CRANFIELD UNIVERSITY

BERKCAN UYAN

PASSENGER CHOICES AND PREFERENCES FOR AIRCRAFT CABINS IN A CULTURE-SPECIFIC CASE: JAPAN

SCHOOL OF AEROSPACE, TRANSPORT AND MANUFACTURING

Centre for Air Transport Management in

Transport Systems

Ph.D. Thesis

2016 – 2019

Supervisor: Dr. Thomas Budd

Previous supervisor: Dr. Chikage Miyoshi

Associate supervisor: Dr. Romano Pagliari

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This thesis is submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

ABSTRACT

This thesis aims to identify the key aspects in the cabin interior and services by focusing on passengers' preferences and to estimate the willingness to pay for different services and attributes in a culture-specific setting. The scope of the study includes passengers in Japan across all airline business segments for short-haul and medium-haul flights, utilising 2,700 stated preference observations included within a passenger survey conducted in Japan in 2016. While the identification of culture-specific characteristics and trends in Japan are analysed with a qualitative study, choice models and willingness to pay estimates for cabin features and services are revealed with a quantitative study. A stated preference (SP) survey is designed for choice models developed with multinomial and mixed logit models to analyse the results.

The study includes two main categories in cabin; cabin interior and cabin services. Key aspects in the cabin interior included in the study are the physical attributes of the cabin in terms of space and seats. For in-cabin services, different levels of technologies including inflight entertainment (IFE), internet connection, and power supply and meal service are considered. A significant difference between medium (3-6 hours) and short-haul (<3 hours) flights is found based on entertainment and seating space along with expected meal services provided (i.e. the willingness to pay for seat pitch is $2.82 for short-haul while it is $12.76 for medium-haul flights).

While the overall expectations for in-cabin services are not relatively high in short-haul flights, the results indicate towards high expectations for some attributes in medium-haul flights. These outcomes along with the understanding of Japanese passengers can contribute to the knowledge for an optimal ancillary revenue system, and the cabin interior and configurations in a culture-specific setting. Eventually, they may act as important parameters for the aircraft investment appraisal as a result in a specific region. Through the analysis, the value of seat pitch along with internet connection which can be interpreted as a form of IFE are found to be significant for passengers in Japan. In addition, the difference in the preferences of passengers for short and medium-haul flights are revealed and forecasted for different flight durations to give an insight into the valuation of cabin attributes for longer flights. The results indicate valuable outcomes to be considered based on culture-specific preferences for cabin design and services.

Keywords: *stated preference (SP) data; discrete choice models; airline cabin design; culture-specific business strategies*

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LIST OF ABBREVIATIONS

ACI	Airport Council International	LGW	Gatwick Airport
ANA or NH	All Nippon Airways	LH	Long-haul
ASK	Available seat kilometers	LHR	Heathrow Airport
BC	Skymark Airlines	LTN	Luton Airport
BVA	Beauvais-Tillé Airport	MAR	Multiple airport region
BYOD	Bring your own device	MH	Medium-haul
CAGR	Compound annual growth rate	MHLW	Ministry of Health, Labour and Welfare
CDG	Charles de Gaulle Airport	ML	Mixed logit
CIE	Centre for International Economics	MLIT	Ministry of Land, Infrastructure, Transport and Tourism
CJRC or JR	Cenral Japan Rail Company	MM	Peach Aviation Limited
CTS	New Chitose Airport	MNL	Multinomial logit
CX	Cathay Pacific Airways	MRO	Maintenance and repair operations
DCM	Discrete choice model	MYJ	Matsuyama Airport
DL	Delta Air Lines	NGO	Central Japan International Airport
EMSR	Expected marginal seat revenue	NGS	Nagasaki Airport
EUR or €	Euro	NL	Nested logit
EWR	Newark Liberty International Airport	NRT	Narita International Airport
FFP	Frequent flier program	O/D	Origin and destination
FSC	Full service carrier	OECD	The Organisation for Economic Co-operation and Development
FUCAM	Future Cabin for the Asian Market	OIT	Oita Airport
FUK	Fukuoka Airport	OKA	Kalaeloa Airport
GDP	Gross domestic product	ORY	Orly Airport
GE	Transasia Airways	OTA	Online travel agency

GK	Jetstar Japan	RP	Revealed preference
HD	AirDo	SAS	Scandinavian Airlines
HEL	Helsinki Airport	SBJ	Statistics Bureau of Japan
HIJ	Hiroshima Airport	SD	Standard deviation
HKD	Hakodate Airport	SDJ	Sendai Airport
HND	Tokyo International (Haneda) Airport	SEN	London Southend Airport
HS2	High Speed 2	SH	Short-haul
IATA	International Air Transport Association	SMNL	Scaled mutlinomial logit
ICN	Incheon International Airport	SP	Stated preference
IFE	Inflight entertainment	SPK	Sapporo
IIA	Indepence of irrelevant alternatives	STN	Stansted Airport
IJ	Spring Airlines Japan	TAK	Takamatsu Airport
IMF	International Monetary Fund	TPE	Taipei
ISG	Ishigaki Airport	TYO	Tokyo
IT	Tigerair Taiwan Co. Ltd	TZ	Scoot
ITM	Osaka-Itami International Airport	UHL	Ultra long-haul
JAL or JL	Japan Airlines	UK	United Kingdom
JFK	John F. Kennedy Airport	UKB	Kobe Airport
JPY or JP¥	Japanese yen	UN	United Nations
JW	Vanilla Air	US or USA	United States of America
KIX	Kansai International Airport	USB	Universal serial bus
KMI	Miyazaki Airport	USD or $	United States dollar
KMJ	Kumamoto Airport	VFR	Visiting friends and relatives
KOJ	Kagoshima Airport	WP	Work package

KPI	Key performance indicator	WTA	Willingness to accept
LCC	Low cost carrier	WTP	Willingness to pay
LCY	London City Airport		
LGA	LaGuardia Airport		

CHAPTER 1 - INTRODUCTION

Understanding airline passenger preferences for services and products represents a key priority for airlines, both from a commercial and passenger satisfaction perspective. As a result, this is also a key area of academic research. In that context, the research is conducted to reveal some of these preferences to improve passenger satisfaction and comfort while presenting strategies for improving revenues while reducing costs for airlines in a culture-specific environment undertaken in the scope of this research. In this chapter, the introduction to the research is presented by establishing the background and the research problem.

A concrete understanding of answers relating to the questions what, why, and how the research is undertaken and presented through various sections. In Section 1.1, the research background is explained. Relatively, the subject of the study and the problem statement are presented. While more in depth knowledge and relative information provided throughout the paper, this section establishes the context of the research question and provides justification as to why the research is undertaken and necessary. In the following Section 1.2, the research aim is revealed based on the defined problem statement in terms of addressing the related research questions. With regards to the research questions, in Section 1.3, the research objectives are identified, followed by the Section 1.4, presenting the methodology and tools proposed to achieve the aim and these objectives. In Section 1.5, overall contribution of this research to the past and present knowledge are presented. Lastly, in Section 1.6, the layout and the structure of this research is defined.

With the introduction of this research, a strong basis for the research is established. Based on defined statements for what to achieve, the next chapter presents past and present knowledge exists in the literature and industry.

1.1.Research background

Today, airline and air transport industry has grown substantially since the introduction of air travel. In 2015, almost 4 billion passengers, which is more than half of the world's population, were carried by airlines worldwide (World Bank, 2018). Almost all forecasts indicate a growing trend for this number for the future. While this is the case, the airline

industry proves to be very volatile. The rapid growth in the market potential, related competition, low profit margins, high sensitivity to economic changes, and regulations that are still in place are all factors deeply affecting airlines.

