.4: Sample of the safety need identification

In addition, according to Participant 23 (Table 8.5), electronic display technology (TNG-3) can guaranty safe parking, to reduce the negative effects of age-related physical changes (SAS-1). Furthermore, smart alarm technology (TNG-3) can assist elderly vehicle users to avoid potential risk, and ensure their security (PMN-1.3) (Table 8.5: Participant 7). Lastly, Participant 12 (Table 8.5) preferred to look on the vehicle as health emergency support technology (PMN-1.3) and a self-concern metaphor (SMN-2.7) due to age-related capability decline. The safety need is generated due to the influence of social accessibility (SAS-1). In summary, although
these data segments (Table 8.5) interpret the safety needs from different perspectives, the technology category is a constant factor that has emerged in the data, and drives innovation in vehicle properties.

Designers should employ proper, user-friendly technology to support the elderly drivers’ need for travel safety, rather than utilize unevaluated ‘high’ technology. The technology instructions and usage information should be easy to comprehend, and remember, by elderly vehicle users (Fisk et al. 2004). From the human-factor design point of view, this study demonstrates that safety is a major concern in vehicle design for elderly drivers (Sections 2.2 and 2.3), and the role of the culture and technology affecting it demands considerable attention (Sections 2.4, 3.5 and 4.3).

8.3.2 Utility

Utility can be defined as a product’s ability to accomplish specific acts, based on properties such as its physical characteristics and features (Fournier 1991). An artifact’s physical characteristics and features create utility that aids the user in reaching a specific outcome. This study suggests that utility (N2-utility) is one of the most significant vehicle users’ needs because both age cohorts emphasized this factor, not only currently but also in the future (Table 8.4, p. 167). Moreover, both age cohorts presented similar attitudes toward utility need.

When the categories were entered into the travel needs identify model (Figure 8.3, p. 166), this study found that utility needs involved different meanings within the different contexts. Concerning utility needs, elderly Chinese users choose vehicles that most successfully and most thoroughly complete a specific social practice and task. One type of utility is related to the economic benefits provided by the vehicle. These benefits involve purchase and use economies (ECM-1 and ECM-2), cost-cutting and ease of maintenance (FCT-2), or sustainability technology (TNG-3). The participants revealed that age-related income (SEF-1) and physiology (SAS-1) declines are major preconditions to lead such needs, in which the vehicle reflects the traditional Chinese cultural value of harmony with nature (CMN-1). Another type of utility is concerned with the effectiveness and usefulness endowed with a vehicle. For instance, when the elderly users attempt to maintain the high quality of social
practice such as keeping leisurely lifestyles (SAL-1), going to the hospital (SAL-2), and reinforcing social networks (SRA-1 and SRA-2), they usually look on their personal vehicle as a tool for mobility, carrying objects, time management, and family gatherings (PMN-1).

Table 8.6: Statement on utility need and three vehicle meanings embedded in this need

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 23:</td>
<td>My life became efficient when I got this car. I can manage my daily schedule flexibly … for example, I can drive to the home of my mother-in-law and send some food to her when I am off duty and then go to the gym to do excise. It just takes two hours. That is, when these activities are finished, I still have enough time to go back home and prepare the dinner for my husband. So I feel freedom.</td>
</tr>
<tr>
<td>Participant 25:</td>
<td>I do not like a sedan because it looks like an official car. It is not convenient for the family usage. But the hatch back and station wagon are different. They have multiple utility features because their interior spaces are large and flexible. They are useful to contain a lot of objects and collect more passengers. So I like these kinds of package rather than the formalistic sedan.</td>
</tr>
</tbody>
</table>

Figure 8.5: Three meaning levels of utility needs for the future elderly vehicle users

Although previous research has claimed that only functional meaning and a product’s form affect product utility (Fournier 1991; Helfenstein 2005), the present study suggests that utility needs can be shaped by the interrelation among a vehicle’s practical meaning, social meaning and cultural meaning. For example, in order to
achieve a particular social practice such as reinforcing family relationships (SRA-1) and maintaining fitness (SAL-2), Participant 23 (Table 8.6) interpreted the utility need from different levels of vehicle meaning. These three meaning levels emerged from the data segment, and include (i) practical meaning, such as a tool for mobility (PMN-1.2) and a daily schedule management (PMN-1.5), (ii) social meaning, such as a metaphor for feelings of freedom (SMN-2.2) and concern for extended family members (SMN-2.7), and (iii) cultural meaning, such as interdependence with family members (CMN-1.3). Figure 8.5 illustrates three meaning levels of utility needs interpreted by Chinese future elderly vehicle users. The practical meaning (the vehicle as a tool for carrying objects, mobility, time management, gathering and exploring), social meaning (the vehicle as a metaphor of expectations, memory, freedom, status and concerns) combined with cultural meaning (the vehicle as a reflector of independence, harmony, neutral attitude, collective, conventional customs and efficient technology) are working together to construct the future elderly users’ utility needs.

In addition, the utility need has close relationships with other needs. For instance, Participant 25 (Table 8.6) suggested that utility needs such as the capability to carry cargo and gather passengers can cause the love emotion (N5) and status identity (N4). The vehicle’s package and framework play key roles in influencing these three sorts of needs. The meaning of a vehicle for this participant revolved about activity experiences he could have by interacting with the vehicle; the accent is on the utilitarian, enjoyable characteristics of the vehicle, and the outcome refers exclusively to the respondent’s own personal self. Elderly users’ needs were constructed through three meaning levels, where the juxtaposition and the harmonious combination of vehicle properties emerge as indicators of travel-related needs. The visible and intrinsic vehicle properties are matched against elderly users’ multiple needs and associate them with each other.

### 8.3.3 Comfort

Comfort or discomfort is often noticed during long-distance travel in a vehicle. Comfort is a subjective phenomenon (Vink, Overbeeke and Desmet 2005) and is influenced by many factors in the particular context. For elderly vehicle users,
comfort is more related to clustered descriptors such as relaxation, at ease, load relief, and calm. Many aspects of comfort and discomfort play roles during driving and traveling, including thermal comfort, acoustic comfort, visual comfort and physical comfort.

Table 8.4 (p. 167) shows that comfort is a key turning point for the future new aging generation, since the proportion of future younger-old users exceeds the proportion of future older-old users from this needs category. It is worth noting that safety (N1) and utility (N2) needs, which were emphasized by current elderly vehicle users, are more related to objective cultural experience and practical meaning. However, the comfort (N3), identity (N4), emotional (N5) and spiritual (N6) needs that are highlighted by the future younger-old users are more associated with subjective experience.

Figure 8.6: Participant’s sketch of a comfort vehicle, which emphasizes travel enjoyment

This study suggests that there are visible and intrinsic relationships between comfort needs and other needs categories, such as emotion and safety. For example, the travel experience of leisure journey is itself a key part of the whole activity (Anable 2002). Therefore, comfort and enjoyment are important for elderly vehicle users. The 51-year-old member of academic staff drew a sketch to illustrate his future leisure travel (Figure 8.6). He imagined that he will enjoy (SMN-2.6) beautiful natural scenery and heritage (LGF-2.2) during his retirement on journeys for leisure (SAL-1.4). These
activities would be supported by particular vehicle properties, which include particular facilities of entertainment (STT-2.1), rest (STT-2.2), food preparation (STT-2.11), and a flexible framework (STT-1.1) in which part of the side of the vehicle could be changed to a flat roof to support sightseeing. The future vehicle’s meanings, such as a relaxation tool (PMN-1.4), metaphor of enjoyment (SMN-2.6), and harmony with nature (CMN-1.1) are constructed or reconstructed within this sub-cultural context. The interrelationships among these categories not only identified the comfort needs which future younger-old vehicle users are pursuing during their leisure journeys, but also those that result in emotional pleasure.

The data suggest that comfort is not only related to emotion, but also affects safety and utility. This finding challenges the hierarchy of basic human needs, which indicates that there can be no comfort if safety and function are not satisfied (Lawton 2001; Maslow 1987). For example, the comfort benefits obtained from the vehicle directly influence driving safety. Here, comfort is a significant condition factor which can lead to safety (Table 8.7: Participant 13). Moreover, the relation between comfort and utility that were presented by Participant 3 (Table 8.7) is that they are in conflict with one another. The comfortable interior space can be affected by the capabilities of the cargo boot due to the limited vehicle package size. It is important to note that these relationships overthrow the linear hierarchy needs model that was originally established by Maslow (1987) (Section 5.2).

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
</tr>
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<tbody>
<tr>
<td>Participant 13</td>
<td>It is hard to adjust the angle and position of the seat in my personal car. My wife and I have different body size. Therefore, I feel uncomfortable and have to adjust the seat angle if my wife has driven the car before… Sometimes I have to change the seat angle to get a comfortable position while driving. You know such behavior is dangerous, especially while driving on the freeway.</td>
</tr>
<tr>
<td>Participant 3</td>
<td>The capacity of the boot should be big to contain objects as much as possible. Of course, the boot should not affect the comfort of the interior. If the cabin becomes small due to a large space being occupied by the boot, an elderly driver like me must feel uncomfortable. But it is hard to balance…</td>
</tr>
</tbody>
</table>

This study supports the previous research which suggests that discomfort is more related to physical characteristics (Haperen, Vink, Overbeeke, Djajadiningrat and Lee 2005), whereas comfort is more related to clustered descriptors such as relaxation, being at ease, load relief, calmness and luxury. This concerns research
regarding seating, posture, physical loading, and foot pressure measurements. Designers should provide a comfortable and well-designed vehicle interior which may improve postures and provide an environment stimulating optimal operator performance (Vink, Looze and Kuijt-Evers 2005). During this process, designers should not only focus on research into the elderly users’ comfort needs and the influencing factors, but also consider the relation between comfort needs and other needs categories to balance multiple needs through proper design features (Sections 5.2 and 5.3).

8.3.4 Identity

Social motives of belongingness are evident when elderly Chinese users want to buy personal vehicles that are well regarded by others so that the use of the vehicle brings the users peer approval. ‘Identity is created, maintained and reconstructed by an accumulation of knowledge, codes, values, stores of experience and guiding principles of action’ (Kalviainen 2002, p. 80). Identity need (N4-identity) illustrates a considerable difference between the two age cohorts. The future younger-old users emphasized identity needs more significantly than the future older-old users (78 per cent versus 39 per cent) (Table 8.4, p. 167).

Table 8.8: Statement on identity need

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
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<tbody>
<tr>
<td>Participant 10:</td>
<td>I love fashionable style. In my opinion, the fashion model should have strong national characteristics. It is so cool if I drive such a unique car on the road.</td>
</tr>
<tr>
<td>Participant 11:</td>
<td>I like the tidy, simple and dark colour interior style. You know, some young girls would like a light coloured interior and add some small floss animal toys to decorate their car. But I do not like it. I think that a light coloured interior is hard to clean, especially in Beijing because the environment of this city is dirty. On the other hand, people of an older generation like me will feel embarrassed if the car is unclean and has a lot of flossy toy decorations. It is not to elderly people’s taste.</td>
</tr>
<tr>
<td>Participant 15:</td>
<td>My car should not look like the vehicle which is driven by a governor and boss because I am just middle class. It is a symbol of my taste and daily life. It should look like a family car which has economic characteristics.</td>
</tr>
<tr>
<td>Participant 1:</td>
<td>I think the driver’s status should match the model of the car. It is like cloth, if an adolescent has an Armani suit, he cannot match this luxury brand. Similarly, the manner and behaviour of driving should match the status of drivers. Elderly drivers would like to drive more stably and safely than young guys.</td>
</tr>
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</table>

Identity need is a fundamental need that influences a great deal of social interaction at the group, intergroup and international levels (Fisher 1990). When entering the relevant categories of social practice, local context, travel activity adaptation, vehicle
meaning and vehicle property into the travel need identification model (Figure 8.3, p. 166), this study defines the identity need as having different meanings within particular social and cultural contexts. The future younger-old users need vehicles as evidence for self-belongingness, physical capability, peer acceptance, collective prestige, social status, and national identity. For example, the need for identity can be satisfied by arrangements recognizing the political autonomy of nations and other cultural identity groups (Rubinstein 1990). The vehicle model or style plays an important role in constructing national identity (Table 8.8: Participant 10) (Section 5.4). Vehicle designing for the future younger-old users should embed existing visual conventions in new vehicle design. Chinese culture with its historical, national and regional characteristics is decomposed into design features. These elements might be re-introduced during the development of conceptually new vehicles (Sections 5.3 and 5.5).

For designers, vehicle meanings function as the translation from elderly users’ lifestyle preferences and orientations to physical vehicle properties, so that certain vehicle user groups can have personal vehicles that correspond with their orientation or identity. There are more concepts within the social and cultural meanings to assist in shaping the identity need than there are concepts within the practical meaning. For the future younger-old users, several concepts interact to pinpoint integrated multiple identity needs. These are (i) practical meaning, which includes a tool for gatherings (PMN-1.6), (ii) social meaning, which includes events of expectation (SMN-1.1), metaphors of status (SMN-2.3), skills (SMN-2.4) and personality (SMN-2.5), and (iii) cultural meaning, which includes neutral attitudes (CMN-1.2), interdependencies (CMN-1.3), face saving (CMN-1.5), expressive styles (CMN-2.2) and individual values (CMN-2.3). Chinese new aging generations would employ material objects such as a personal vehicle to compensate for perceived inadequacies in their concepts of self or selves. In summary, social identity grows from differences and status acquired through not only symbolic meaning (Solomon 1983), but also practical meaning and cultural meaning. Social acceptability of the future younger-old users is associated with collection of artefacts (vehicles), context (local cultural traditions) and activities (social practices).
In addition, identity needs have implicit or explicit relationships with other needs categories. Social identity derives from the social categories to which the user belongs and the emotional and value significance of such membership (Fisher 1990). The findings of this study demonstrate that identity is associated with other needs categories such as emotion (Table 8.8: Participant 11), utility (Table 8.8: Participant 15), and safety (Table 8.8: Participant 1) to shape elderly vehicle users’ future multiple-travel needs. Culture is a terrain upon which different social groups play out power struggles, seek to resist subordination and assert their identities (Lawton 2001; Press and Cooper 2003). Cultural variations and social norms condition all need-satisfying activities, but their influences on affiliation are particularly notable (Section 5.2 and 5.4). For example, objective cultural elements such as city environment (Table 8.8: Participant 11), social customs (Table 8.8: Participant 15 and 1) combined with subjective cultural elements such as generation differences (Table 8.8: Participant 11), and social role adaptations (Table 8.8: Participant 11, 15 and 1) might construct a particular context to define the future younger-old users’ identity through vehicle usage. The cultural meanings and values which include face saving (CMN-1.5) and neutral attitude (CMN-1.2) can be obtained when elderly users interact with their personal vehicles within the relevant cultural variations and social norms.