Despite various challenges, air transport has continued to grow, and each challenge has changed the course of transportation. These challenges were overcome through technology, policy changes, operational optimisations, and strategy differentiations. Collectively, these aspects are referred to as the 'four enablers' in this study that improve the business of airlines. As technology improves, airlines are able to provide faster, longer, more convenient, and more economically efficient services. With policy changes, airlines operate in a less regulated environment enabling them to be more flexible and adapt to changes in a global scale more easily. Operational optimisations support airlines to make the most out of the services they provide by maximising their revenues. Finally, strategy differentiations help airlines to adjust to changes in various markets through how they choose to provide their services.

Competition in the airline industry as a result of deregulation has caused airlines to differentiate their business strategies. Low cost carriers (LCCs) have emerged and proved successful over a relatively short period of time. For instance, the available seat kilometre (ASK) of Ryanair, one of Europe's largest LCCs, has grown 20 times in Europe since 2001 and almost caught up with a major full service carrier (FSC) in the UK, British Airways with more than 40 years of history, which has grown 1.1 times within the European region (OAG, 2018). Over the years, this phenomenon has led air travel to become more of a commodity rather than a luxury experience, and as a result, airlines have increasingly sought to redefine their core service offering. As well as travelling from point A to point B, airlines also now commonly provide additional secondary services as well as unbundled services which were once considered to be primary services. As a result of increased competition, FSCs have also started to customize their services, introducing ancillary services and further cabin classes (premium economy, economy plus, etc.) with a view to differentiating their product and generating additional revenue. The revenue from these products and services has been a major source of income for many airlines (Hind and Kitching, 2016). Further differentiation of services requires further analysis on decision-making in order to optimize the services and pricing to maximize profit.

With rapid growth of the air travel market, changing societal trends, and improved technologies, it is crucial, yet increasingly challenging, to meet the rapidly evolving demands of passengers. In order to sustain market growth and remain competitive with other carriers, passenger-centred decision making plays an important role in decision-making stage. As the expectations of passengers are met, relative customer satisfaction also improves, eventually increasing brand loyalty and profitability (Anderson et al., 1994; Dresner and Xu, 1995; Behn and Riley, 1999; Mittal and Kamakura, 2001; Homburg et al., 2005).

In air travel, aspects relating to cabin comfort through services and cabin interiors are important interaction points between passengers and the airlines. Ideally, these services should be adjusted so that they fit the expectations of the passenger in terms of their need for a satisfactory experience as well as commercially prove viable. In this context, the utilization of the cabin space and optimizing ancillary service revenue while cutting costs becomes really important considering passenger preferences and expectations.

One of the main factors affecting passenger preferences can be identified as the national culture of passengers. In order to understand passengers' evaluations, national culture is found to be a measurable factor among other factors such as gender and socio-economic level on the perception of service attributes that influences the decision making process for consumers (Crotts and Erdmann, 2000). By focusing on the regional or local cultures, services provided by carriers can be adjusted to further improve comfort and satisfaction in relevant markets while optimising revenues for airlines. Therefore, culture-specific cabin design could be a future strategy for airlines and aircraft manufacturers to improve their services thereby potentially securing a competitive edge in various markets. A regional focus in terms of national culture then seems appropriate to study the service quality measures and issues (Sultan and Simpson, 2000).

Within the concept introduced, cabin features and services can be improved in a culture-specific context within the 'four enablers'. With new technologies, current constraints and problems faced both by passengers and airlines can be improved. Policy changes provided by regulators can enhance the opportunities that are available for cabin design to utilise the space. Optimisations at operational level in the cabin help airlines to save costs. And strategy differentiation can determine on how the product and services are

provided within the cabin. With all these factors in mind, passenger-centred cabin design and improvement is possible within a culture-specific market through the correct understanding of passenger preferences.

In this context, new projects and research are made possible in academia and industry. This is the case with this research which forms part of a larger research project entitled 'Future Cabin for the Asian Market' (FUCAM) conducted in coordination with various academic and industrial organisations (FUCAM, 2018a; 2018b). Future Cabin for the Asian Market (FUCAM) project is an EU funded Horizon 2020 project led by the Airbus Group and including six other partners within the consortium. The aim of the project is to address the future needs of Asian passengers for inflight experiences for 2025 and onwards. Six distinct work packages (WPs) are included in the project to analyse the user requirements in Asia for cabin features and services. Part of this research contributed to WP 2, with quantitative analysis of the air transport market in the region and of passenger preferences in Japan.

1.2. Research aim and questions

Understanding passenger preferences in the scope of a culture-specific environment can help to adjust services and products tailored to customers. In order to reveal the significance of a culture-specific study for cabin features and services, a careful consideration for the subject of the study is necessary.

Within the growing Asian air transport market, the general focus of the research, Japanese passengers, have relatively higher expectations for services provided by airlines when compared to other passengers with different nationalities (Gilbert and Wong, 2003). This indicates a study on passenger preferences for in-cabin attributes with a focus on Japanese passengers could provide a unique insight into indications for a culture-specific cabin design. Hence, the aim of this research is:

To investigate the preferences of culture-specific passenger group based on the cabin interior and services for short to medium-haul flights in order to identify key factors which contribute to their decision making process.

The expectation and preferences of passengers are researched in order to present how comfort and satisfaction is perceived for short and medium-haul flights within the focus on a specific national culture.

With respect to the aim of this research, this research will seek to answer several related research questions, as listed;

1. What is the current situation of Japan based on demographic, economic and infrastructure aspects?
2. How is the future air travel market evolving in Japan compared to Asia region?
3. What is the national culture in Japan for the identification of passenger trends and requirements?
4. What is passenger comfort and satisfaction during flight in air travel and how is it perceived?
5. What are the current cabin designs and basis for future advancement?
6. How can cabin features and services be categorised in terms of passenger preferences and requirements?
7. How can passenger choices be modelled and predicted?
8. What are passengers' preferences and requirements for cabin features and services in Japan?
9. How much are passengers in Japan willing to pay for certain cabin features and services?
10. How can the relationship between passengers and cabin features and services be interpreted categorically?

These research questions aid in identifying specific objectives to be able to answer them and fulfil the aim of the research.

1.3.Research objectives

Based on the presented aim and the related research questions, there are three main objectives identified. The objectives are grouped in three categories; (1) market research in the region, (2) cabin design and comfort & satisfaction, (3) investigating passenger preferences with a quantitative study in Japan. Within these main topics, there are total of ten specific objectives as listed below;

- Market research in the region
    1. To describe the demographic, economic, and infrastructure aspects of Japan
    2. To present the evolution of air travel market in Japan and relative region
    3. To understand national culture in Japan
- Cabin design and comfort & satisfaction
    4. To define passenger/customer satisfaction and comfort within the changing business environment
    5. To explore current progress and future concepts in cabin design and services
    6. To develop a baseline for cabin features and services for Japanese passengers
- Quantitative study in Japan
    7. To learn different methods for predicting passenger preferences
    8. To identify passenger choice and requirements in Japan
    9. To estimate economic impact of cabin services and features on Japanese passengers
    10. To reveal culture-specific findings and suggestions on cabin design in Japan

The research objectives are determined specifically to establish a clear pathway towards achieving the aim of the research. The three main topics reveal the generic framework of the research with related objectives, each building up the knowledge to other.

In market research in the region, specific information is needed to be described in order to understand socioeconomic and sociodemographic nature of Japan. Along with this understanding, the air transport market and its evolution needs to be presented for the applicability of this research in the respective region. And, eventually, the lead passenger characteristics and behaviour are analysed through a national culture.

Moving on, based on the scope of this research which is the inflight experience, cabin design and related satisfaction and comfort needs to be defined. Understanding of a clear understanding for definitions regarding to satisfaction and comfort is crucial when applying the study. In addition, the awareness for present and future concepts in cabin

design is important. Eventually, application of these knowledge on Japanese passengers provides an understanding in terms of the connection between the cabin design and related satisfaction and comfort.

To present clear results on the preferences of Japanese passengers for cabin features and services, a quantitative study should be designed. First objective in this topics is the investigation of different methods for estimating and predicting the passenger choices. Based on the investigation, passenger choices and preferences are revealed with supplementary economic evaluation. Lastly, the findings and suggestion are presented.

In the next section, methodologies proposed for each of the objectives are listed based on the defined objectives are presented.

1.4.Research methodology and tools

As to the main focus of this research, in order to reveal the preferences of Japanese passengers, a discrete choice model is developed with a stated preference survey designed along with the collection of demographic data. In addition to the main focus, the research utilises several methodologies and tools to accomplish the objectives defined to achieve the aim of the research. The methodologies and tools implemented in this study with respective to each objective are listed as;

- Market research in the region
    1. Research on key countries in Asia based on demographic, economic, and infrastructure aspects using secondary data provided by government and official sources.
    2. Analyse the air travel market in Japan retrospectively and forecast the growth of the market using passenger traffic trend data per airline, and O/D relative to the other countries in the region.
    3. Investigate national culture (in Japan) through a literature review.
- Cabin design and comfort & satisfaction
    4. Conduct a thorough literature review on passenger/customer satisfaction and comfort within the changing business environment.
    5. Investigate current progress and future concepts in cabin design and services through literature, manufacturers and airlines.

6. Categorise factors in cabin features and services affecting passengers develop a table using the qualitative research synthesis.

- Quantitative study in Japan for passenger preferences on cabin features and services
    7. Conduct a literature review on the methodology for revealing passenger preferences and choice models.
    8. Design and conduct a stated preference survey study using discrete choice modelling for cabin features and services.
    9. Analyse survey output using different logit models (multinomial and mixed logit models) and reveal willingness to pay for cabin features and services.
    10. Integrate and apply results from the quantitative study to provide suggestion with the findings on characteristics of Japanese passengers.

The objectives identified are completed using methodologies listed above. In more detail, for market research in the region, an analysis is conducted using several government and industry data. The analysis presents knowledge on Japan in terms of demographic and economic aspects in addition to air transport market dynamics in Japan and the region. Lastly, a literature review is conducted to be able to characterise passengers in Japan in terms of national culture.

Similarly, cabin design and related satisfaction and comfort objectives are completed through a detailed literature review and a qualitative analysis. Upon establishing and understanding for satisfaction and comfort through definitions and theories in the literature, future cabin concepts are investigated. Lastly, a qualitative analysis is conducted to reveal the understanding of Japanese passenger preferences in terms of cabin features and services

For the quantitative study in the research, an understanding of choice models and applications are presented through a literature review. Based on the literature review, discrete choice models are applied in the study with stated preference data. The analysis is then conducted with multinomial logit and mixed logit models. Economic valuation of different cabin features and services are estimated with willingness to pay calculations.

1.5. Contribution to knowledge

While there are literature on discrete choice model studies in airline preference with included cabin features, this study aims to add to the body of knowledge and understanding the use of discrete choice model for a specific national culture to understand and reveal cabin preferences of passengers to assist a more passenger friendly cabin design. With the methodology using multinomial logit (MNL) and mixed logit (ML) models, this research integrates and applies the knowledge to Japan. More specifically, the idea of achieving passenger friendly cabin design with culture-specific factors explored with a discrete choice model through passenger preferences. The current literature, in general, aims to estimate demand for airline preferences, and there are only limited number of literature where a culture specific passenger behaviour is investigated to reveal passenger preferences in cabin features and attributes for an improved cabin design.

1.6. Research structure and thesis layout

A straightforward research structure is implemented in this study from introduction to conclusion with a total of seven chapters. In this context, the research is introduced in Chapter 1, then relative knowledge is presented in Chapter 2 with literature review. This is followed by the introduction of the air transport market in Japan in Chapter 3. Consecutively, the methodology of the research is presented in Chapter 4. Knowledge established from literature review and methodology is applied in the analysis and results are presented in Chapter 5 and Chapter 6. Finally, the conclusion of the research with discussion and findings is presented in Chapter 7.

In more detail, the thesis layout is presented below, starting from Chapter 2;

II. Literature review:

Chapter 2 explores the literature related to this research. Understanding of several subjects including satisfaction, comfort, airline business, cabin features and services, choice models are investigated through extensive literature review. In addition, the analysis of Japan and relative air transport market is presented.

III. Air transport market in Japan:

Chapter 3 introduces the air transport market in Japan and in the region. An analysis of the overview of demographic and economic aspects of Japan as well as the

infrastructure is presented. Domestic and the regional market in addition to the international routes are analysed inclusive of two major carriers in Japan. Overall, the future of air transport market in Japan based on the analysis.

IV. Research methodology and design:

Chapter 4 aims to establish the design of the research as well as to identify the methodologies adopted in the studies. Upon presenting the research design, specific methodologies and tools are explained for qualitative and quantitative studies.

V. User trends and characteristics:

Chapter 5 presents the results based on the qualitative analysis conducted to identify lead user information. In this context, a conceptual description of potential characters and expectations of Japanese passengers in terms of cabin features and services are revealed.

VI. Choice model for Japanese passengers:

Chapter 6 includes the survey design and the analysis of the results. In the first half of the section, insight into the specific survey design and preliminary results from the survey are presented with descriptive statistics. It is followed by the development of the choice model and relative economic valuations of the cabin attributes included in the study

VII. Conclusion:

Chapter 7 presents the conclusive remarks of the research based on the identified aim, research questions, and objectives. Discussion of the findings and derived recommendations and suggestions are explained. The importance of this study in terms of contribution to the knowledge is revealed. Finally, limitations faced in the research and the potential research areas and further research related to this study are discussed.

CHAPTER 2 - LITERATURE REVIEW

In this chapter, the literature review on different topics investigated in this research are presented while present and previous research and knowledge are introduced with the relation to the study. The purpose of this literature review is to reflect and present the overview and the background of the framework developed for this research through extensive academic and industrial researches.

The structure of this chapter includes four main topics. Firstly, the definition of passenger comfort and satisfaction is explored in different segments of air travel in Section 2.1. The introduction and understanding of passenger comfort and satisfaction related to air travel are investigated using different approaches within the literature. Next, in Section 2.2, airline strategies are examined within the changing passenger needs and characteristics along with the advancements in technology. In addition, with the passenger comfort and satisfaction is investigated in the previous section, relative passenger-oriented strategies on cabin design choices are discussed and new and existing technologies to improve passenger experience through cabin design and attributes are presented and discussed.

In Section 2.3, relative studies in discrete choice models (DCMs) are reviewed in the context of air transport. As air transport involves a wide range of operations and processes, discrete choice models are investigated in two main categories with choice models in airport preferences and choice models in airline preferences. Even though the methodology follows the similar principle in both context, attributes and key performance indicators (KPIs) included shows some differences.

Next, in Section 2.4, the definition and the significance of the term “culture-specific” is discussed. Basic terminology leading up to the culture-specific preferences are explained including national character and national culture. Based on the literature, six dimension identifying culture characteristics are applied as a comparative tool for clear definition for further analysis in the research.

Finally, in the last section, the findings and the knowledge established through this review are concluded and summarised. Overall, this chapter presents the literature review

conducted to be analysed and included in the study. Following this chapter, in Chapter 3, socioeconomic, sociodemographic, and air transport market of Japan are investigated.

2.1. Passenger satisfaction and comfort

One of the key objectives in achieving a successful business is through customer satisfaction. The same objective applies to airlines as it does to all other businesses. The main transaction between an airline and a passenger is that a passenger pays a price to be transported from an origin city to a destination city in an aircraft within the defined safety and security standards. However, the competition in the passenger airline market drives airlines to offer their services at higher quality levels or within different concepts other than their competitors. While service quality lacks a clear definition in the literature as it revolves around passenger perception on what the important measures are, it eventually determines the customer satisfaction together with the price (Gupta et al., 2004; Clemes et al., 2008). As the expectations of passengers are met, the relative customer satisfaction also improves increasing brand loyalty and respectively profitability (Anderson et al., 1994; Dresner and Xu, 1995; Behn and Riley, 1999; Mittal and Kamakura, 2001; Homburg et al., 2005). Hence the fact that airlines strive to keep their passengers happy for long term sustainability.