According to the above discussion, it is expected that satisfaction with a vehicle may be derived not solely from one’s expectations towards, but from most members of the family and peer cohort within, the Chinese cultural traditions. These findings suggest that elderly Chinese users need vehicles for integrated multiple identities rather than unitary characteristics. The future younger-old users need vehicles to fulfill their multiple identity need more significantly than current older users. Therefore, vehicle designing should focus on transforming social and cultural meaning into symbolic design features to match not only future elderly users’ preferences, but also their family and peer cohorts’ tastes (Sections 5.3 and 5.5).

8.3.5 Emotion

Many scholars (Csikszentmihalyi and Rochberg-Halton 1981; Fournier 1991; Helfenstein 2005; Jordan 2000a) acknowledge that products provide sensory
pleasure, enjoyment, and generalized emotional arousal as well as investment of a
degree of emotional attachment. For the current research, emotional need is the
vehicle users’ capacity to make distinctions between physical vehicle properties and
feelings of attachment to them. This kind of user’s need is based on people’s beliefs
and attitudes, and on values that are dependent upon social and cultural context
(Kalviainen 2002). This study shows that distinct differences emerged between the
two age cohorts at the point of emotional need. The future younger-old users were
more concerned with emotional needs compared with current older and future older-old
users (Table 8.4, p. 167).

Utilizing the travel needs identify model (Figure 8.3, p. 166), this study shows that
the emotional need towards a vehicle is related to socially and culturally interpreted
qualities such as maintaining social networks (SRA-2), cohort identity (SAP-1),
social accessibility (SAS-1), local rituals (LCT-2), and travel resources (LGF-2).
Within this macro level of context, middle-aged and elderly vehicle users’ emotional
experiences are directly affected by embodied aesthetics (ATS), ease of use (FCT-1),
smart technology (TNG-3), collective cultural value (CMN-1), personality (CMN-2)
and so on. It is worth noting that these categories cover all major themes, such as
social practice, local context, vehicle meaning and vehicle property. Therefore it is
necessary to consider all these themes and categories in order to fully understand the
emotional needs of the current and future elderly generations because this
phenomenon is so complex. Moreover, the findings of this study indicate that
practical, social, and cultural vehicle meanings interact with each other to shape
emotional needs. Compared with practical meaning, more categories within the
social and cultural meanings are closely linked with emotional needs.

This study supports the idea that affective transfer is included in any psychological
process where previously experienced feeling and attitudes towards a situation,
object, or task are re-evoked in a current engagement with related ‘symbols’ (Hobson
and Patrick 1995). This involves the transfer of affective connotations to situations or
the socio-emotional values attached to an artefact (Damasio 1995). Participant 32
(Table 8.9) suggested that a previous experience, especially an event that occurred in
the childhood, is closely associated with elderly users’ emotion related to the vehicle.
In addition, the findings of this study suggest that emotion can be defined as having different meanings within different contexts. Different cultural and social contexts separate emotions from objective, logical decision-making or display their emotions as a legitimate part of the process (Chapter 5). Here emotional need refers to the personal vehicle creating the appropriate feelings and emotions such as love, memories, expectations, attachments, fun, excitement, enjoyment, and personification. The interactions between social practice and local elements shape different contexts to characterize the different meanings of emotional need. For example, the different vehicle users interpreted the love emotion towards their vehicle differently, due to different social practices and local contexts (Table 8.9: Participants 29, 19, 16, 7, and 18).

Challenging Jordan’s hierarchal structure of product design in which pleasure or emotion is on the top level of users’ needs (Jordan 2003), this study suggests that emotional need may be closely associated with the following needs variables: safety (Table 8.9: Participant 29), utility (Table 8.9: Participant 19), comfort (Table 8.9: Participant 16), identity (Table 8.9: Participant 7) and spirituality (Table 8.9: Participant 18). These needs categories interact with each other to map up the holistic elderly users’ needs system. Compared with future younger-old users, current old users associated emotional need with safety (Table 8.9: Participant 29) and utility (Table 8.9: Participant 19) needs more frequently. The 61-year-old Chinese opera actor (Table 8.9: Participant 29) believed that enjoyment trips relied on a safe vehicle, which directly affected his emotion towards the personal vehicle. Participant 19 (Table 8.9) suggested that the emotional benefits for the current elderly vehicle users obtained from the product may be traded off for utilitarian consequences (Boztepe 2004) such as mobility, carrying objects and economic usage. Clearly, safety and utility of vehicles would help current older users to remedy age-related decline, and further, to achieve more positive emotions. In contrast, comfort (Table 8.9: Participant 16), identity (Table 8.9: Participant 7), and spirituality (Table 8.9: Participant 18) play important roles in generating positive emotion for the future younger-old users. Such emotion-related differences between the two age cohorts show similar patterns as the differences in travel needs categories (Table 8.4, p. 167).
Table 8.9: Statement on emotional need

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statements</th>
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<tbody>
<tr>
<td>Participant 32:</td>
<td>I am happy when I am driving. I think that a vehicle is just like a big toy for me… This idea is rooted from a dream in my childhood… I remember that I played with a small clay vehicle toy when I was a child. I looked on it as my heart. At that moment, it would have seemed unbelievable that I could own a real private car now. So, I love this vehicle very much.</td>
</tr>
<tr>
<td>Participant 29:</td>
<td>I went to grassland with my son and his friends. These young guys equipped my car with lots of safety devices such as a walkie-talkie. So I took a relaxed and funny holiday with them because I need not worry about age-related safety issues. Now, I love my unique car with these sorts of safety equipments.</td>
</tr>
<tr>
<td>Participant 19:</td>
<td>Look, this car over there has few requirements. It just needs a little petrol and it can carry us to anywhere …I look on it as a living creature, absolutely. It is hard to divide between me and my car. This is because it can help me to travel everywhere and carry any objects.</td>
</tr>
<tr>
<td>Participant 16:</td>
<td>My next car should have a large inner space. It is not only related to interior comfort, but it also affects an older diver’s mood. I might feel depressed when I am seated in an uncomfortable, small and scanty interior space.</td>
</tr>
<tr>
<td>Participant 7:</td>
<td>Most Western drivers like a light coloured interior. Some car sellers told me that light coloured interiors mean elegance. But I do not think so. I love dark colours such as brown. It not only shows my unique personality, but also relates to interior neatness. The environment of Beijing is dirty, the dark colour for an inner space is easy to clean.</td>
</tr>
<tr>
<td>Participant 18:</td>
<td>I love my car because it means freedom for me. I rely on it so much because I have already driven it more than ten years. It is impossible to do leisure travel without it when I retire. I cannot imagine that I would have to take a bus when I retire. It would be a hard life to me.</td>
</tr>
</tbody>
</table>

From the design point of view, metaphor can help designers to build a pleasurable vehicle character as a relatively coherent set of characteristics and attributes (Kalviainen 2002) (Section 5.5). These might cut across different functions, contexts and value systems such as esthetical, technical and ethical in the object (Janlert and Stolterman 1997). Three levels of vehicle meanings provide concrete parameters to guide designers in creating tangible or intangible shapes, colours, functions, features, and interactions to arouse future elderly users’ positive emotions. On the other hand, designing pleasure vehicles should not only to focus on relevant vehicle meanings and contexts, but also to fulfil multiple users’ needs. This is because once other needs categories are satisfied, the elderly users might explore and extend the bounds of their potential – emotion or pleasure. Therefore, vehicle designers should not study emotion in isolation.

### 8.3.6 Spirituality

Spirituality is a post-materialist trend which reflects a desire to rise above consuming, to experiencing (Jordan 2000b). Spirituality has the capacity to empower
large numbers of users to find meaning and fulfilment in action directed to the well-being and life enhancement of themselves and others (Margolin 2002). Data suggests that the most obvious reflection of the spirituality trend is the increasing influence of culture, religion and politics. Moreover, it is worth noting that both age cohorts in the future have the same attitude to spiritual needs (Table 8.4, p. 167). This demonstrates that spirituality embedded in vehicle usage is steady and an essential element for both age cohorts.

It is easy to identify the different meanings of spirituality when entering categories into the travel needs identity model (Figure 8.3, p. 166). For instance, Participant 4 in Table 8.10 interpreted the spirituality need from different levels of vehicle meaning. The three levels of vehicle meaning that emerged from this data segment include practical meaning such as tool for mobility (PMN-1.2) and safety (PMN-1.3), social meaning such as metaphor of luck (SMN-2.1), and cultural meaning such as conventional custom (CMMN-1.4). Social practices such as reinforcing family relationships (SRA-1.1) and local contexts such as social filial ethics (LCT-1.2) can be defined as a macro level of context to identify future younger-old users’ spirituality needs. For example, the boulder turtle, as a traditional auspicious feature, contains a conventional ritual cultural meaning (CMN-1.4) to express future younger-old users’ expectations such as luck (SMN-2.1) and safe driving (PMN-1.3). Here, practical, social and cultural meanings are linked firmly to shape future younger-old vehicle users’ spirituality needs. This is symbolized and materialized by tangible aesthetics elements such as material, color, features and detailed decorations.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Statement</th>
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</thead>
<tbody>
<tr>
<td>Participant 4</td>
<td>My daughter gave this auspicious symbol to me as a birthday present when I was 55 years old. It is an elegant turtle which is made from a boulder. My daughter said it means peace, good luck and safety. It seems that some particular power protects me to drive safely when I hang it below the rear mirror.</td>
</tr>
</tbody>
</table>

Users differentiate spirituality needs from the value of satisfaction of outer nature objects such as utility, aesthetics (Tang 1967) and safety. On the other hand, different meanings of spirituality are based on a certain kind of social value, which comes from the effects of certain activities within the social cultural context (Section 5.4).
This study suggests that six need categories are interrelated with each other: that spirituality is more firmly associated with utility, safety, comfort, identity and emotion. For example, mobility, which is an imperative factor of the utility need, is seen as a basic freedom and one indicator of the quality of life that elderly vehicle users experience. Leisure travel is closely associated with the psychology of future elderly drivers with a car, such as freedom of choice, freedom from obligation, and liberty and free access. Such spirituality needs directly affect the users’ emotions. The culture surrounding the automobile with its suggestions of freedom, autonomy and heightened self-esteem have fostered the psycho-social car dependence even further (Gorham 2002) (Section 5.4).

Safety is firmly linked to spirituality. The symbolic features or decorations which bond safety and spirituality include not only traditional auspiciousness, but also contemporary political leaders. For example, the left-hand picture in Figure 8.7 shows that Mao has become a superstitious guardian for both age cohorts in China to prevent evil attacks and to wish for travelling safety. Choosing a powerful leader, Mao, as the guardian rather than any existing god certainly reminds people of the socialist institution of political culture. In Figure 8.7, Chinese aging population members use symbolic meanings systematically to seek good fortune, to define national identity, to assist easy of use, to keep a clean interior environment, and so on. The Chinese users are superstitious about the color red, which is preferred by them as decorations in their personal cars. For example, the red color is not only used in the auspicious item that is hung below the rear mirror, but is also employed on the silk covers that keep the transmission bar clean. Moreover, the 66-year-old mechanical engineer attached a visible red arrow on the steering wheel to help

Figure 8.7: Samples of spirituality need
himself to easily and safely identify the right direction of the wheel. Such user-driven design symbols are not only to remedy elderly users’ age-related physical decline, but also to seek for safety, based on the superstitious beliefs about traditional colours and features (left-hand picture in Figure 8.7). Compared with current older users who employ the traditional elements to decorate car interiors, the 59-year-old carpenter (future younger-old user) would like to use the colour red and contemporary symbols to ornament his car exterior (right-hand picture in Figure 8.7). The red silk which clothes the foundation of the antenna, and the red sign of the Beijing Olympic Games which is printed on the car door, have strong metaphorical meanings to help future younger-old vehicle users identify with national belongingness.

It is clear that Chinese vehicle users think of cultural tradition as a related source of needs fulfillment, in the sense that merging with an organized symbolic system is a source of personal strength, and a spiritual and affective experience (Lawton 2001). One of the ways users satisfy their feelings of freedom and safety, and fulfill their responsibility of self-definition, is through the systematic appropriation of the meaningful properties of a vehicle. Designers should utilize the cultural design approach, which embeds existing cultural elements in new designs to fulfill the future elderly users’ spirituality needs. Each cultural element defines a type, in that it represents a visual series such as the color red, auspicious features, and so on (Sections 5.3, 5.5 and 5.6).

8.3.7 Elderly Vehicle User Needs Structure

This study claims that Chinese elderly vehicle users’ needs structure ranges from a more concrete level of need fulfillment to a more abstract level. Similarly, the way in which vehicle users identify with and apply meaning to their travel activity also occurs within a range among the practical, social and cultural meanings. In order to obtain a holistic vision of the future elderly vehicle users’ need system from the designers’ point of view, this study examines detailed relationships among vehicle properties, vehicle meanings and Chinese user needs categories (Appendix 8). By thinking in terms of a condition/consequence matrix (Figure 7.1, p. 114) and using the concept model of travel needs identification (Figure 8.3, p. 166) as a guide tool, this study obtains a grasp of the complex nature of travel phenomena and establishes...
a network among the core categories (vehicle users’ needs, vehicle meaning, and vehicle properties). This study has found that each need category is shaped by interrelations among practical, social, and cultural vehicle meanings. This demonstrates that Chinese future younger-old users’ travel needs involve three levels of meaning (practical, social, and cultural). In addition, from the design point of view, the relationships among vehicle property variables and vehicle meaning variables vary in their density (Appendix 8). The future younger-old vehicle users (solid features in Appendix 8) link practical meaning variables to vehicle structure variables more densely. In contrast, the social meaning variables are more associated with aesthetics properties to construct travel-related needs. In other words, vehicle aesthetics properties generate more social meaning for the future younger-old users based on the form, style or sculptural content of a vehicle. These may appeal to the new aging generation within the future Chinese vehicle market. It is important to note that the cultural meaning variables are evenly distributed among all vehicle property variables (Appendix 8). Therefore, cultural elements or contexts present stable characteristics, and play an important role in defining the future younger-old users’ needs.

Generally speaking, social practice and local context form the macro level of the social and cultural contexts of elderly vehicle users’ travel needs. Any changes of these factors can lead to the change of travel-related needs categories and meanings. For instance, when utilizing the concept model of travel needs identification to analyze data segments in Table 8.11, this study found that both participants in Table 8.11 presented the same vehicle property such as food preparation accessories (STT-2.11) and vehicle meaning such as reflecting traditional cultural customs (CMN-1.4). However, two participants presented different social practice and local context categories which form the macro social and cultural context. The condition and context presented by Participant 28 (Table 8.11) involved health attributes (SAS-1.0), cohort identity (SAP-1.1), local food ritual (LCT-2.2), and travel service (LGF-2.1) (Model A of Figure 8.8), whereas the condition and context expressed by Participant 2 (Table 8.11) contained maintaining leisure travel (SAL-1), maintaining social networks (SRA-2), and travel scenery (LGF-2) (Model B of Figure 8.8). Therefore, the different travel-related needs are generated, based on different conditions and contexts. Participant 28 (Table 8.11) needed a utility vehicle because
the in-vehicle food preparation accessory was a functional and necessary tool to maintain his good health due to his age-related capability decline and the poor condition of the local travel service. Participant 2 (Table 8.11) stated that the food preparation facility could support him to enjoy his leisure travel. Therefore, this can be defined as a comfort need based on this context. Clearly, it is impossible to identify the detail of users’ needs without considering changes to the relevant social and cultural context. It seems that vehicle innovations can not only focus on the vehicle property and vehicle meaning in isolation to fulfill the future younger-old users’ needs. The cultural contexts which include subjective culture generated by social practice and objective culture generated by local context play import roles in defining the local users’ needs (Chapter 5).

Table 8.11: Statement on relationships between context and needs

<table>
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<tr>
<th>Participant</th>
<th>Statements</th>
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<tbody>
<tr>
<td>Participant 28:</td>
<td>I need a water heater in the car during the long distance trip such as leisure travel to countryside. It is so useful for me because most of Chinese older guys have stomach problem. We can not drink the cool water. Moreover, the unheated water in the countryside contains lots of bacteria which are harm to our health.</td>
</tr>
<tr>
<td>Participant 2:</td>
<td>The comfortable car should have multiple functions such as accessories to support cooking and sleeping. I will enjoy cooking during the leisure travel. It is exciting when a group of older guys cooking and having the dinner together in the nature.</td>
</tr>
</tbody>
</table>

Figure 8.8: Relationships between context and need identify
Based on the above findings, this study has developed a conceptual framework to define the future younger-old vehicle users’ travel needs, and to establish relationships among the different needs categories. This framework might assist vehicle designers to put a user-centred perspective at the core when they design vehicles for the future Chinese local elderly users. This study demonstrates that the future elderly vehicle users’ needs are outcomes of the combinations of social practice, local context, travel activity adaptation, vehicle property and vehicle meaning elements. There are six travel-related need categories that have emerged from the data analysis: (i) safety, (ii) utility, (iii) comfort, (iv) identity, (v) emotion, and (vi) spirituality. The findings of this study demonstrate that the interrelationships among the six need categories constitute an interactive circularity structure (Figure 8.9) rather than a linear hierarchical arrangement. This is because ‘the human being has not one need in the concrete activity but a whole cluster’ (Bodker 1991, p. 24). Therefore, this challenges the pyramidal human need models developed by Maslow (1987) and Jordan (2003) from the vehicle design perspective (Section 5.2). Chinese traditional and contemporary cultures which are generated from particular local contexts and users’ social practices play a dynamic role in linking and shaping the future older vehicle users’ travel needs (Section 5.4). The vehicle serves to give a tangible expression to elderly users’ experience, activity of interactions, and self-identity (Zhao, Popovic and Ferreira 2007). The vehicle design may be structured into three meaning levels pertaining to the future younger-old users’ needs: (i) the practical meaning level, (ii) the social meaning level, and (iii) the cultural meaning level (Figure 8.9). With reference to these levels, the vehicle’s physical properties might involve economy, structure, function, technology and aesthetics.

The application of this framework involves two initial areas. Firstly, it offers a general analytic criterion for the evaluation of existing vehicles used by elderly drivers in the Chinese cultural context. Designers could employ this user-needs framework to assess potential transport product drawbacks in the Chinese future markets. Secondly, the application of this model would contribute new knowledge to the concept of vehicle design and implementation stage. It could not only help in the classification of vehicle adaptation requirements, but also assist the definition of
future vehicle particular properties in terms of how design decisions might fulfil the Chinese new aging generation’s potential needs in the future.

Figure 8.9: Concept model of future older users’ travel needs

8.4 Summary

This chapter displays the findings from data analysis in a systematic way that helps to develop a future older Chinese vehicle users’ needs framework. The theoretical model considered here can in principle demonstrate that it is possible to drive vehicle design innovation and evaluation within the particular local context. The next chapter deals with how designers transform the framework of future older users’ needs into meaningful vehicle properties. This entails embedding the above-mentioned three kinds of vehicle meanings into tangible or intangible vehicle design features which can satisfy the future younger-old generations’ travel needs.
9.1 Introduction

This study investigates key methodological issues, and contributes to a better understanding of the dimensional character of vehicle meaning, cultural context and users’ travel needs for the future Chinese elderly vehicle users. Reviewing relevant literature demonstrates that major themes developed from this research are often studied in a detached manner within the domains of transportation and consumer psychology. However, this study aims to advance insights into how these variables can be explored in an associated way to identify the future Chinese younger-old users’ travel needs from the vehicle design point of view. Finally, it promotes a design transformation by linking these variables and elderly users’ needs to the vehicle design approach to satisfy the future Chinese younger-old vehicle users’ travel demands.

9.2 Discussion of Findings

The questions posed for the experiment aimed to achieve understanding from the middle-aged vehicle users and from older vehicle users about differences between their current travel needs and future travel needs. By comparing the data, this study forecasts future Chinese younger-old vehicle users’ travel needs which can give designers new knowledge to assist them in their innovations. Based on grounded theory, the data analysis produced five travel-needs-influencing factors: (T1) social practice for maintaining quality of life, (T2) local context, (T3) travel activity adaptation, (T4) vehicle meaning for users and (T5) vehicle properties of users’ aspirations. It envisages that future older generations’ travel needs might be shaped among the interrelationships between these five themes within the Chinese social and
cultural framework. Through integrated comparisons and interpretations of the above five themes, this study generates six travel-related needs from the elderly vehicle users’ point of view: (N1) safety, (N2) utility, (N3) comfort, (N4) identity, (N5) emotion, and (N6) spirituality.

The data analysis demonstrates that there are significantly different factors, or dominant factors, in the major characteristics of each user’s needs. Challenging the traditional human needs pyramidal model, this study demonstrates that interrelationships among the six need categories for the future younger-old vehicle users operate in an interactive circularity structure (Figure 8.9, p. 187) rather than in a linear hierarchical arrangement. In the meantime, constant factors such as cultural and technological elements play dynamic roles in shaping future elderly users’ needs. This suggests that designing for the future older users have to take the six needs categories into the integrated and circular considerations within the technological, social and cultural context, rather than treating design as a linear process (Section 4.2.3).

In addition, this study identifies vehicle meaning as the most significant theme. The meaning of a vehicle is a reflection of human needs, and focuses more sharply on specific needs and their direct implications for design. The future younger-old vehicle users’ needs are mental and abstractive entities, which means that attributing these needs to users is not a straightforward process. Future Chinese elderly vehicle users’ needs might include inferences on latent variables such as vehicle meaning. The product’s meaning is about the roles that artefacts take in users’ lives. It is about the artefact attachments and stories reflecting human abstractive mental needs (Chapter 5). Therefore, it is useful to know how artefacts once used to be, how artefacts have been changed and what has changed them and why (Jaasko, Mattelmaki and Ylirisku 2003). In addition, in understanding the dynamics involved in the future elderly vehicle users’ needs assignment and the balance between different need categories, it is essential to grasp the cultural context, especially the traditional cultural values of the future local younger-old users. Here, cultural elements that influence future elderly vehicle users’ travel needs include (i) objective cultural factors which are generated from local context, and (ii) subjective cultural factors which are created by social practice and activity.
While earlier research has emphasized elderly vehicle users’ physical accessibility needs (Section 2.2), this study suggests that designing vehicles for the future Chinese younger-old users can be considered to serve both physiological, psychological, social and cultural functions that embody the future elderly users’ needs based on a vehicle’s practical, social, and cultural meanings. These functions are closely related to the basic dimensions of elderly users’ experience and needs: (N1) safety, (N2) utility, (N3) comfort, (N4) identity, (N5) emotion and (N6) spirituality. These six user-need categories all affect the way current and future elderly users carry out the social and cultural interactions that occur in the use of the personal vehicle. They form patterns of activity through practical, social and cultural meaning. On the other hand, social and cultural contexts change these travel needs, and these changes should be accepted through elderly users’ interactions.

The findings from this research argue that vehicles have a variety of tangible properties pertaining practical, social and cultural meaning. Users’ needs can be identified and reflected by associating these three levels of product meanings because vehicles are perceived by the Chinese future elderly users from various semiotic perspectives (Section 5.5). In other words, all meaning dimensions are working together to influence future younger-old vehicle users’ particular travel needs. Vehicle designers should consider these three levels of meaning to better understand future elderly users’ particular needs, and create physical product properties to satisfy the users’ demands. It is hard to gain a holistic vision of the future younger-old vehicle users’ travel needs if designers only examine a particular level of meaning in isolation. The three dimensions — practical, social, and cultural meanings — may indeed compose a hidden structure underlying elderly user’s relation to the vehicle. This study found that current older vehicle users are more concerned with the concrete travel needs (safety and utility) at a practical meaning level, whereas future younger-old users are more concerned with abstract travel needs (comfort, identity, emotion, and spirituality) at social and cultural meaning levels.

This study provided evidence that different meanings of vehicles and activities of the older users closely affect the vehicle design for a local market, not only with regard
to the experience of the older users, but also with respect to the transfer of these connotations to the innovation and evaluation of a related product (vehicle) (Sections 5.5 and 5.6). Correlative analyses were used to identify the main covariates (Helfenstein 2005) that were needed to establish the interrelationships among the elderly users’ needs, vehicle meanings and vehicle properties. By associating core categories that emerged from analysis, this study argues that practical meanings link with vehicle structure more densely, and social meanings associate with aesthetics more frequently. Meanwhile, cultural meanings present stable characteristics because variables within the cultural meanings are evenly distributed among the different vehicle properties (Appendix 8).

Currently, two contradictory trends have emerged in international business: the homogenization of consumer needs and products, and the intensification of cultural heterogeneity (Victor 1992). Future Chinese younger-old vehicle users seem to begin to resist homogenization by reemphasizing their cultural uniqueness. The elderly users who interact with their personal vehicles feel that they are interacting with a certain culture, especially traditional Chinese culture. The vehicle is often instrumental in developing the central theme in the future Chinese elderly user’s life by providing a cultural model around which one can organize one’s activities and satisfy one’s needs. Culture transmitted and created content and patterns of functional and symbolic meaningful systems as factors in the shaping of human activity and artefacts produced through human activity and needs (Chapter 5). This definition stresses that cultural meaning is firmly embedded in the practical and social meanings of personal vehicles.

Each culture has its own symbols and patterns of action (Gould 2005). Chinese culture specifies how elderly vehicle users make sense of shapes, colours, textures and functions and so determines how users make use of vehicles. In other words, vehicles can be seen as an opportunity to express the categorical scheme established by the traditional and contemporary Chinese culture. Like any other species of material culture, vehicles allow users to discriminate visually among culturally specified categories by encoding these categories in the form of material distinctions (McCracken 1986). The complex symbol systems such as form, feature and colour give rise to metaphor, grammar, and semantics for vehicle design (Section 5.5). The
future elderly vehicle users learn these systems within the social and cultural context that uses them. The interactions between older users and vehicles also construct these symbolic systems which reflect a particular subjective culture. Therefore, this study argues that vehicle designing should go beyond the surface level of the objective cultural system. Designers should integrate the objective culture, which is embedded in the local context, and the subjective culture, which is embedded in the social practice. It is essential for the human-centred design approach to explore this macro-level of context because characteristics of elderly users’ needs variables firmly depend on changes of social practice and local context.

9.3 Theoretical Implications of Findings

Based on the above discussions, this study attempts to develop the theoretical design approach and strategy to help designers transfer the knowledge (generated from this study) to the tangible vehicle design. This theoretical model consists of two parts: the concept model for structuring user information and the Older-User-Need-Based vehicle design approach.