Kano (1984) categorises different attributes of the offerings of a business in four distinct qualities. These qualities include “must-be”, “one-dimensional”, “attractive”, and “indifferent” qualities (**Figure 2.1**). “Must-be” qualities include any core service that customers expect (i.e. transport passengers from origin to destination for airlines). These qualities determines the minimum level of service and the lack of these qualities result in a definite customer dissatisfaction while the presence of the service is expected with no further satisfaction. “One-dimensional” qualities have a linear effect on customer satisfaction. As the level of fulfilment or quality increases or decreases, the customer satisfaction is affected accordingly. “Attractive” qualities are attributes that are not necessarily expected by customers, but add to customer satisfaction levels if they are present. In a case of providing the relative attributes, customer satisfaction increases significantly. “Indifferent” qualities include any attribute that is irrelevant for the customer. These qualities do not affect the customer satisfaction in any way. As the time changes and technology develops, many attributes become a necessity for customers

increasing the number of attributes considered as "must-be" qualities. Some "attractive" and "one-dimensional" qualities transforms into "must-be" qualities over time as necessities and technologies change (Suzlmaier, 2001).

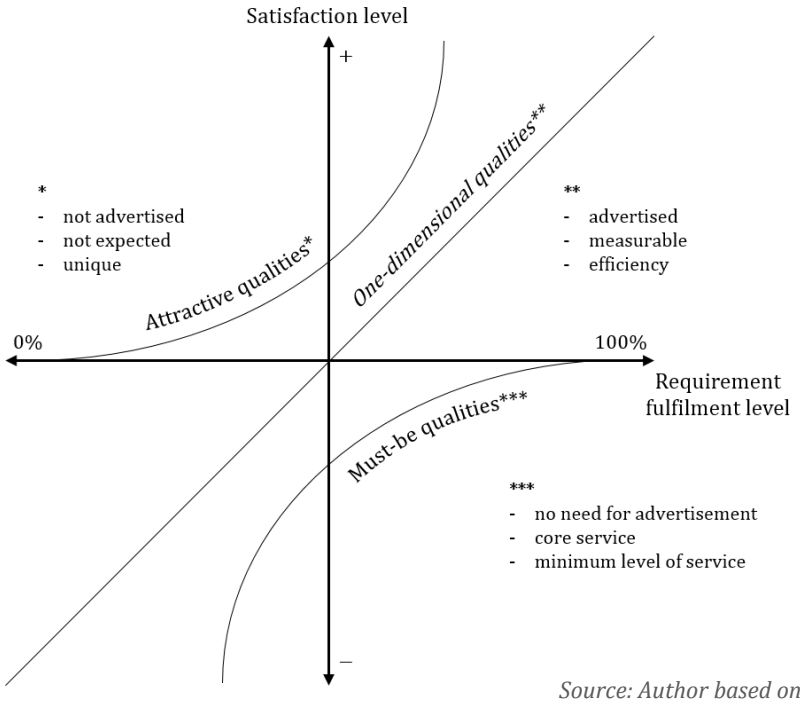
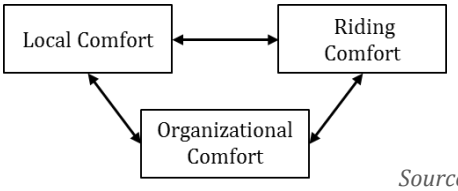


Figure 2.1. *Qualities and relative satisfaction in Kano model*

Applying Kano's model on a generic airline business model also including inflight experience reveals different attributes and features that are necessary and further benefits the passenger satisfaction. First quality discussed is the "must-be" qualities. In terms of airlines, this refers transporting the passenger from point A to point B within the stated departure and arrival time with a safe aircraft, the core service passenger expects to receive. In addition to the core service, if additional basic services advertised are provided, these are also included as "must-be" qualities such as baggage services, clear communication, safety instructions and demonstrations, and meal service. In these cases, it is important for airlines to take precautions (fleet maintenance, effective fleet and crew scheduling, route planning, overbooking, etc.) and have resilient management plans for delays or cancellations and unexpected events (weather, missing baggage, etc.) to make sure to sustain the core service passengers expect. The second quality mentioned is the "one-dimensional" qualities. For airlines, these advertised and measurable qualities can include on-time performance, seat size, in-flight services (meal quantity and quality, IFE

content quality, amenities bags, crew service and communication, etc.), and customer service. At this point, the quantity and quality of these attributes and services should meet the expectation of passengers to achieve desired level of satisfaction. The third quality stated is the "attractive" qualities. Based on studies on different cultures, "attractive" qualities for airline services and products include good reputation of the airline, giveaways during flight (memorabilia, toys for children, etc.), and visually appealing buildings and facilities (Hsu et al., 2007; Basfirinci and Mitra, 2015). In addition, any unexpected service provided by the airline is an "attractive" quality. For example, Lufthansa provides complimentary hot beverages for passengers waiting at gates in main airports in Germany which is not expected by many passengers (Airline Trends, 2017).

Similar to satisfaction, passenger comfort is also a difficult term to distinguish as it depends on passenger characteristics as well as it relies on physical attributes of the provided service. Still, comfort can be described as "a pleasant state or relaxed feeling of a human being in reaction to its environment" (Vink and Hallbeck, 2011). The idea behind providing a comfortable service can be analysed further in three distinct stages of travel as Mayr (1959) stated in the late 1950s which are still applicable today; riding comfort, local comfort, and organizational comfort (**Figure 2.2**). In our case, local comfort is the stage of travel that is experienced at airports. Organizational comfort is the operational reliability and the satisfactory network and schedule that are provided by the organization. Finally, riding comfort is experienced within the aircraft itself during the flight.



Source: Author based on Mayr (1959)

***Figure 2.2**. Three stages of comfort in travel*

According to Richard et al. (1978), customer satisfaction is related to comfort. The strong correlation between satisfaction and comfort shows that if the overall satisfaction is high throughout the journey, the negative experience in comfort during the journey can be offset and vice versa (Oborne, 1978). This trade-off can be extended throughout the comfort in three stages of travel. Having a comfortable transition from ground services to the aircraft can offset certain discomfort during the flight. In other words, the total

satisfaction or comfort for the journey can defined as the result of the trade-off between satisfaction gained and comfort achieved from different attributes within the different stages of travel.

In this research, the passenger comfort and satisfaction are discussed in relation to the passenger preferences in terms of inflight experience. In addition to booking process, ground accessibility, and smooth airport operations, the aspect of cabin services and cabin interior is an important interaction point for passengers and airlines. These services should be adjusted so that it fits passenger needs for a satisfactory experience. As stated, the definition of customer satisfaction depends on passenger perceptions. In a broader context, some perception differences may be influenced by different cultures and their related expectations, which results in the need for specific studies for satisfaction outcomes. As identified by Crotts and Erdmann (2000), national culture is among other measurable factors such as gender and socio-economic level that influences the decision making process for consumers. A regional focus then seems appropriate to study the service quality measures and issues in a specific market (Sultan and Simpson, 2000).

Overall, air travel is one of the fastest and convenient modes of transport especially on long-haul travel. However, a passenger has to sit in an enclosed tubular cabin throughout their flight with other passengers. With the increasing air traffic and competition environment, airlines want to ensure that their passengers arrive to their destinations with satisfaction so they can welcome them back for future flights. The passenger satisfaction can be defined as a function of perceived comfort and service level provided in cabin relative to the price. Therefore, it is crucial for airlines to provide services that meet the expectations of their passengers at reasonable prices. In other words, considering the highest level of service in airlines, first class cannot be expected to be marketed at a ticket price of an LCC. Hence, it is important to achieve an optimal level of service addressed at right passengers with reasonable prices.