9.3.1 Structuring User Research Information

Figure 9.1 illustrates the conceptual model which suggests an approach for the collection and structuring of user information during the vehicle design process. Through examining the data from the perspective of their influence on elderly users’ needs, designers will easily be able to relate the data to vehicle properties as defined by older users themselves. In the users’ domain, understanding the objective and subjective cultural contexts helps predict future younger-old vehicle users’ needs. The variables within the social practice and local context drive the future elderly users’ travel activity adaptations. The cultural elements (red circle in Figure 9.1) play an important role in integrating these categories. In the vehicle domain, to fulfil the future younger-old users’ needs, technology (blue circle in Figure 9.1) drives the intangible and tangible attributes such as economy, structure, function, and aesthetics to shape physical vehicle properties. The vehicle meanings generated by the interaction between the vehicle domain and the older users’ domain help designers to better understand the relationships among the properties, and the experiences that they provide. Such understanding in depth helps designers to identify the details of
elderly users’ needs. The overall interactions among the older users’ domain, the vehicle domain and the vehicle meaning construct the design performance domain, which is driven by multiple dynamics such as culture, technology and experience.

Designers expect that potential users have some preconception and attitude toward their products, and their use at the initial interaction with artefacts (Helfenstein 2005). Users carry over such experience-based information contents to novel interactions with artefacts. The older vehicle users’ experiences (yellow circle in Figure 9.1) involve not only cultural context, but also technological factors when they interact with motor vehicles. These contents will affect both physiological and psychological representations that future older users construct of interactions between vehicles and themselves, in which certain vehicle meanings are generated. The multiple facets of future older users’ needs provide a range of experiences gained through older users’ relationships with the material culture. The designed vehicles are the media that provide these experiences. On the other hand, such experiences help to define the contemporary and traditional Chinese cultures, and indeed to redefine the future younger-old vehicle users and provide them with meaning (Chapter 5).

Figure 9.1: The conceptual model for structuring user information
All in all, Figure 9.1 attempts to demonstrate the dynamic factors for the future older Chinese vehicle users: culture, technology and experience. The categories of social practice and local context are vital for understanding the differences and diversity of future elderly vehicle users’ needs. Vehicle design can be defined as a cultural production and technology adaptation system to construct the future older users’ experience. It goes beyond material culture, which emphasizes only the material object. This study suggests the frame of reference that surrounds the object (vehicle property) for the future elderly Chinese vehicle users. These include a vehicle’s social context, ways of using it, the meanings it provides to the older users and the overall experience that its use and ownership enable. Therefore, the concept of experience for the future younger-old users is essential as a unifying issue between the culture and technology of design, as a means of understanding the context of vehicle design, and as dynamic factors to inspire design thinking. In summary, this conceptual model has integrated the structures of all categories generated by this research. It suggests how these categories relate to each other and how design activity synthesizes them logically. This theoretical model provides a framework for identifying a boundary between a coherent body of knowledge specific to designing and the body of knowledge related to other disciplines (Love 2002). That is, it develops a theory on the interactions involving human (older users), objects (vehicles), and contexts (Chinese social and cultural contexts) together.

9.3.2 Older-User-Needs-Based Vehicle Design Approach

Currently, there are few design processes or approaches of integrated problem understanding and solution development (Section 4.2). To fill such huge gap, which emerges in most design situations, especially in designing vehicles for the Chinese future aging generations, this study develops a dynamic design process model which is based on an Older-User-Needs-Based approach, rather than a solution-focused approach (Cross 2000). The structure of the Older-User-Needs-Based vehicle design approach is shown in Figure 9.2 (p. 200). It is based on four stages, each with particular output and with feedback loops showing the iterative returns to earlier stages. Two grey balls, which represent (T1) social practice and (T2) local context, interact with each other to shape the social and cultural context columns which are located outside the double helix structure. The central double helix strips illustrate
vehicle meaning and vehicle property. These two core factors associate with each other to shape three meaning levels of elderly users’ needs. In other words, older users’ needs serve as the bonds to link vehicle meaning and vehicle property.

The first stage, task clarification and the future older vehicle users’ need identification, involves evaluation of user-vehicle interactions to pinpoint what categories of elderly users’ needs are derived from experiences with the vehicle. The original coding scheme (Table 6.4, pp. 109–110) provides the basic perspective for exploring the future older vehicle users’ travel needs in detail. The conceptual model for travel needs identification (Figure 8.3, p. 166) could be used as a tool for defining users’ needs related to vehicle usage. The three meaning levels of the future older users’ needs frameworks (Figure 8.9, p. 187) play an important role in clarifying the design task.

The second stage is focusing on conceptual design, which involves fully understanding the design problem (older users’ needs), establishing a functional structure, preliminary layout, and decision-making. The conceptual design stage might generate broad initial solutions based on the better understanding of the three meaning levels of elderly users’ needs (Figure 8.9, p. 187) which link vehicle property and vehicle meaning together. This stage might make the greatest demands on the vehicle designers, and this is where there is the most scope for striking improvements (French 1985) (Section 4.2). The conceptual model of structuring future older users’ information (Figure 9.1, p. 194) might be useful for organizing the data from the fieldwork and stimulating conceptual solutions. The coding scheme (Table 6.4, pp. 109–110) provides details to inspire the conceptual design solutions. Three meaning levels of users’ needs, which combine the vehicle property and vehicle meaning categories, provide criteria for taking decisions about function, structure and preliminary layout.

The third stage of this process concentrates on the embodiment design. Starting from the concept, the designers determine and optimize the functions and forms based on the future older users’ needs framework (Figure 8.9, p. 187). The transport solution develops in accordance with the detailed categories within the practical, social, and cultural vehicle meaning considerations (Figure 7.12, p. 138). The conceptual models
of travel needs identification (Figure 8.3, p. 166) and structuring user information (Figure 9.1, p. 194) could be used as tools to better understand the significance of the social and cultural context for vehicle design innovations. They might help designers to go back to the context to get deeper insights about the design task, and to make optimizing the process rationally.

The forth stage, the *detail design*, finalizes the vehicle design. Designers should work on arrangement, form, dimensions, colour, material and surface properties of all the vehicle parts, and make sure all details are finally laid down. These detail design elements contribute to the overall aesthetic quality of vehicle design. It is necessary to re-check all concepts within the vehicle meaning (Figure 7.12, p. 138) and vehicle property (Figure 7.20, p. 153) schemes to link them logically (Appendix 8). The decision making on the final details solution is rooted in the future elderly users’ needs framework (Figure 8.9, p. 187).

It is envisaged that designers might explore and develop the problem and solution together when they utilize this approach. This design approach suggests that the design strategies should systematically and explicitly incorporate contextual, social and culturally specific perspectives that influence design, implementation and use (Moen, Gregory and Brennan 2007) for the local elderly users. The designers should realize that vehicle usage goes beyond driving per se. The future younger-old vehicle users’ experiences need to be enhanced through the whole process, which involves the social practice, local context, travel activity, vehicle property and vehicle meaning, because the ride comprises not only the journey, but also its beginning and end. Therefore, vehicle designers should follow the four stages with consideration of interrelationships between different categories. The design starts at the cultural and social contexts, which include the future elderly users’ activities, patterns of travel, and local context. It is possible to generate new design metaphors by starting out from the structure of activity (Kuutti 1991), local customs, and shared culture (Section 5.5).

Working with vehicle meanings and properties together ensures a constant transfer of the designer’s attention backwards and forwards between the problem space and the solution space. The four design stages presented in Figure 9.2 (p. 200) do not rigidly
follow, one after the other. They are frequently carried out iteratively, returning to earlier stages to further achieve a step-by-step optimization. It is important to note that the future older vehicle users’ needs play the critical role at every design stage. That is, each stage starts from fully understanding the future older users’ needs and ends by decision-making based on the older users’ needs criteria. Therefore, this model has to be extremely critical and reflective to avoid a design process that incorporates the designer’s own value-based views about usage. It also challenges the conventional design process in which clarification of task and identification of needs are just introduced and represented in the early stage of process (Section 4.2).

In addition, this approach emphasizes that design research and practice should involve not only socio-technical, but also socio-cultural dimensions (Moen, Gregory and Brennan 2007) to be the dynamic elements. That is, as dynamic factors, culture and technology elements play important roles in inspiring designers’ innovations for the future new aging generation. On the one hand, technology constructs the vehicle property as a system of signs and objects with which Chinese elderly users can interact. Technological understanding drives the elderly users’ interaction with the vehicle to fulfil their future multiple travel needs. The future needs are assessed against predictions of future activity and future technology development (Bonner and Porter 2002). Through technology, the future younger-old vehicle users enhance their leisure lifestyle, social interactions and independence, in the context of diverse and dynamically changing functionality, needs and desires that will accompany them. From a design point of view, a variety of cutting-edge technologies provides more freedom for vehicle designers to create relevant physical vehicle properties in order to meet future younger-old users’ needs. For instance, small engines which can be integrated into the floor panel, and smart construction with more use of plastics will draw the interest of designers to design more emotional or organic interior and exterior styling. Spacious and compatible interior space with more flexibility can be introduced for elderly recreational purposes and collective use. Solar energy technology assists future older generation to achieve sustainable mobility. The smart, sustainable and electronics technology should be evaluated and utilized in future vehicle design (Sections 3.3.5 and 4.3.2).
On the other hand, culture is constantly substantiated by human practice and local context. Meaning is first rooted in the culturally constituted world of social practice and local context. To become resident in personal vehicles, meanings are disengaged from this world and transferred to objects (Section 5.4). Vehicle design is one of the most important institutions that are used as instruments of meaning transfer. If the sources of cultural meaning are dynamic and numerous, so are the designers who gather up cultural meaning and effect its transfer to artefacts such as vehicles. Therefore, designers should decompose culture into correlative cultural elements. Firstly, these elements belong to a system evolving over time and space, with strong local cultural characteristics such as representative visualization which relate to the tangible local culture. Secondly, the future elderly users’ social practice and activities shape the subjective culture which drives designers to gain insights about users’ potential needs. From the design point of view, most categories within this study are correlated with interdependent self-explanations and with personal needs derived from the Chinese collectivist culture. It provides direction on the most important functions, structures, features and aesthetic symbols to emphasize, in developing exterior and interior vehicle design for future older users with collective Chinese cultural values and needs. For instance, a personal car is often used to indicate the future younger-old user’s status as belonging to certain cohorts and expressing the public self. Vehicle designs that are more visible and visually attractive in their form, colours, and ornaments would appeal to a certain users’ group rather than to individual users. In addition, the cultural elements also attempt to overcome current perceptions of designers about ease of use. For example, the elderly Chinese users can be expected to be confused, and take longer to learn arbitrary in-vehicle design features such as English worlds, abbreviations, icons and other symbolic displays. Providing clearly visible Chinese characters will benefit the elderly native language speakers. In-vehicle communication systems, displays or interfaces should use Chinese characters, rather than English text and icons, to convey information clearly.
Figure 9.2: Older-User-Needs-Based vehicle design approach
It is also important for vehicle designers to transform multiple levels of meaning into symbolic and physical properties to fulfil future older users’ needs within the particular local context. As activity theory suggests, ‘reflective design processes are needed to more fully attend to socio-cultural influences for critical and constructive consideration’ (Moen, Gregory and Brennan 2007, p. 170). Technology and cultural elements are needed to drive vehicle innovations for the future Chinese elderly users efficiently.

9.4 Summary

This study has sought to provide understanding of the future elderly vehicle users’ needs in the practical, social and cultural contexts. That is, the vehicles are used for interpreting the practice, symbolism and culture of collective dreams displayed in the elderly users’ lifestyles. Designers have to create new vehicles to carry meanings through these systems governed by activities and context. This chapter has discussed the main theoretical contribution of the study, and developed the conceptual model for structuring user information and the Older-User-Needs-Based vehicle design approach to assist vehicle innovation for the Chinese future aging population. Within this design approach, the three meaning levels of older users’ needs framework play a key role in associating vehicle meanings and vehicle properties, and provide criteria for design decision making.
Chapter 10: Conclusions

10.1 Introduction

This study explores the future Chinese older vehicle users’ travel needs. The focus on Chinese future younger-old vehicle users was motivated by the fact that travel activities and travel needs in China differ from those in North America, Europe or other metropolitan areas across the world. Moreover, compared with the current aging population, the future younger-old users will experience new lifestyle choices and leisure activities. Therefore, the original Western or Japan designed vehicles need to be redesigned for the Chinese market.

The literature demonstrates many improvements in theoretical explanations of travel activities of older vehicle users. However, these must still be translated into effective vehicle design methodology to assist it the design of personal transport for the Chinese future younger-old users. Vehicle designers need frameworks to make transitions from theoretical understanding of older users to design implementation. These frameworks can integrate models of older users’ needs technologically, aesthetically, socially, and culturally.

It is worth noting that the Chinese future older users have a strong drive to remain independent and to contribute to the community, but are hampered by inappropriate vehicle design. Better design can play an important role in enabling older users to maintain not only physical but also social and cultural activity. For the future Chinese younger-old users, age-related social and cultural changes are more important than physiological changes in shaping their travel needs. Therefore, this empirical study goes beyond a simple categorization of the physical properties served
by the vehicle; it examines the dynamics that give rise to the structure of user-vehicle relations and experiences. This study argues that the interaction between elderly users and vehicles is made meaningful by the technological, social, and cultural context in which it takes place.

The future Chinese older vehicle users’ travel needs are generated from interrelationships among five themes (T1) social practice, (T2) local context, (T3) travel activity adaptation, (T4) vehicle meaning, and (T5) vehicle property (Chapter 7). These research findings demonstrate that travel activity relates to conditions such as social practice and local context, and to consequences such as vehicle meaning and properties. Vehicle meaning is identified as the most significant theme for older Chinese vehicle users. Meanwhile, local context retains constant characteristics. Both current and future aging cohorts emphasize core categories such as social activity for maintaining daily lifestyle (SAL), practical meaning of vehicles (PMN), social meaning of vehicles (SMN), and cultural meaning of vehicles (CMN). Social acceptability (SAP), practical meaning (PMN), and social meaning (SMN) show significantly different patterns between the two age cohorts, compared with cultural meaning (CMN) and present constant characteristics. The interpretations of this study suggest that most categories have implicit or explicit relationships associated with others to shape future older users’ travel needs.

10.2 Contribution and Transfer of Knowledge

Margolin (1997) argues for an expansion of design knowledge from a knowledge of technique, which has been the traditional emphasis of design training, to a knowledge of user experience. From an activity-centred perspective, rationales for design research are made explicit and are meant as catalysts (resources, prototypes, and models) for reflective, participatory discussion in multi-disciplinary collaborations with practitioners (Gregory 2000).

In the area of designing for older users, most of the current knowledge gained by the profession has been through direct experience, rather than the transfer of knowledge from research. Designers need help in knowing the path to follow to elicit the correct information from research activities, how to work with the tools available, and how
to evaluate solutions derived. It is essential that knowledge is widely disseminated and that research findings are presented in a manner that can be implemented effectively and efficiently by designers (Warburton 2003).

Currently, many design approaches for allowing accessibility and usability by older users focus on their disabilities. However, the principal concern for the designer is physiological capabilities, irrespective of cause and context. Therefore, there is an urgent need for design research, based on a better understanding of age-related changes within the particular social and cultural context, which will lead to minimising the impact of impairments and thereby extending quality of life. To support design for older adults, it is necessary to understand the knowledge requirements of designers who are working in a particular domain such as the transportation design area. The knowledge requirements include information about the older users’ needs, and also the tools and approaches for making design decisions and for developing solutions.

Based on above understanding, the significance of this study lies in its contributions to the body of knowledge in three aspects; that is, contributions to research methodology, theory, and design. Although this study focuses on the personal vehicle design for future Chinese older users, the theoretical models and knowledge can be transferred to any other design domain outside vehicle design. For example, designers can use these methodologies to design aircraft, agricultural equipment or kitchen appliances to fulfil other target populations’ needs. Moreover, it is worth noting that this research not only focuses on travel behaviour per se, but also closely links travel activity with its conditions and consequences to better understand older vehicle-user’s travel needs. The three aspects of contribution have been better addressed in the following sections (Sections 10.2.1, 10.2.2, and 10.2.3).

**10.2.1 Contribution to Research Methodology**

The first contribution to knowledge is the development of an original coding scheme (Table 6.4, pp. 109–110). This provides the basic perspective for exploring the future older vehicle users’ travel needs in detail. This coding framework, and interpreting the relationships between the categories within it, has generated the new knowledge
to develop the theoretical model for the future older vehicle users’ travel needs. In addition, considering that many complex technological products (e.g. personal vehicles) are involved in the context of everyday activities, this study developed a validated research methodology (Figure 6.2, p. 97) to probe the rich context of user–product interactions and to forecast future older users’ needs from social and cultural perspectives. The triangulation approach consisting of co-discovery, logbook, and interview has produced valuable, rich and articulated qualitative data to assist exploring the older users’ need in particular cultural context. This methodological approach and coding scheme can be transferred to other studies that require the exploration of future target populations in their particular social and cultural contexts.

10.2.2 Contribution to Theory

In the classical literature on human needs, most theoretical models have studied human needs from general and abstract levels, and cannot provide new knowledge to designers that help them design transport for local older people. The main theoretical contribution of this study is the development of an older Chinese vehicle users’ travel-needs model (Figure 8.9, p. 187). The older vehicle users’ travel needs are identified among the interrelationships between five themes (social practice, local context, travel activity adaptation, vehicle meaning, and vehicle property) within the Chinese cultural framework. The older vehicle users’ needs model involves six categories: (N1) safety, (N2) utility, (N3) comfort, (N4) identity, (N5) emotion, and (N6) spirituality. These needs categories are based on the older users’ beliefs and attitudes, and on values that are dependent upon social and cultural context. The interrelationships among these six categories can be seen as an interactive circularity structure rather than a linear hierarchical arrangement. Chinese cultural values, which are generated from particular local contexts and users’ social practices, play a dynamic role in linking and shaping the future older vehicle users’ travel needs. It specifies how older users make sense of shapes, colours, textures and factions and so determines how users make use of vehicles.

In addition, this study divides the older users’ needs model into three levels of meaning to guide the direction of vehicle design: (i) the practical meaning level, (ii) the social meaning level and (ii) the cultural meaning level. By associating three
meaning levels with vehicle properties from the design perspective, this study emphasizes that practical meanings link with vehicle structure more densely, and social meanings associate with aesthetics more frequently. Cultural meanings are evenly distributed among the different vehicle properties and firmly embedded in the practical and social meanings of personal vehicles.

This theoretical user-need model could assist in gaining greater knowledge about the differences between current and future older users in particular technological, social, and cultural contexts. The age-related lifestyle changes such as social acceptability and social activity are more important than physiological changes to shape the future younger-old vehicle users’ needs. It is worth noting that (N1) safety and (N2) utility needs, which are emphasized by current elderly vehicle users, are more related to practical vehicle meanings and objective cultural experiences (Section 7.4). However, the (N3) comfort, (N4) identity, (N5) emotion and (N6) spirituality needs, which are highlighted by the future younger-old users, are more associated with subjective experience. Moreover, Chinese future younger-old users are concerned more with social meaning (SMN) and less with practical meaning (PMN) than are the current older cohort. Meanwhile, the traditional Chinese cultural values are the stable and constant factors, rooted in the aging population’s current travel activities and influencing their future travel needs.

This older user needs model can be utilized to propose a new vehicle design approach to help designers gain the new knowledge needed to design concept vehicles for future Chinese aging populations. It provides design criteria to support decision making during the vehicle design process. This model can be transferred to other domains and is applicable to understanding other populations’ needs.

10.2.3 Contribution to Design

From the user-centred design point of view, this study contributes to the building of design knowledge in China where vehicle design for the local older user is in its initial developmental stage. The most important contribution of this study is in developing a series of design tools, models and approaches from the vehicle design perspective. These include a conditional/consequential matrix (Figure 7.1, p. 114), a
travel needs identification model (Figure 8.3, p. 166), an elderly users’ travel-related needs framework (Figure 8.9, p. 187), a user information structure model (Figure 9.1, p. 194), and an Older-User-Needs-Based vehicle design approach (Figure 9.2, p. 200). These models suggest a basic framework to the design process, which might assist designers to design new vehicles to fulfil the future Chinese aging generation’s needs. They will also assist in generating new knowledge relevant for designers to apply during the design process and to evaluate relevant vehicle prototypes.

It is important to note that the Older-User-Needs-Based vehicle design approach (Figure 9.2, p. 200) provides a new method of addressing the need-oriented design approach in the particular technological, social, and cultural context. This well structured approach transforms the innovation process into a useful vehicle design method. It suggests that a more comprehensive explanation exists if designers can identify both the artefact (vehicle) meaning and artefact (vehicle) property associated with the fulfilled older users’ needs. Designers need to consider the relation among the six older users’ needs categories to balance multiple needs through proper design features. Moreover, three levels of vehicle meanings provide concrete parameters to guide designers in creating tangible and intangible shapes, colours, functions, features, and interactions to fulfil the future older users’ multiple needs.

In addition, this research obtains an artefact’s (vehicle) definition by understanding future older user activity in the social and cultural contexts, not only from the tangible property perspective but also from the intangible perspective. Designers should integrate the objective culture which embedded in the local context, and subjective culture, which is embedded in the social practice. Therefore, they need to create the proper context for experience (Overbeeke, Djajadiningrat, Hummels, Wensveen and Frens 2003), rather than the physical vehicle’s property. Vehicle innovation for the local elderly users should systematically study the user—vehicle interaction rather than focus on the products properties in isolation. Vehicle design for the older users can be defined as cultural production and technology adaptation system to construct the future older users’ experience. Such a theoretical model might not only assist designers to design private transport for the elderly Chinese vehicle users, but also inspire similar efforts of developing culturally and socially appropriate products. In other words, this model is transferable to other design
domains such as human computer interaction, product design, interior design and graphic design.

10.3 Future Research Areas

This study has provided a foundation for further research work, and will provoke many questions which will need answers that are beyond its scope. Firstly, although there has been some attention given to gender differences in this study, there is more work to be done on these differences and urban–rural considerations because there are limited female and rural elderly vehicle users in the current Chinese society. Further investigations will expand this research to involve more female and rural older users in China.

Secondly, another important issue involves implementation for design practice. The new knowledge which is generated by this research will be applied in design practice. To test the theoretical model, a four-week vehicle-design workshop will be conducted in Tsinghua University. The participants will include transport design students and in-house vehicle designers. Based on understanding the theoretical models generated by this study, designers will design concept vehicles for future Chinese older vehicle users. During the design process, a focus group consisting of the current and future older vehicle users will be asked to discuss and evaluate these design outcomes. This approach is appropriate for learning exactly the potential of future older users’ ideas for the concept vehicle design. The concept of vehicle design based on this research application will serve as a bridge between theoretical research and design practice.

Thirdly, an additional topic for research could be to test the feasibility and potential transferability of theoretical models such as the Older Vehicle Users’ Travel Needs Model (Figure 8.9, p. 187) and the Older-User-Needs-Based Vehicle Design Approach (Figure 9.2, p. 200) to other cultural contexts and domains. Moreover, underlying the future research is a suggestion that it might be designed to support Chinese government policy in controlling the manufacturing and import/export of vehicles and vehicle innovation.
10.4 Summary

This thesis develops a methodological approach to vehicle design as a reflection of some of the new significant knowledge for design practice from the Chinese social and cultural perspective, allied to significant information about local older users’ needs. The systems approach appears appropriate. It holistically links diverse phenomena that influence relationships between older users, vehicles and their surroundings, including the practical, social and cultural contexts. From a design point of view, the design of cars is subject to technological, social, cultural, economic, ergonomic, and political forces and transformations. It needs users to harness these forces and make them meaningful. Using the resultant culture-specific insights about older drivers’ travel needs and the Older-User-Needs-Based design approach, designers in the vehicle industry will improve their innovation process to assist in improving the quality of future older adults’ life in China.
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Appendices
Appendix 1:

Participants Screener and Profiles
Invitation and Questionnaire (Screener)

My name is Chao Zhao from the Faculty of Built Environment and Engineering at QUT. Thank you for expressing interest in collaborating with this study. This study is part of my PhD degree and it is intended to contribute to the design vehicle for the future Chinese older drivers.

The test consists of interview, logbook, co-discovery and focus group. All your comments will be kept anonymous in the presentation of the research outcomes. As a necessary step in this study, we need some information to help us screening participants and organizing the study outcomes. That is the intention of this questionnaire; please fill it out and return it by email to the address below as soon as you can. We will contact you to organize an experiment session.

Email completed questionnaires to: c3.zhao@student.qut.edu.au
Thank you.

**Personal information**

Name:

Gender:   Female [ ] Male [ ]

Age:  45-50 [ ] 51-55 [ ] 56-60 [ ] 61-65 [ ] 66-70 [ ]
      71-75 [ ] 76-80 [ ]

Email:

Tel:

Education:  Elementary [ ] Secondary [ ] College/University [ ]

Occupation:

Current employment situation:  On the job [ ] Retired [ ]

The number of family members:  1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ] 6 [ ]
      7 [ ] 8 [ ] 9 [ ] 10 [ ] more than 10 [ ]

Do you hold a Chinese drive license?   Yes [ ] No [ ]

How long does it take since you got drive license?

Have you participated in a research experiment like this?  Yes [ ] No [ ]

Please suggest two persons who potentially would like to participate in this study:

Please introduce their age:  45-50 [ ] 51-55 [ ] 56-60 [ ] 61-65 [ ]
          66-70 [ ] 71-75 [ ] 76-80 [ ]

Please introduce their occupation:

Please introduce their detail contact information:

Thank you! Your collaboration is valuable.

For any questions regarding this study, please contact: Chao Zhao
Industrial design department, Academy of Arts & design, Tsinghua University
C3.zhao@student.qut.edu.au
## Participants’ profiles

<table>
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<tr>
<th>Participant</th>
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<th>Sex</th>
<th>Service condition</th>
<th>Occupation</th>
<th>Education</th>
<th>Household type</th>
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<td>In-service</td>
<td>Academic staff</td>
<td>University</td>
<td>Extended Family</td>
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<td>M</td>
<td>In-service</td>
<td>Designer</td>
<td>University</td>
<td>Extended Family</td>
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<tr>
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<td>57</td>
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Appendix 2:

Representative Example of Information Package and Consent Form
Participant Information Sheet

“Aging in China and its Impact on Vehicle Design”

Chao Zhao
Queensland University of Technology,
School of Design
D Block, Level 3, Room 304
Gardens Point Campus, GPO Box 2434
Brisbane QLD 4001
Ph: 3864 9184

Description
This project is being undertaken as part of a PhD project for Chao Zhao.

The purpose of this project is to explore the current travel activities and travel patterns of older and middle-aged drivers within the Chinese cultural framework. It is envisaged to apply these findings to the theoretical model in order to predict the older vehicle users’ future travel needs. It is proposed that the theoretical model be tested on a concept vehicle design for the future older Chinese users.

The research team requests your assistance in identifying.

Participation
Your participation will involve an interview, logbook, and co-discovery.

The interview will involve face to face conversation which related to difficulty of using the vehicle. The process of interview will take about half an hour in your private car, in which time you will be video and audio recorded.

You also might be asked to fill several pages of diary about your daily travel activities on Tuesday, Thursday and Sunday in one week. The setting of this experiment depends on your choice (e.g. you can finish the dairy in the vehicle or at home).

Furthermore, you will be asked to discuss some topics which are related to imagining your future travel patterns and lifestyle with another participant. You will also be asked to image and draw your own future car and explain your sketch to another participant, in which time you will be video and audio recorded. This co-discovery will take approximately one hour and conduct in the meeting.

In addition, all of comments in interviews and co-discoveries will be verified by the participants prior to final inclusion. Moreover, the audio and video recordings will be verified by the participants prior to final inclusion as well. The video and audio data collected will be stored in a secure place which will only be accessed by the research team. The recordings will not be destroyed after use; instead it will be stored in a secure place as backups. Participation in this project is not possible without being video taped.

Expected benefits
As this is only an academic research study, we will not be able to pay for your participation, but we will provide complimentary refreshments and nibbles during the session for your comfort. Moreover, the results will help further my study, which can be used to generate new knowledge about design of the vehicle for the older vehicle users. The results will be published in my thesis and any other published research papers. Furthermore some or all of results may be presented at various conferences and presentations.
Risks
There are no additional risks associated with your participation in this project.