Only in Asia, which proves to be the fastest growing air transport market in the world, the numbers indicate that there will be 1.6 billion passengers travelling in 2037 (IATA, 2019). To improve passenger comfort and satisfaction in cabin context, two big manufacturers, Airbus and Boeing with almost 25% of total orders are from Asia, has been investing and developing more passenger friendly cabin interiors and services

(Airbus, 2018; Boeing, 2018). With increasing numbers, passengers demand more from the service providers. Considering the differences in various markets and passenger expectations, the configuration of cabin interior and provided services may have different specifications. With the ongoing growth and the potential growth in region, the competition among airlines has been increasing. Therefore, it is important that growing markets meet customer satisfaction expectations and get competitive advantage far ahead in terms of inflight passenger satisfaction and comfort. As for the focus of this study, this research looks into these expectations for future prospective.

2.2. Airline business strategies

The airline industry is notoriously competitive, characterized by low profit margins and volatility. Based on 2017 figures, average return fare per passengers was $380[1] with an average profit of $9.27[1] per passenger. The profit per passenger has increased 3.5% compared to 2016 along with the 7.3% increase in passenger numbers (IATA, 2018). Due to this sensitive nature and other factors of the airline industry, competition among service providers is high.

A competition analysis of the airline industry with Porter's five forces implemented gives a clear view of how much an airline is under pressure. Porter (1979) in his research proposed that the level of competition depends on five forces affecting the relative market. These forces include threat of new entrants, the bargaining power of customers, the bargaining power of suppliers, threat of substitute products or services, and the industry rivalry.

Threat of new entrants is related to any new competitors emerging within competitive environment. New entrants can bring more capacity and diversified products or services into the market. Regarding to the airline industry, due to the high cost of capital and investment, and substantial market growth required to generate profits, threat of new entrants is low. And while there is room for product differentiation, it is deemed risky. In addition, regulatory limitations and slots available at airports can be difficult constraints

[1] Based on USD value in 2018

for new entrants (Shaw, 2011). Finally, the existing airlines could easily react to a new entry with their well-established resources if new entrants pose a risk while the existing airlines with subsidiaries for maintenance and ground handling are ready to provide these services (Shaw, 2011).

The bargaining power of customers relates to level of impact of end-users on the competition. The impact mainly depends on the volume of customers and number of alternative suppliers. In the case of the airline industry, volume of passengers (customers) is large considering regional and international markets. In terms of number of airlines, there are 294 airlines registered with IATA (2018). While in international routes there are different options for passengers, in most domestic markets, usually one airline has majority of market shares even though these shares seem to decrease over time with competition (Stavins, 2001). Considering the factors, passengers have medium to high bargaining power.

The bargaining power of suppliers is related to the businesses that provide services or products to the industry. Within the airline industry, equipment suppliers including aircraft and engines are numbered including two biggest aircraft manufacturers (Airbus and Boeing) with a combine market share of 66% in 2016 and cost of switching between these suppliers can be high due to change of management and repair operations (MRO) and necessary training of personnel (Aviation Week, 2016). In addition to the equipment, global distribution system (GDS) providers are also numbered with only three global companies (Amadeus, Sabre, and Travelport) (Shaw, 2011). Essentially, GDS provides a comprehensive platform for airlines to sell their tickets through agencies and other third parties. The services and products required by the airline industry are very specialized and unique. With these in mind, the bargaining power of suppliers in the airline industry is high.

Threat of substitutes relates to any alternatives that can provide the same or similar purpose for the end-user to the relative industry. The level of threat is mainly based on the trade-off between price and performance. In the airline industry, while there is no substitute for a long-haul journey, for short to medium haul journey may face a threat from high speed and more traditional rail systems. Behrens and Pels (2012) reveal the competition between two alternatives on London-Paris route slowly forcing airlines to

withdraw from the relative market as profitability decreases. In addition, advancements in technology pose another risk mainly for business travelers as they can have their meetings over video calls and presentations (Shaw, 2011). It can be concluded that the threat level of substitutes in airline industry can be high.

Lastly, industry rivalry refers to any competition within the industry. This force depends on the number of competitors and their relative sizes, industry potential and market accessibility, different strategies within the industry, and price sensitivity. There are many competitors in the airline industry, however, top 15 airlines have a global market share of 48% (IATA, 2018). As a result, most of the airlines has formed strategic partnerships through alliances to widen their market and smoothen the competition. These alliances provide airlines to code share widening the marketplace to sell tickets and improving network connectivity, share lounges at airports to attract more passengers, share airport facilities and offices for administrative procedures decreasing costs, and eventually access to more audience to advertise member airlines' brands. Looking at the size of the alliances in terms of passenger traffic, top three airline alliances (Star Alliance, Oneworld, and SkyTeam) have 62% of the global market share. While the alliances weakens the industry rivalry to a degree among members of the same airlines, the competition among the alliances in addition to the airlines that are assigned to an alliance is still strong. In terms different strategies, there are two major strategic approaches in the airline industry, low cost carriers (LCCs) and full-service carriers (FSCs). In addition, some hybrid carriers have been emerging adopting a mixed strategy utilizing both LCC and FSC concepts. Essentially, LCCs introduced revolutionary strategies through product segregation and differentiation diverging from FSCs offering lower fares. With that in mind, the airline industry is price sensitive which limits differentiation and strategy diversion and increases the competition. It can be concluded that the competition within the industry is high.

Overall, the airline industry is extremely competitive and it is difficult for new entrants to sustain a growing business in many regions. Within this competition, airlines are in constant progress to increase their competitiveness within their controls. For example, revenue management discipline became the core part of every airline for their booking and pricing processes. Over the years, different approaches have been researched and applied. Rothstein (1971) tackles the problem of overbooking by implementing a Markov

decision process. Belobaba (1989) developed the Expected Marginal Seat Revenue (EMSR) to optimize booking process to increase revenue. Van Ryzin and McGill (2000) investigates adaptive approaches to optimize booking limits (number of seats to reserve for high yield fare classes). Bertsimas and De Boer (2005) introduces a simulation approach with stochastic gradient algorithm and approximate dynamic programming to improve revenue. Other examples include advanced scheduling and fleet assignment strategies, introduction of new ancillary products, joining alliances or code sharing, and attractive loyalty programs. In addition to these examples, another area of progress is the improved cabin design and services. Through the implementation of a passenger-friendly or passenger-centered cabin design and services, airlines can improve their brand image which proves a competitive advantage in the market. As stated in the analysis of competition forces, threat of buyers (i.e. passengers) is high in the airline industry and it is an area that airlines have to improve constantly in the changing customer requirements within "one-dimensional" qualities in the services and products provided.

2.2.1. Changing passenger requirements

Changing customer needs and requirements can be analyzed in seven different topics within the air travel market according to Shaw (2011) in terms of requirements; (1) frequency and timings, (2) punctuality, (3) airport location and access, (4) seat accessibility and ticket flexibility, (5) frequent flyer programs (FFPs), (6) airport services, and (7) in-flight services. Although these topics are discussed for business travel market by Shaw (2011) in his book, they can be further discussed for passengers with different purpose of travel.

Frequency and timings

Frequency and timings relates to the schedule of services provided by airlines (i.e., frequency of flights in a week and departure times of flights). While these aspects are particularly important for business travelers who have busy schedules and last minute change of plans, leisure travelers and passengers visiting friends and relatives (VFR) can be more flexible and work their travel plans around the provided airline service. However, several research in airport and airline choice models found frequency of flights to be an important factor for all passengers in their decision making (Ashford and Benchemam, 1987; Cohas et al., 1995; Pels et al., 2000; Jung and Yoo, 2016). With growing market potential and service providers, the options available for passengers are increasing.

Regardless of the purpose of travel (i.e., business, leisure, VFR), passengers can arrange their travels with more flexibility. It becomes more important for airlines to provide adequate frequency of their services at right times to sustain or increase their market share.

Punctuality

In addition to frequency and timings, punctuality is an important need for passengers. Specifically, for business travelers with tight schedules, it is crucial that airlines have a good record of on-time performance. While the punctuality may not be as crucial for leisure passengers as it may be for business travelers, it is important in cases of prearranged travel plans to/from airport and check-in times at destination if applicable. It has been widely accepted that punctuality is one of the factors defining the quality of service and reputation of an airline (Proussaloglou and Koppelman, 1999). As stated in the previous paragraph, the frequency of flights are increasing in many routes which provides prospective travelers to be able to consider on-time performance between airlines based on their preferences.

Airport location and access

The location of the airport has importance in terms of ease of access and access time. In major cities, there are often two or more airports serving the same region. These areas are called multiple airport regions (MARs). Examples to these areas include but not limited to New York metropolitan MAR (including John F. Kennedy International Airport (JFK), Newark Liberty International Airport (EWR), and LaGuardia Airport (LGA)), London metropolitan MRA (including London City Airport (LCY), Heathrow Airport (LHR), Gatwick Airport (LGW), Luton Airport (LTN), Stansted Airport (STN), and London Southend Airport (SEN)), Paris metropolitan MRA (including Charles de Gaulle Airport (CDG), Orly Airport (ORY), and Beauvais-Tillé Airport (BVA)) (**Table 2.1**).

In general, while full service carriers (FSCs) use major airports that are closer to the city center, low cost carriers have traditionally used relatively smaller and more remote airports. Business travelers usually prefer to use local and easily accessible airports while leisure travelers may tolerate a more distant airport depending on the overall cost of the travel (Ashford and Benchemam, 1987; Shaw, 2011).

Table 2.1. *Examples of MRA*

Area	Airport
New York Metropolitan Area	John F. Kennedy Airport (JFK)
	Newark Liberty International Airport (EWR)
	LaGuardia Airport (LGA)
London Metropolitan Area	London City Airport (LCY)
	Heathrow Airport (LHR)
	Gatwick Airport (LGW)
	Luton Airport (LTN)
	Stansted Airport (STN)
	London Southend Airport (SEN)
Paris Metropolitan Area	Charles de Gaulle Airport (CDG)
	Orly Airport (ORY)
	Beauvais-Tillé Airport (BVA)

Harvey (1987), in his early study, shows that the importance of access time decreases as the duration of flight increases. The recent studies shows the significant importance of airport accessibility, access cost, and access time (Gelhausen, 2011; Jung and Yoo, 2016; Usami et al., 2017). As the connectivity improves among regions, the catchment areas of individual airports increases. An example to this is the introduction of High Speed 2 (HS2) which will increase the catchment areas of airports in the south (London area) and in the north (Birmingham, Manchester and Leeds areas) (GOV.UK, 2018a).

Seat accessibility and ticket flexibility

Seat accessibility and ticket flexibility is part of the booking process and booking policies that an airline follows. Seat accessibility, in this case, refers to the availability of booking a seat in short notice before departure (Shaw, 2011). This aspect is especially important for business travelers with last minute travel plans. In this case, they may also need an earlier or later flight than the originally booked flight. With this in mind, the flexibility of ticket in terms of changes, cancellations, and no-shows, becomes important. On the other hand, leisure travelers are more likely to make their plans ahead of time and book their seats well in advance, making seat accessibility and ticket flexibility less important for them. Caussade and Hess (2009), in their analysis of passenger preferences for LAN airlines (currently LATAM Airlines), include the aspect of reservation changes and

refund policies which are found to be significant for passengers making a decision on the fare groups (Basic, Basic Plus, Flexible, etc.).

Frequent flier programs (FFPs)

As part of loyalty programs, many airlines provide frequent flier benefits for passengers. These programs can be in conjunction with partner airlines or within an airline alliance where passengers collect points/miles based on the fare class and distance flown. Initially, these points/miles could be used to purchase reward tickets and upgrades, however with increasing competition and changing customer needs, with points/miles passengers can pay for variety of products and/or services including different experiences (i.e. concerts, sports events, and spa treatment), rental car, and hotel reservations. These programs can be interpreted to have significant importance for some passengers as it is estimated that they are willing to pay around $0.56 for a FFP per every kilometer they fly in a study for Latin America (Caussade and Hess, 2009).

Airport services

Shaw (2011) discusses the importance of airport services for business travelers in aspects of check-in process, security and immigration checks, and baggage services. In addition to these, other aspects like signs, lavatory facilities, shopping areas, dining areas, rest areas, multi-faith prayer facilities, and lounge facilities can be included in airport services which relates different variety of travelers. With technology developing and customer needs changing, certain aspects of airport services needs to adjust. Firstly, over the past decade, check-in services have been adapting to technology in terms of easier online and mobile check-in processes and self-check-in kiosks followed by baggage drop services. Navigating within the airport also has seen further improvements with the introduction maps integration in to the mobile phones. Other improvements and adjustments in airport services include easier immigration checks. For example, within the United Kingdom (UK), passengers who are citizens of European Economic Area (EEA), and several other countries from Asia, Africa, Middle-East, North America, Oceania, and South and Central America who are members of Registered Traveller can use ePassport gates for automated border control (GOV.UK, 2018b). As the economy grows, the potential market for air travel also grows increasing congestion at the airports creating the necessity for more efficient operations and more effective facilities.

Inflight services

From both the perspectives of carriers and passengers, inflight experience provided is one of the most important point of contact with the customer/passengers and the service provider. On top of operational efficiencies discussed previously, airlines have to meet the passengers' needs for the duration of the flight within the regulated safety standards. Inflight services include seating comfort (seat width, seat pitch, material, etc.), meals and drink, inflight entertainment (IFE) systems, inflight shopping, lavatory facilities, and different amenities based on the characteristics of the flight. In addition to these service, aspects like hygiene, noise, illumination, and overall space perception play supplementary roles in inflight experience. There are studies investigating the importance of inflight services based on passenger preferences while making a choice for their flight. Based on the findings, seat size (including legroom), meal and drinks service, and inflight entertainment (IFE) are all found to have some significance for passengers when making their decision for a flight (Espino et al. 2008; Balcombe et al., 2009; Caussade and Hess, 2009; Collins et al., 2012). Considering the changing customer needs and technology, several attributes within the inflight services are in need of improvement. For example, the connectivity (internet connection) has become more of an accessible service rather than a rare luxury for consumers. Therefore, many airlines have started the integration of services providing inflight internet service over the past years which then may change the inflight entertainment structure or usage.

2.2.2. Airline business strategies on cabin design

There are various factors and attributes included for the inflight experience. Different airlines have adopted different business strategies which is eventually reflected on the cabin design and services provided. There are two major business strategies adopted by airlines; full service and no-frills (Doganis, 2005). From one point of view, full-service carriers (FSCs) can be characterised as one price for fare and services while no-frills, low cost carriers (LCCs), can be identified as fare only price excluding other relative services passengers might be interested. In addition, over the past decade, hybrid business strategy has emerged which combining different features from two major strategies. Looking at two distinct strategies (LCCs and FSCs), there is a significant difference based on the cabin design and configuration approach (Daft and Albers, 2013). Apart from operational differences such as turnaround times at airports (shorter times for LCCs), network

connectivity (point-to-point for LCCs and hub and spoke for FSCs), and fleet selection (commonality for LCCs and various types for FSCs), differences related to inflight services differs in terms of cabin configuration, seating, inflight entertainment (IFE) systems, meal and drinks, and baggage allowance (O'Connell and Williams, 2005).