Confidentiality
All comments and responses are anonymous and will be treated confidentially. The names of individual persons are not required in any of the responses.

Only the research team will have access to the information you provide. Your anonymity and confidentiality will be safeguarded in any publication of the results of this research, through the use of pseudonyms.

During the video recording, your confidentiality/ anonymity will be maintained. Although you will be videotaped and others may view this video, your details including your name will not appear on any of the footage. Only the research team will be able to connect you with your personal information.

Voluntary participation
Your participation in this project is voluntary. If you do agree to participate, you can withdraw from participations at any time during the project without comment or penalty. Your decision to participate will in no way impact upon your current or future relationship with QUT.

Questions / further information
You will be required to sign a Consent Form at the beginning the session. This study has been approved by the Human Research Ethics Committee (QUT application 0600000009). Please contact the researchers if you require further information about the project, or to have any questions answered.

Concerns / complaints
Please contact the Research Ethics Officer on 3864 2340 or ethicscontact@qut.edu.au if you have any concerns or complaints about the ethical conduct of the project.
Participant Information Sheet

Consent Form

“Aging in China and its Impact on Vehicle Design”

Chao Zhao
Queensland University of Technology,
School of Design
D Block, Level 3, Room 304
Gardens Point Campus, GPO Box 2434
Brisbane QLD 4001
Ph: 3864 9184

Statement of consent
By signing below, you are indicating that you:

• have read and understood the information sheet about this project;
• have had any questions answered to your satisfaction;
• understand that if you have any additional questions you can contact the research team;
• understand that you are free to withdraw at any time, without comment or penalty;
• understand that you can contact the research team if you have any questions about the project, or the Research Ethics Officer on 3864 2340 or ethicscontact@qut.edu.au if you have concerns about the ethical conduct of the project;
• understand that the project will include audio and/or video recording; and that the data will be kept in a safe and secure place where only the research team can access it;
• agree to participate in the project.

Further, by signing below, you are stating that you will not take any alcohol or drugs (some examples include antihistamines, tranquillisers, pain killers) likely to affect your driving performance within 24 hours of the study, and that you will not in any way be under the influence of alcohol or drugs.

Name

Signature

Date

______ / ______ / ______
Appendix 3:

Samples of Co-discovery Structure and Transcription
Sample of Co-Discovery Structure

Introduction

Welcome and thank you for your participation in this session. This co-discovery will consist of two stages which will last one hour. In the first stage, you will be asked to discuss and imagine your future lifestyle and social activities related to vehicle using for about 30 minutes. In the second stage, you will be asked to design your own future car using pencil and paper within 20 minutes. You need talk to each other to explain your sketch.

Stage one (within 30 minutes)
1. Please introduce yourself to each other.
2. Please imagine your future family life in the next decade.
3. Please discuss your future social life in the next decade.
4. Please imagine how you use private car in the next decade.
5. Please discuss your ideal lifestyle in the next decade.
6. Please describe your future car in the next decade.

Stage two (within 30 minutes)
1. Please image and draw your own future car in the next decade. (20 minutes)
2. Please explain your sketch each other. (10 minutes)
Transcription of Co-discovery Sample (English version)

Date: 08/04/2006
Participant1 =Y Participant2 =C Researcher =R
Setting: "Meeting room at Academy of Art and Design, Tsinghua University, Beijing"
TASK: Imagining your lifestyle in the next decade. How will you use the vehicle in the next decade?

TIME PAR. PROTOCOL
00.00.01 R: Both of you are over 45 years older drivers. Could you please discuss and imagine your lifestyle in the next decade? Or how will you use the vehicle in the next decade?

00.01.09 C: We have different situations now. Yan lives nearby the university. So he is close to the necessary facilities such as primary school, hospital and shopping centre, especially hospital.

00.01.30 I live far away from the University. However, there is a hospital nearby my home as well. Both of us will retire in the next decade. I will be 61 years old in 10 years. So, there are two possibilities for my future. When I was retired, the family will be the centre for my life. Travel relates to go to hospital, shopping centre and my child's apartment ... I think that it is my future life.

00.02.05 Maybe, there are some works I need to do, for instance part-time working and teaching. That is my future life. I am wondering what your future situations are.

00.02.18 Y: I think that the Chinese society develops fast. In the next decade, there will be several factors which can influence people's travel pattern. One is health condition. Generally speaking, when people are about 60 years old, they will have good health conditions and activity functions.

00.02.43 In addition, they have desire to do the work as well. I will lay a course for my retire life before I am going to retire, which maybe include some of works, and also include some leisure travelling and so on.

00.03.05 Let me say, travel patterns depend on some conditions. En... for the daily travel, if public transportation systems of the city develop well ... of course, there are no similar conditions in the overseas, you know, more than 10 lines of subway will be established in the next decade in Beijing. Generally speaking, daily travelling in the city areas may depend on the public transportation.

00.03.38 However, in case of some special situations such as illness or some somewhere public transportation can not reach, I think that I will drive the car to there. Well then, this is just one type that is daily travelling in city ... So, this is the special needs for using personal car.

00.04.20 C: Yes, basically, public transportation is an important mode in the city.

00.04.30 Y: Yes.

00.04.31 C: I visited Japan several days ago. Tokyo spans so huge, in fact, the area of Tokyo is 2-3 times as Beijing. It is big city. See, just like from Tsinghua (university) to Shunyi (suburb of Beijing). It is possible to take subway. It probably takes 40 min or one hour. So, I would like to live in the suburb of Beijing, honestly. So, for the older people, the public transportation probably is first important choice in the future.

00.05.03 Y: I think that public transportation maybe an important choice in daily travel. However, if we discuss what kind of vehicle I want to buy, I think that people such as our cohort, who have driving experience before, must will be buy a vehicle before we retired. Actually, I am just thinking about this question recently. I also ask students to imagine the vehicle which is designed for the older people who are retired. I think this is an interesting topic. Firstly, I think that the cost of vehicle using should not be high, because older people's income will decline. So, petrol-consumption should be low, vehicle's function should be credible, and it also should be easy to use and maintenance.

00.06.00 This seems ambivalent. This vehicle should meet the older person's travel planning. Cause the older guys have new envision about their future lifestyle related retirement. Probably it is not actually satisfaction. For example, I imagine that my future vehicle should have bigger size. Just in several years ago, I thought that people might buy a small car before he or she retire. But I change such idea now. Probably the older people think that they will have a lot of spare time for themselves. I may be go to Pingyao, Shanxi province, or go to Tai mountain and so on... Of course, I will take plane or train if the destination is far away from the Beijing. But ...because you have spare time, and
you have good health condition as well. The areas of Chinese country are so wide and
you can drive the car to travel everywhere.

00.06.57  I would like to buy the Volkswagen's Caddy, just like S's car. Probably, it is a little bit
early if I buy this car now. Maybe, I will buy it before I retire.

00.07.08 C:  I think that the vehicle you mentioned is one possibility when I retire. Moreover, our
children will grow to adults. Probably they can drive, and have vehicle. They might
drive and take you to everywhere. If older couples want to travel by themselves, the
vehicle maybe just has two seats. And… there should be enough space in vehicle's back
in order to store some objects or carry a dog. So, there should be some proper space in
this vehicle, but the space should not be too big.

00.07.40 Y:  I do not think so.

00.07.42 C:  It maybe use the sustainable energy sources such as recharging electric power.
Moreover, it must be have auto transmission. The older driver does not like to operate
troublesomely. However, the space Caddy maybe just one of options for the older guys
…

00.08.05  But, I should not buy a luxury car or sedan/saloon such as Buick's Excelle and
Hyundai's Elantra.

00.08.20 Y:  Yea, I am with you. I think that older people does not think a lot of status or class issues
which is showed by his car when he retires.

00.08.30 C:  However, inconsistently, the group such as us are similar. Probably the people in other
class will look on such issue importantly and they will splurge through their cars …

00.08.41 Y:  I think that I will buy a car which should not be too small. You just mentioned the
Coupes …

00.08.47 C:  Two seats and plus appropriate space, I mean.

00.08.50 Y:  I do not think so I don't like a coupe because it's an exclusive vehicle, which means it
is impossible to sit three or more people in the small car. You know, older people need
bigger space for their peers when they are travel together… we can look after each
other while enjoying the journey.

00.09.01 C:  Yes. There is a factor, we concern with it little. In the next decade, our children may be
married. You probably will get a grandson. So, you will carry your grandson to enjoy
your travelling when you drive car. It is possible for us.

00.09.14 Y:  Yes. I have some expectations when I retire. Of course, some older guys might feel
depressed when they are retired. But many people might believe that they will start a
new life stage when they are retired.

00.09.35 C:  I am going to make handicrafts and exhibit them in the art gallery in the next decade.
So I need a big car to carry these things.

00.09.58 Y:  After I am retired, I would like to be a gardener because I like nature. Maybe I will
possess a small garden in my house. I need a particular car to carry plants.

00.10.19 C:  Is it possible that the older people want to travel place by place? They do not worry
about time and they just drive 200-300 km per time when they are travelling.

00.10.26 Y:  Yes, it is.

00.10.27 C:  I might stay one place for several days and then drive to the next place.

00.10.30 Y:  You know, there is a typical example, en … my friend, CH, is 60 years old now. He
bought a Picasso (CITROEN) last year. It is a big car. There are five seats in this car in
fact, but it has a big space. It is expansive which approximately takes 170-180
thousands RMB. I asked him why did he buy it? He said that he will drive this car until
he is too old to drive it. So, people must think carefully when they want to buy a vehicle
before they retire. The older people may not change this car after they retire. This is the
last car for the older people. Therefore, this car should be durable and reliable; its using
cost should be low; it should consume less energy resource. It should have good
quality. I believe that it should have a big space…

00.11.37 C:  Well, I suppose that Ch’s car might consume more petrol when considering its size.

00.11.38 Y:  Its space should contain all of the older people's dreams … just dreams. It is hard to say
what kind of things he actually wants to do by using this car. Maybe he is suddenly sick
and can not move after he buy this car; or he just gets his grandchild and has to stay at
the home to take care of grandson for one or two years. So he cannot travel far away in
above situations. However, he must have some dreams before he is retired, because he
has spare time to imagine a lot of dreams. So, the small car cannot contain all of his
dreams. I believe that this car is a dream container. Let me say, for example, if you are
retired, you might think that you will take 1-2 months to make a leisure journey per
If the destination is far away from the Beijing, you probably will take the plane …

00.12.40 C: Probably, we drive to the small village in southern China and live there for two months.

00.12.45 Y: That is right. Current older guys have such experiences as well. They are not hurry. They just drive 4-5 hours per day, and then lodge …

00.12.54 C: Maybe the older people will depend on public transportation in the city centre. The private car will be mainly used when they make a long distance leisure travel …

00.13.07 Y: It will depend on many situations. In next decade, if using private car is not convenient, for example, if it costs too much money; and older people still have good health condition, they maybe depend on public transportation … However, if the older guys are sick and want to go to hospital, they do not like to take public transportation. I still like the vehicle which S bought. I think I probably buy this kind of vehicle before I am retired. But I will not buy SUV, because SUV consumes too much petrol, and it will cost more money during using it. According to current salary level, my retirement pension will be about 3000 RMB (per month). I do not know. Maybe about 3000 RMB. If the vehicle consumes petrol 12 litre / 100 km, I can not accept it. It is better from 8litre/100km to 9 litre/100 km.

00.14.07 C: it is better to use battery for my next car …

00.14.08 Y: S's vehicle is a typical example. It is a successful case from a design perspective, but it is an unsuccessful case from a commercial perspective. Especially in Chinese market, there are only about 1000 vehicles (Caddy) have been sold.

00.14.30 C: I think that it is expensive.

00.14.32 Y: But it has good quality.

00.14.33 C: Yes, it has good quality. But it costs around 160 thousand RMB?

00.14.38 Y: For its good quality, it is not expensive, I think.

00.14.40 C: There are many other brands such as Toyota and Nissan which also take about 160 thousand RMB. Basically, their models look more fashionable than Caddy.

00.14.50 Y: But I think that Caddy satisfies older retired people's taste. You know, the older guys do not pay more attention to the luxury manner which expressed by their vehicle’s model. They need not to do the business negotiation any more. They might pay attention to inherent factor their car can give to themselves.

00.15.02 C: They may pay more attention to their life than their status when they use the car. The older people will wonder whether their car is more comfortable and convenient as the living tools, and cars' details …

00.15.19 Y: It does not make sense that the vehicle reveals the symbol of status and wealth for the older people. I feel strange that CH might buy that kind of car when I saw it firstly. However, actually, it is rational option when I think about it now. You know, it takes him about two years to think and look for such proper car for himself. We took the same bus together every day; and he always talked with me about the car choices. You know, he sat behind me; he always discussed with me which kind of vehicle he should buy. We discussed most brands cars which are sold in the market. However, we just did not talk about this Picasso. It is interesting that he made a final decision and bought this car. I guess that he will buy Caddy if he saw it before two years ago.

00.16.00 C: Probably.

00.16.05 Y: So, I think that this vehicle can carry the dreams. It does not carry the information which tell other people you are boss … something like that. It contains the quality of life actually.

00.16.17 C: I do not want to buy a racecar like young generations. The elderly driver would like to operate steadily and slowly to ensure driving safety. So the model of my car should not look like ambitious, luxury or speedy. That is not the proper style that our generations wanted.

00.16.39 Y: I think that such vehicle, just like Caddy, looks simple; but it has good quality inside. If designers want to redesign it, they just need add a few of facilities to meet the demands of older drivers based on this kind of vehicle's framework… Of course, there are little market for this kind of car now, but in the next ten years, it should get good market. For instant, there should be a toilet bowl in such car, but I do not know how to solve the technique problems. Maybe, there should be a curtain around the toilet facility in the vehicle … It can solve the sanitation problem. In addition, there should be some medical assisting device such as transfusion facilities in the car. Older people will feel
safe when they drive a car that has such facilities. In case of facing a health-related emergency, they can get some tools to solve it.