Based on the adopted strategy, LCCs provide a more basic and densely configured cabin configuration for passengers while having lower quality smaller seats in terms of pitch and width size with minimal legroom. FSCs, on the other hand, generally provide more comfortable and passenger oriented cabin with a less dense cabin configuration including larger seats in terms of pitch and width size. The main focus of LCCs is to aggressively minimise costs and increase revenue per passenger with lower fares which proves to be a more attractive option for price sensitive passengers. A study by Chiou and Chen (2010) in China reveals that LCC passengers are price sensitive. Taking this into account, passengers accept a no-frill service if the price is right. While it can be interpreted that passenger satisfaction, in this case, largely depends on the price of the flight, the service quality of an LCC is still found to be a priority for passengers (Kim and Lee., 2011). The cabin design of FSCs attract passengers that prioritise comfort over price considering the all other factors static such as flight availability and origin and destination (O/D) airports. In both cases, there are improvements involved to improve passenger experience.

In terms of inflight entertainment (IFE), meal and drinks, and baggage allowance, they prove to be a source of another income for LCCs which are defined as ancillary services/revenues. In 2015, the total ancillary revenue for LCCs was recorded as $7.2 billion which is an important source of income (IdeaWorks, 2016). As the main objective of an LCC is maximizing profits while running the business at the lowest cost possible, meeting the necessities of passengers willing to pay for certain services through an optimum selection of in-cabin services is crucial. FSCs, on the other hand, provide in-cabin services that come in a fixed price for different service levels. Even though some FSCs have been introducing à la carte services, they still have to maintain their in-cabin services at a defined level. As discussed in Park et al. (2004), a study in South Korea, the airlines would benefit from developing passenger-focused services through understanding of passengers' expectation in increased passenger satisfaction and value perception. This would also help airlines to minimize their costs through eliminating services or products that passengers do not value.

In any case, for both LCCs and FSCs, the value of passenger expectations and their relative level of satisfaction are important factors to establish a sustainable business model. Chang and Yeh (2002) emphasize that the competitive advantage an airline has is the perceived service quality of the passenger as Gursoy et al. (2005) found that the passengers perceive a higher service quality for Southwest Airlines, a US LCC, than US FSCs. Both strategies require the understanding of passengers' expectations for the best in-cabin services to be provided determined based on the demand for improved service quality and satisfaction. The main difference between LCCs and FSCs is then the passenger profiles that each segment has and the services directed within that profile expectations.

2.2.3. Emerging aircraft cabin technologies

Within the defined competitive environment an airline has to operate, especially with the changing passenger requirements, it is crucial to have an up-to-date services and products that are available for passengers. Regardless of their approach or business strategy, airlines provide similar services to meet passengers' expectations. In this review of technologies that involve in aircraft cabin context, these technologies are divided in two distinct purposes; ancillary services or products and baseline cabin services.

In this context, ancillary services are defined as any secondary product or service offering that is different than the primary product or service and the revenue derived from these services are called ancillary revenues (Hind and Kitching, 2017). Especially for LCCs, ancillary revenue is major source of income. As part of the LCC strategy many service or products considered to be primary has been unbundled to increase revenue such as hold baggage, seat allocation/selection, and on-board meal services. Many FSCs have also started to incorporate this strategy especially on short-haul routes (Hind and Kitching, 2017). Airline industry is in constant progress to offer new and different ancillary services and products to meet variety of expectations. On the other hand, baseline cabin services are tangible or intangible services or products offered without any extra charge that is the cost of these services or products are already reflected in the fare price group.

In this review, the involvement of new technologies from the preliminary work conducted as part of the FUCAM project, Deliverable 4.3 - Presentation and assessment of emerging technologies in relation to selected concepts, see Kirenskis et al. (2018), are discussed. In

the report, there are 21 different application scenarios are presented. In this review, these scenarios are categorized in 4 topics as (1) health and wellbeing, (2) connectivity and communication, (3) IFE systems and meal, (4) seating. In the review, application scenarios with regards to the airline operations are omitted (i.e. indifferent qualities such as power generation or supply, profitable seating configurations).

In the report, technologies related to the health and wellbeing of passengers are explored in detail. The technologies involved in this topic enables health monitoring and improvement, improved hygiene and wellbeing through applications in seat and in lavatories (Kirenskis et al., 2018). Health monitoring and improvement technologies can be offered to passengers with health problems during their flight as some key technologies discussed in the report includes smart watches for health monitoring and health check stations in lavatories. In addition, wellbeing and hygiene can be improved with new technologies promoted as ancillary products such as fatigue reducing anti-jetlag goggles in long-haul flights and ultra-light water saving showers (Kirenskis et al., 2018). In addition, overall cabin environment can be improved with air quality and acoustics measured and controlled through a conscious cabin (smart cabin) scenario.

Connectivity and communication topic includes very important aspects of cabin services. As the connectivity becomes more of a commodity rather than a luxury, the integration of technologies regarding to this is crucial. In Kirenskis et al. (2018), some key technologies discussed are the integration Li-Fi[2] for high speed broadband and wireless power distribution through Wi-Fi.

IFE systems and meal are two services that enhances passenger experience. Different technologies included in IFE systems are being developed everyday with creative solutions. In the report, a holistic interactive IFE system is discussed as expanding the IFE experience across the passengers' surroundings through smart projections, holograms and virtual reality goggles rather than merely in the form of a mounted screen and audio ports (Kirenskis et al., 2018). In addition to the IFE, meal services are also investigated and personalized meal service scenario with accessible in-flight dining technologies are presented. A key technology discussed in the report is the food printer which can prepare individualized meals using a set of ingredients which can also decrease costs for the

[2] Technology that uses light to transmit wireless data (pureLiFi, 2018)

airline. The technology involves using generic ingredients extruded through a nozzle to create different combinations of meals.

The last topic is the seating. Several aspects of seating and seating environment are discussed in the report. Some of the key technologies included are light weight in-seat massager as an ancillary product and vibration absorbent seats for improved comfort. As for the seating environment, a key scenario included is the windowless cabin solutions. It is stated that windowless cabin structure significantly improves the structural efficiency of the cabin while proving a lighter structure effectively reducing fuel consumption (Kirenskis, et al., 2018). While windowless cabin idea is beneficial for the airlines reducing costs, it constricts the passenger perception. In that case, high definition screen panels covering the walls, ceiling, and floor panels and transparent material options are investigated in the report to give passengers a sense of greater space.

Although some of the technologies discussed in this section may seem too far from the reality, they show the transition of passengers understanding and expectation in cabin context with available and emerging technologies. Overall, it can be realized easily the individualistic progress of air travel within cabin context with increased connectivity and personalized choices. As the technologies enable different applications in a cabin environment, the threshold for comfort and satisfaction of passengers increase with changing norms. While there are challenges present in terms whether the specific technologies would suit the business strategy of airlines (i.e. LCCs) and if the technologies would be available for retrofitting, the indication for a basis of change in implementing new technologies is present. Based on this, it is important to reveal passenger behavior and preferences as explained in the next section.

2.3. Passenger behaviour and choice models

There are several factors influencing passenger choice. Assuming a single class scenario, in terms of airline choice, these factors can include but not limited to fare, seat related attributes, inflight entertainment (IFE), meal service, travel time, connections, departing/arriving airport, departure/arrival times, airline brand, and frequent flier programs (Espino et al. 2008; Balcombe et al., 2009; Caussade and Hess, 2009; Collins et al., 2012). These attributes affect passenger choice based on their expectation and/or preference. Identification and estimation of passenger expectations and preferences can

be achieved through various ways. However, discrete choice models (DCMs) are widely used throughout the literature in air transport studies (Ben-Akiva and Lerman, 1985). Discrete choice models provide a framework for the analysis of choice probabilities of passengers for different alternatives based on defined attributes in scenarios through respective survey studies. As the choice probabilities of passengers are revealed, passengers' willingness to pay (WTP) for different attributes can be estimated based on the price attribute to provide an economical valuation (Martin et al., 2008). Then, the estimated demand can be utilized for future decision making.

2.3.1. Stated preference survey

Discrete choice models are used to estimate the choices made by decision makers. The model follows a decision rule that is based on the preferences of the decision maker. The probability of the decision maker's choice is then revealed by the probability of having greater utilization for a given alternative (Ben-Akiva and Lerman, 1985).