00.17.28 C: They will be transfused during driving ...ha ha. It is unbelievable.
00.17.30 Y: It is may be unused forever. But if there are these kinds of facilities in the vehicle, the older people maybe feel safety when they drive this car. In case of facing the emergency, they can get some tools to solve it.

00.17.42 C: It seems that the older people look on their vehicle as a small home, especially during the tour. There would be a fold desk in the car. The older guys can sit in the car, look around scene and have a cup of tea ... And then, they draw back desk and drive continue their travel.
00.18.00 Y: You know, my son will study in the university when I am retired. He maybe stay in Beijing, or go to another city. Anyway, it is possible for me and my wife, to travel together at that moment.
00.18.17 C: Yes, you need not worry about and take care your son during that time.
00.18.19 Y: Yes. It will take us about one month to make a leisure tour every time. It is impossible to take more than one month for travel purpose. I maybe drive the vehicle to travel 400 km/per day...
00.18.33 C: There is a special train which just serve for the older people in current China. The older people take this train to go to Xinjiang province and enjoy their journey, because most of the current older people have no license. Probably in the next decade, however, the older people who are 60-70 years old will drive their private car to travel together.
00.18.53 Y: It is just our cohort ...
00.18.54 C: They maybe organize a car-friend union for themselves, say, 'older driver friend union'. It must be interesting that they drive together and their travel speed is slowly.
00.19.00 Y: There also should be a train to carry their private car to get the destination. I guess that you maybe participate. Sometimes I browse some 'driver friend union' website, they organize some driving tours to Haerbin or Xiaoxingan mountain. The older guys just need drive their car into the train, and this train will take the older drivers and their cars to the destination of city.
00.19.25 C: Is there such service at this moment?
00.19.26 Y: Yes, of course. The train will carry your car to the Haerbin, and then participants convene together in Haerbin. And then they drive their cars to the key scene points such as Wudalianshi from the Haerbin.
00.19.38 C: This is good idea. En... I have never heard this before.
00.19.41 Y: You can take the air plane or take that train which carry your car from Beijing to Haerbin. It is travel agent’s responsibilities to embark your car from Beijing, and then to unload your car in destination. But generally speaking, participants are young guys now, no older people. They will start their driving journey from the train destination such as Haerbin and Dalian.
00.20.11 C: When we become older in the next decade, our cohort’s attitude must be different from the current 60's older people. We are more active than the current old generation.
00.20.27 Y: Moreover, we have many years driving experiences, you know, when our cohort are retired. We have driven more than ten years, probably, yea, should be 15 years. It is impossible if we have no car to drive. We probably rarely use it in daily life. We maybe take bus or subway in the city, and maybe drive the car occasionally. However, we will absolutely buy a car in the future.
00.20.57 C: Yea, there should be different time concept between the older people and middle-aged people. We use vehicle in order to work against time now. You know, there are so many works need to do now. If we retire, we will have a lot of spare time, and we will have different time concept.
00.21.10 Y: I have a dream that I get a ‘private moving studio’ in the future. I have talked with L, he joked me and said 'you are labour all your life’... The best future lifestyle which I can imagine is just working in my vehicle.
00.21.30 C: You know, my friend Z, who was full prof. In Central Fine Art Institute before he retired, is 72 years old. He got license when he was 64 or 69 years old. This old guy drives a small Sail (Chevrolet) from Dongdaqiao to Jingshen Highway every day. He fixed and decorated his house by himself. He has good health condition. He has jean, and shakes hands powerfully. He told me that the old people might face the health problem at any moment, especially when they are over 70 years old. But I do not think
so when I saw he was driving. He is a typical new aging generation who have open-minded and accept the new idea easily. You know, He is already 72 years old.

00.22.23 Y: generally speaking, there are no critical health problems when people are 72 years old.
00.22.29 C: All of my friends who are our cohort in my hometown, Chongqing, are driving the personal car now. You know, they have good career. For example, one of my friends who are also nearly 50 years old, just bought a CITROEN recently. He wants to drive this CITROEN for 10 years, probably.
00.22.57 Y: Really, he will drive it for 10 years and then buy a new car. I think that our cohort will buy the third vehicle when we are retired.

00.23.09 C: Has the Caddy (VOLKSWAGEN) auto transmission? 00.23.11 Y: No.
00.23.13 C: I think that I need an auto transmission vehicle when I retire.
00.23.15 Y: Yes, I think so. It will cost more 10,000 RMB than manual transmission vehicle. But the price of vehicle will decline. For example, the price of Caddy (VOLKSWAGEN) will decline to 120-130 thousand in the future, probably.
00.23.28 C: However, I think that different people have different option. We would like to select simple style car. However, some old guys would like to buy a Sedan or Saloon.

00.23.43 Y: Old people like Sedan or Saloon? 00.23.45 C: I do not know. But there should be some old guys who like Sedan.
00.23.47 Y: Yes, there should be… But, I think…
00.23.51 C: Anyway, they will absolutely choice the auto transmission vehicle.
00.23.54 Y: Designing a vehicle with toilet…
00.24.01 R: Could you please imagine your retirement lifestyle concretely?

00.24.15 Y: I think that different people have different condition when they are retired. Let me say, both of us are teachers, and we are designer as well. The characteristic of this career is that your career is your hobby as well. I think that I will keep this sort of interesting until I am retired. It is probably that I am too old to do design practice, but I still can do the lecture and write books on the design. I might be invited by other university to do lecture or write books when I am just retired. I will keep the academic activities or personal hobbies during the retirement. In order to achieve these activities, I need legs; need flexible mobility. I might often travel to another city when I am retired. So, I might take the plane or train to do the long distance travelling, and drive the private car if the distance is not so long. Moreover, I absolutely will make a tourism plan. I think that everyone would like to make this sort of leisure travel when he is retired.

00.25.48 C: Yes, regardless travel meaning, we must … we have some dream. There are a lot of places we never visit before.

00.25.54 Y: Yes, in fact, there are a lot of places I never visit, including places in China. You know, China has wide area. I have no time to visit these places during the working time. So I might go when I am retired … Let me see, my parents make tours until they are 80 years old. The last time they travel together just at their 80-years-old. At that time, they took part in the old people travelling group which were organized by Social Research Institute, you know, my mother used to work in there. They make a tour per year. So, I think that it is common needs for the older people, regardless the difference of their career and experience. The vehicle is a carrier to contain old people's tourism dream. I can imagine that my child becomes adult, and he does not need my help. And then, my wife and I drive the car which carries all of necessary things we need during the trip. We might bring a tent in the car probably, even if it maybe useless during the trip, we will still carry it. We travel to some heritages from Beijing. We might drive for several hours and then stop to find a hotel, and stay there for 1 or 2 days. During these days, we can look around in this place and then continue our driving trip.

00.27.21 C: You might lodge in Rujia hotel which is a new chain-inn in China. It is cheap and clean. They supply the breakfast as well. It is so nice.

00.27.44 Y: Is there this kind of inn now? 00.27.46 C: Yes, it develops very fast recently.
00.27.53 Y: Another trend, I guess, will appear in the next decade. That is camping car. I think some persons will own the camping cars because some of car-makers are manufacturing it now.

00.28.16 C: Possibly, the people just rent it.
00.28.18 Y: Rent fee is expensive. This kind of vehicle can carry …
00.28.28 C: I think that it is impossible that the camping cars have a good Chinese market.
However, the preconditions are that China has wide land just like America and Europe. China has a good environment to support you travelling during all of your life. But I think that there should be some good condition hotels in the scene points and heritages. It is impossible to use camping car during your trip. You have to cook by yourself in the camping car, and you have to buy some necessary things for living. There should be some encampments to support the camping cars. But such facilities do not develop well in China at this moment. You know, there are some encampments in America and Europe. When you drive your camping car to the encampments, you can connect your car with facilities of encampments by some pipes and cables. For example, water supply, electric something likes that. I think that Chinese people have lazy habits, which means they do not like to do such activity by themselves. No, it will change.
European family will connect the water and electricity when they arrive the encampments. They might buy the local vegetable, cook and take shower in the vehicle. But I think that Chinese people would like enjoy living in hotel. It is a kind of lifestyle actually. I need a big camping car in the future. A group of people… they probably drive several camping cars to travel together. At the destination, these camping cars make a circular space that looks like a Chinese yard. We can celebrate the Chinese new year in this yard, cooking and eating together, playing games together, and helping each other…you know, my family, my friends, a group of people… I think we shall make tours one or two times every year in the future, driving or taking the train… I guess. En… I imagine that I have a studio and I can make artefact works in the future. It would be good if some people like these works; otherwise, I would like to enjoy by myself. For my family, if my child grows up and she will study in university, so she can take care by herself. I will enjoy my retirement time if this problem was solved. I think I will write something during that time. Yes. You will need a car if you want to write something. You need to visit the museums, the enterprises, the universities and the libraries in different place. You need travel between these places. So you might need a car. I might focus on culture research because it is hard to keep good relationship with enterprise when I am retired. Yes, you might want to make a furniture, a lamp or a ceramic. You do need a vehicle when you do these activities. So, this car should be bigger. Moreover, I imagine that I can surf Internet in my car, because … It is possible when 3G technology appears. Yes, it would be good that computer becomes a part of vehicle in the future. I do need to surf the internet because I need check email from my child. I might need talk with my child through MSN if she is in overseas. Maybe I am just travelling in some village, and I might ask my child to send her photo through internet. So I can understand her recent situations.
We imagine is so conservative from that perspective you just mentioned. The technology of wireless wide band will develop so convenience in the next decade. So, it will benefit not only to the old people, but also to the young people. They maybe do not need a fixed office and can work at anywhere and in anytime… Okay, thank you very much.
Appendix 4:

*Samples of Interview Questions and Transcription*
Sample of Interview Questions

Introduction

Welcome and thank you very much for your participation in this session. Please answer following questions to clarify your experiences and activities related to the vehicle using.

1. Gender: Female [ ] Male [ ]
2. Age: 45-50 [ ] 51-55 [ ] 56-60 [ ] 61-65 [ ] 66-70 [ ] 71-75 [ ] 76-80 [ ]
3. Education: Elementary [ ] Secondary [ ] College/University [ ]
4. Occupation:
5. Current employment situation: On the job [ ] Retired [ ]
6. The number of family members: 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ] 6 [ ] 7 [ ] 8 [ ] 9 [ ] 10 [ ] more than 10 [ ]
7. Do you like driving a vehicle? If not, why not? If so, why?
8. Could you describe your vehicle to me, as if I were someone who had never seen it?
9. Are you trying to have a certain style or atmosphere in your vehicle? Why? Describe.
10. How many cars are in your family?
11. How often do you use a car in the daily life? And when do you use the vehicle?
12. Where do you go frequently when you are driving? And what is your purpose when you drive there?
13. Who are the passengers when you are driving? And why do you carry them?
14. How, and when, have your driving habits changed?
15. What difficulties do you have when you use the vehicle?
16. Can you suggest reasons for these difficulties?
17. What are the things in your private car which are special for you? Why they are special?
18. What would it mean to you not to have these things?
19. What does the private car mean to you?
20. When did you acquire these things? How did you acquire each of these things?

Thank you for your participation; it is greatly appreciated.
Date: 11/04/2006
Setting: "Meeting room at Academy of Art and Design, Tsinghua University, Beijing"

Task: Interview

TIME   PAR. STATEMENTS
00.00.16 R: How old are you?
00.00.22 C: I am 51 years old.
00.00.25 R: Do you like driving a vehicle? If not, why not? If so, why?
00.00.30 C: I do not like driving so much. But I do not hate driving. It is impossible for me to drive
just like some young guys who are 20-30 years old, because I am already 51 years old.
The reason is probably that these young guys have not their own private car yet. It is
boring when I have to drive every day, especially driving to the office and back home
as a routine activity. Moreover, I find that the ability of my legs is declining. This is
probably because I am old. So, I would like to walk a few minutes after I drive to home.
You know, I still sit when I at home because there are not enough space to do the
exercise at my home. So my legs’ function is declining. It is too bad. So I change my
attitude toward the driving. I would like to walk and jog recently. I also persuaded my
colleagues to do the exercise. But, I have to drive in some special situations. My family
took part in several Drivers’ Unions. They often organize some journeys during the
long public holidays. This is different from in overseas. You know, Chinese people
have the private car now and they want to drive to make the leisure journeys. So, some
nice persons organized such club - ‘Drivers Unions’. They might find some appropriate
restaurants and hotels in advance. Every participant need submit hundreds or thousands
RMB to the union. The organizers will arrange the route of tours. For example, we used
to travel to Inner-Mongolia province. It takes 1800 km for return. Participants were
divided into 3 groups, and every group is composed by 15-16 vehicles. The first and
last vehicles of the group equip a transmitter-receiver. The walkie-talkie was equipped
in every vehicle. It is interesting. It is safer than travelling alone. The first and the last
vehicles might report the road condition to the group members. The other cars just
followed them. The organizers usually arrange the participants to lodge in some normal
level hotel. Sometimes they might ask participants to bring the sleeping bags by
themselves. Ha … Most of these participants are white collars who would like to do
such leisure travel. My family members would like to take part in such club. The
‘Drivers Unions’ will organize the people to visit Jinggang mountain and Jigong
mountain in this labour day public holiday. I think this is a special characteristic of
China.

00.04.00 R: Does this club organized the people based on their vehicle brands? Such as Toyota
‘Yaris’s Driver Club’?
00.04.06 C: No. this club I took part in is different from others. There are different brand vehicles in
this club. It is interesting that participants drive different vehicles such as Audi A6,
Nissan’s four wheel drive, Volkswagen’s Polo and Toyota’s Yaris. It is interesting that
all of participants call each other by their alias. For example, I call myself as ‘dragon
cat’, Ha … No body is concerned about your career. No body interests your private
information. They just call each other by alias… ha ha … For example, we just call the
girl who is organizer as ‘Cisi princess’.

00.04.57 R: I know that most young guys would like to take part in such activities in China. How do
you think the participants who are over 50 years old in such club? Just like you …
00.05.04 C: This club I take part in includes not only young guys but also middle-aged people and
older people. The Union also organize some community activities. I carried my kid to
take part in tree planting which was organized by this Union. A couple who drive a
Builk’ Sail call themselves as ‘old man and old women’… Ha … The participants
include lots of families which are composed by three members. However, there are
some participants who are above 50 or 60 years old as well. Of course, most
participants are young guys who are not married yet.

00.05.47 R: Well, which age groups are the major participants in the Union?
00.05.53 C: Probably, more than 1/3 participants have families, and 2/3 participants are not married
or have no child. Well, there are so many young guys in the club. I found that there are
many couples take part in this club as well.

00.06.22 R: How many percent do the middle-aged drivers such as you take part in this Union?
There are so many middle-aged drivers who are above 40 years old in this Union. It is probably 50 per cent, at least 50 per cent. They might enjoy delicious food, and playing games together. The Union also organized some sub-club such as ‘Drinking-Club’ and ‘Tennis-Club’. Sometimes the older participants act matchmakers for the young guys who want to marry. Ha ha … They organized a lot of activities every week.

What about the people who are above 50 years old? How many such participants in this Union?

There are probably 1/3 participants who are above 50 years old just like me. There are 1/3 participants who are 35-50 years old. The rest parts of participants look like 28-30 years old. Of course, all of them are white collar. There are little participants who look like 20-25 years old in this club.

Could you please describe the participants who are above 50 years old in this Union?

Most of middle-aged participants carry their family members which include one child and couples. Some of middle-aged couples also carried their older parents in the long-distance travel. Other middle-aged couples carry their dogs in the vehicle, big dogs. We have visited Yalujiang River and Henan province. I think that it is impossible for me to visit such places if I just drive alone.

Could you please describe some detail activities in the journey?

For example, firstly, the organizers will design the travel route in advance, and then, they will publish this information on the web site. They might introduce these places’ scenery to the Union members. These members who want to visit these sceneries have to pay around 1000 RMB to the Union. The money can cover accommodation fee and food fee. We usually sit around a big round table and have a dinner together. And then we will visit some beautiful spot which is not familiar for the Beijing’s visitors but known by the local people. So, 50-60 participants will compose the group. You can follow the collective activities. You also can visit some places alone. But the organizers take the responsibility for the participants. For example, at one time, my family moved slowly and dropped behind the collective because we did not like noisy in the group. So, the organizers worry about us and tried to travel with us together. They are so seriously when they organize these travels.

Does this Union organize some special activities besides visiting beautiful spots?

We drive to the beautiful spot and have a relaxation. Just looking around and eating special local foods. We usually have the dinner in a special place, which is arranged by organizers. Sometimes, the local people concern us so much, and they cook some delicious foods for us. Sometimes, we have the dinner in the restaurant that located nearby the village road. The participants just parked their cars outside the restaurant. The organizers might select some special scenery. Last time, we travel to some nice places located in the Henan province. When we drove back in the night, we lodged in a hotel just beside a beautiful dam. It is wonderful view when we open the window…moon… dam… and we had dinner just in this hotel. It is amazing. The restaurant and bathroom are clean as well. The organizers choose the places carefully, you know. The relationships among the participants are good. There is no complaint in the group. They are kindly and help each other. They also sell some equipments such as car’s battery. These things are cheap. The ‘Driver Union’ organized well in Beijing.

Did you have dinner in the vehicle during the tour, in some particular situations?

No, we did not. We also bring some foods. Because they have design the route in advance, they might tell you drive to a particular place in time. The local people have prepared the dinner when you arrive there… they usually publish the information on line, and participants will pay the money. Then, all participants will gather in a particular place such as outside of a freeway toll. All details information has already showed on the website. Before the driving tour, the organizers will check the participants number, post the unique Union Symbol on the every vehicle, give every driver a walkie-talkie, arrange the vehicle order, tell driver the travel route and transportation regulation, and then set out. The organizers will lead participants’ direction. Sometimes, we might stop, drink water and have a rest. Generally speaking, it will take one day when we arrive the destination. They might organize participants to lodge in the hotel. All of vehicles might park outside of the hotel. During the dinnertime, participants might introduce and make fun by each other… just have the dinner together. Most participants carry their children and they might have different
hobbies, so collective entertainment is simple. Some ‘Drink-Club’ members might
drink together. Some people enjoy the performance in the local restaurant. After
collective activities, the participants would like to enjoy the time by themselves. For
instance, some people would like enjoy peaceful environment; some would like look
around… Of course, they might have breakfast together next morning. So, you have a
good opportunity to stay with your family members when you take part in such club.
You can live in a Mongol’s tent with your family if you want.

00.16.17 R: Which means you can choice the entertainment way based on your hobby?
00.16.19 C: Yes, of course. All of these drivers would like to travel to the peaceful places because
they feel boring to live in the noisy city. However, they might organize the annual
conference every year in the city centre. The members of club meet together in the
conference and perform some program

00.16.49 R: How often do you use a car in daily life?
00.16.53 C: I do not often drive car go to Tsinghua University, because my wife and I have license,
and we have only one car in my family. Moreover, I would like take the regular bus to
work every day. For my family, we do not use vehicle at least 2 days per week, because
the price of petrol is increasing now. So we have to consider such situations. My wife
might use car to shopping sometimes. However, we use vehicle frequently in the
weekend. We always carry my child go to spare time school and carry her go back
home. In the workday, we might use car in 3 days per week. It just takes me 2-3 hours
to drive the car per day in the workday.

00.18.06 R: When do you use the vehicle?
00.18.17 C: My wife might drive the car to go to shopping centre or our new apartment because
these places are far from my home. I just drive the car go to university if I want to go
back home early in the afternoon to deal with my private business. The car in my family
is not for going to the office. Let me say, my wife is a housewife in our family. I might
take only 2/5 times for going and off duty. In the other 3/5 times, my wife and I might
drive the car to go to shopping centre and carry my child to school and so on. This
means that it is so flexible for my family in car usages. I do not drive the car go to
university and park there for the whole day. I think this is not a green behaviour. I
would like take the regular bus go to university in the morning and take the subway go
back home in the evening. I think it is a good opportunity to do the exercise when I
have to walk and take the subway. Of course, it might take about one hour when I take
the subway. However, you know, it might take more than 40 minutes when I drive the
car to go or off duty every day.

00.20.00 R: Where do you go frequently when you are driving?
00.20.04 C: My families often drive the car to my daughter’s school because she is resident at
school. It might take about 40-50 minutes to drive from my home to her school. In
addition, we might drive to shopping centre sometimes, which might take us about half
an hour. I also drive the car to university for about 40 minutes sometimes. Of course,
we might drive to my new apartment in the suburb that might take us about 25 minutes,
because the public transportation from city centre to there is not convenient.

00.21.00 R: Who are the passengers when you are driving? Why do you carry them?
00.21.12 C: Generally speaking, only my wife and my daughter are the passengers when I am
driving. You know, I have little relatives in Beijing. In the most of time, I drive alone or
my wife drives alone. There are several time, probably 1-2 times, I might carry all of
my family members drive to some places per week. The using car in my family is
different from other families. Some of couples might drive car to their different office
together. For example, the husband might escort his wife to her office, and then he
might drive to his own office.

00.21.51 R: How many cars are in your family?
00.21.55 C: This is my first car.

00.22.03 R: How, and when, have your driving habits changed?
00.23.22 C: I have driven the car for two years. I think my driving habits changed a little bit during
these two years. I am not haste when I drive. I would like drive slowly and mildly. My
wife drives faster and more obtrusive than I do. When I meet some heavy traffic
condition, I would like to give others way. I absolutely abide by traffic regulations. So I
never got any fine bill since I got license. Well, the only one that I got is just because I
stopped car in a wrong place… Of course, I was not skilled when I drove the car as
beginner. It is probably because I learned some bad driving habits from my coach… ha ha. However, I have no any problem now.

00.24.43 R: What difficulties do you have when you use the vehicle? And can you suggest reasons for these difficulties?

00.25.02 C: It is related to the interior design, probably. It is hard to adjust the angle and position of the seat in my personal car. My wife and I have different body size. Therefore, I feel uncomfortable and have to adjust the seat angle if my wife has driven the car before… Sometimes I have to change the seat angle to get a comfortable position while driving. You know such behavior is dangerous, especially while driving on the freeway. Of course, my vehicle is just a normal brand product and has no automatic seat adjust device. But, I think that the luxury car which has automatic seat adjust device also has some problems. Others problems… for example, I bought a CD player which can read 6 CD disks at same time. We do not listen to the CD frequently during the driving. I think it is hard to change the CD disks because I have to open the boot to insert new CD disk. Of course, it is maybe old design for this model… So, I always forget to insert new CD because it is not convenient to operate. Probably, because I am familiar this car, I feel that it easy to control. Well, sometimes I might think that I should buy a SUV in the future, especially when we make the leisure tour. You know, the SUV have off-road function and we need not consider the road conditions in the countryside. Maybe I will rent a SUV when my family make a tour in the future. Of course, my car has no problems on the normal city road. It even can pass the shallow river. Moreover, my car is economical. The petrol consumption is not high. When we drive long distance, for example … I take my child to school and carry her when I take part in some community activity such as tree planting. She would like to sleep in the back seat during the journey. It is dangerous because she does not like to wear the safety belt. You know, we have to drive 4-5 hour when we make a leisure tour, so the kid must be so tired. Is it possible to design some special safety belt in the back seat for kid when he or she lies and sleeps in the back seat? I do not know. I think it should be a valuable research topic. Actually, I would like to buy the Fiat’s Palio Weekend when I decided to buy a private car because it is bigger. But my wife does not agree. Moreover, it is more expensive than Toyota Yaris at that time, probably 20-30 thousand RMB.

00.32.52 R: Thank you very much.
Appendix 5:

Samples of Logbook Structure and Transcription
Samples of Travel Logbook

Introduction

Please fill three pages of a diary about your daily travel activities on Tuesday, Thursday and Sunday in one week. You need to report daily travel information. You can finish the travel dairy in anywhere (e.g. in your vehicle or at home).

Participant name:
Date: dd/mm/yy Tuesday

Please describe daily travel time and objects that you carried:

Please describe your travel aims and travel destinations:

Please describe why you need drive to there:

Please describe who did accompany you when you travel to there, and what are relationships between you and your companions:

Please describe the detail process of theses tours:
Transcription of Logbook Sample (English version)

09/04/2006 Sunday | Participant: C | Male | 51 years old | Academic staff

Please describe daily travel time and objects which you carried, and please describe your travel aims and travel destinations:

8.30 AM - 9.00 AM  My wife drove the car and carry my daughter to take part in the Olympic mathematics workshop.
11.30 AM - 12.10 AM  I drove the car to carry my daughter go to 798 Art factory (the famous art community in Beijing) in order to meet with another family.
13.10 PM - 13.40 PM  I drove the car to carry my wife and daughter to take part in a community activity.
15.10 PM - 16.00 PM  I drove the car to carry my wife and daughter to suburb of Beijing in order to take part in a tree planting activity.
16.30 PM - 17.30 PM  I drove the car to carry my daughter to go back her school.
19.30 PM - 20.10 PM  I drove the car to carry my wife go back home.

Please describe why do you need drive to there:

Carry my child to study in spare time school and take part in the community activities.

Please describe who did accompany you when you travel to there, and what are relationships between you and your companions:

All of my family members which include my wife, my daughter and I.

Please describe the detail process of theses tours:

We drove car from city center to suburb of Beijing and then go back to city center. We passed through the free way in city and road in suburb. The road in the suburb has bad conditions.
Appendix 6:

Samples of Coding
<table>
<thead>
<tr>
<th>Time</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00</td>
<td>Do you feel that your lifestyle in the last decade has changed or kept the same? Do you feel that your lifestyle in the last decade has changed or kept the same?</td>
</tr>
<tr>
<td>00:10</td>
<td>Yes, I feel that my lifestyle in the last decade has changed. I feel that my lifestyle in the last decade has changed.</td>
</tr>
<tr>
<td>00:20</td>
<td>I have been working in a different job for the last decade, and I feel that my lifestyle has changed. I feel that my lifestyle has changed.</td>
</tr>
<tr>
<td>00:30</td>
<td>I feel that my lifestyle in the last decade has changed. I feel that my lifestyle has changed.</td>
</tr>
<tr>
<td>00:40</td>
<td>I feel that my lifestyle in the last decade has changed. I feel that my lifestyle has changed.</td>
</tr>
<tr>
<td>00:50</td>
<td>I feel that my lifestyle in the last decade has changed. I feel that my lifestyle has changed.</td>
</tr>
<tr>
<td>1:00</td>
<td>I feel that my lifestyle in the last decade has changed. I feel that my lifestyle has changed.</td>
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Appendix 7:

Comparisons of Travel Activity Adaptation and Vehicle Property at Concept Level
Integrated comparisons of travel activity adaptation at concept level

Integrated comparisons of vehicle property at concept level
Appendix 8:

Interrelationships among User Needs, Vehicle Meanings and Vehicle Properties Categories
Interrelationship among user needs, vehicle meaning, and vehicle property

<table>
<thead>
<tr>
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<th>Comfort</th>
<th>Identity</th>
<th>Utility</th>
<th>Safety</th>
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<td>Low energy consuming</td>
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<td>Low maintenance fee</td>
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<td>Compatibility capacity</td>
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<td>Compact capacity</td>
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Legend:

◆ 1/4 – One group mentioned (including future younger-old users) within the Four groups
◇ 1/4 – One group mentioned (excluding future younger-old users) within the Four groups
▲ 2/4 – Two groups mentioned (including future younger-old users) within the Four groups
△ 2/4 – Two groups mentioned (excluding future younger-old users) within the Four groups
■ 3/4 – Three groups mentioned (including future younger-old users) within the Four groups
□ 3/4 – Three groups mentioned (excluding future younger-old users) within the Four groups
● 4/4 – Involve total four groups mentioned

(*Number of mentioned groups / Total four groups)