Stated preference (SP) experiments are widely used in the analysis of behavioural responses of individuals (Collins et al., 2012). SP is usually compared with revealed preference (RP) where the analysis depends on real historical data contrary to including a hypothetical scenario in stated preference surveys which can prove a limitation in certain cases (Hess et al., 2007). Algers and Beser (2001) conducted a study in collaboration with Scandinavian Airlines (SAS) using both SP and RP data to model choices by passengers on flights with different booking classes with a structured logit model. The study revealed the limitations in the analysis from utilizing RP data. The utility function from the SP data is scaled using the RP data. Economic analysis with SP data is presented with willingness to pay as the outcome and RP data is used to further describe the process and choices. Further research on SP surveys includes Collins et al. (2012) where authors investigate two different SP survey designs for enhanced reality of decision making process. Two surveys are included for long-haul flights and willingness to pay for different aspects are revealed including travel time, number of stops, seat allocation, entertainment system, seat pitch, and legroom. Two SP surveys in the study are consisted of traditional SP and online travel agency (OTA) style SP (i.e. realistic booking website) which allows respondents to sort the flight options and limit the range of variables based on their preferences. With the introduction of OTA style SP survey, authors suggest an interactive and more realistic approach in collecting data from

respondents. The findings show the more realistic the survey is the more robust the outputs are. Overall, SP experiments with realistic scenarios proves to be the most effective way to analyse choice data (Bateman et al., 2002).

SP surveys can be divided into three layers; attributes, alternatives, and scenarios. The aspect of the analysis of a service or product includes identifying specific factors that are important to passengers which are called attributes. Attributes have different levels of values for different alternatives. Different combinations of attributes are defined for different alternatives for preference which are presented in different scenarios (Bateman et al., 2002).

To determine different attributes and relative attribute levels, a pilot study is usually needed. This is important to reflect the correct nature of the responses and to avoid possible biases (Bateman et al., 2002; Pearce and Ozdemiroglu, 2002). When considering alternatives, there should be a distinctive difference between them while they should be related and similar enough to substitute each other for the same purpose of the scenario (Bateman et al., 2002).

2.3.2. Choice modelling and logit models

The key determinant in estimating a discrete choice model is the utilization of an alternative which can be defined as the value or the benefit that a passenger/user has on a certain choice based on different characteristics of attributes compared to other alternatives (Ben-Akiva and Lerman, 1985). In other words, the combined value of all attributes (i) defining an alternative (k) based on the user preference reveals the utilisation of the alternative which then is used for comparison with the utilisations of other alternatives. As a result, it is accepted that the user would choose the alternative with a greater utilisation. Then the choice model is estimated using the probability of one utilisation being greater than others. With SP surveys, through an efficient design, passenger responses are recorded and analysed with a logit model to reveal the preferences and willingness to pay (Bateman et al., 2002).

Earlier applications of the introduction and utilization of choice models in air transport includes Kanafani and Sadoulet (1977) where the authors investigate the air travel demand by passenger choices based on certain economic determinants. Some of the other selected studies in choice models for air travel include Proussaloglou and Koppelman

(1999) who provide a conceptual framework for passenger choice model in terms airline, flight (O/D and schedule), and fare class. The choice model includes the estimation of the importance of airline brand, market, quality of service in terms of punctuality, frequent flier membership, schedule, and price. Other parameters include purpose of travel, attitudes preferences and other air travel alternatives in the market. The study concludes with the willingness to pay for the attributes included in the study and shows the sensitivity of passengers to schedule delays. The demand for travel is also examined with market research within the study.

The key determinant in discrete choice models is the utilization of an alternative which can be defined as the value that a decision maker has on a certain choice based on different characteristics or attributes (Ben-Akiva and Lerman, 1985). With SP surveys, through an efficient design, passenger responses are recorded and analysed with a logit model to reveal the preferences and willingness to pay. The utilization function *U* of an alternative *i* is presented as

$$U_{ni} = \beta_1(x_{n1}) + \beta_2(x_{n2}) + \cdots + \beta_j(x_{nj}) + \varepsilon_{nj} \qquad \textbf{Eq. 2.1}$$

where x_{ni} is attribute j for person n, ε is unobserved attributes, measurement errors, etc. and β is the corresponding vector of coefficients of the observed variables.

In order to assess the factors included in the data in a discrete choice model, there are two major models used to estimate the probabilities of passengers choosing an alternative; (1) multinomial logit (MNL), and (2) mixed logit (ML) models. Both models prove useful and provide significant results. As discussed, while with multinomial logit correlation is not provided, mixed logit provides correlation between attributes on the choice probability. Another difference is the assumption of independence of irrelevant alternatives (IIA); while it is a problem when using multinomial logit model, mixed logit models assume IIA on individual level (McFadden, 1974; Hess, 2007; Espino et al., 2008). IIA assumes that choice probabilities of any two options would be unaffected by the attributes or availability of other options which is not realistic in case of an introduction of a third alternative (Bateman et al., 2002; Pearce and Ozdemiroglu, 2002). Based on the literature, when analysing choice probability with attributes on alternatives, both model proves useful. The results from both models differs in terms of significance

based on the model definition; whether to use certain attributes from both individuals and from alternatives. While certain category of attributes can be explained better with mixed logit, other aspects can be explained better by implementing a multinomial logit model. Multinomial logit models provide probability of a passenger to choose an alternative in a standard way as

$$P_{ni} = \frac{exp(U_{ni})}{\sum_{i=1}^{k} exp(U_{ni})} \qquad \textbf{Eq. 2.2}$$

where the probability *P* of choosing an alternative *i* for person *n* depends on the ratio of the exponential values of utility of an alternative *i* and the total utility of *k* number of alternatives.

Mixed logit models randomizes the coefficient of the observed variable for each observation allowing for correlation among alternatives (McFadden and Train, 2000). Coefficient of the observed variables are randomised based on a distribution with parameters θ describing β. Including the randomisation, mixed logit model is presented as

$$P_{ni} = \int_{\beta} \frac{exp(U_{ni})}{\sum_{i=1}^{k} exp(U_{ni})} f(\beta|\theta) d\beta \qquad \textbf{Eq. 2.3}$$

where, P_{ni} is the probability of choosing an alternative *i* for person *n*, *U* is the utility function, *k* is the number of alternatives, β is the coefficient, θ is the parameter defining the function of β.

Then, probabilities are estimated through simulation. Espino et al. (2008) utilized mixed logit along with multinomial logit models to study the willingness to pay for variety of services provided in the aircraft including on-board catering, legroom and reliability. Balcombe et al. (2009) also develops a choice experiment to reveal willingness to pay for certain attributes in preferences including seat pitch, legroom, seat width, on-board catering, IFE, and bar services utilizing a mixed logit model. The study includes some amenities and services provided on an international medium-haul flight (4.5-5.5 flight hours) departing from the UK. The research concludes with a value of €120 for overall approximate comfort and service level.

In addition, nested logit (NL) model can be introduced for improved results and further understanding of different alternative groups which can also provide flexibility with IIA assumption (Bateman et al., 2002). Similar to mixed logit (ML) models, nested logit (NL) models can be developed for multinomial choices with correlation among attributes with an addition of categorising alternatives into nests (Ben Akiva and Lerman, 1985; Train, 2009). Drabas and Wu (2013) provides improvements on cross-nested logit model to analyse passenger preferences based on airline brand, fleet type, departure time, travel time, cabin class, refundable tickets, and price. Authors state that utilising the proposed nested logit model can improve results compare to other discrete choice models and also can provide more useful passenger behaviour models.

Discrete choice model in air transport has been included in various areas of the industry in studies such as Ashford and Benchmann (1987) and Pels et al. (2000) in airport preferences and Proussaloglou and Koppelman (1999) and Hess et al. (2007) in airline preferences. Major areas studied with discrete choice model are demand estimation for airports and airlines. While estimating demand, passenger preferences, behaviour models, and willingness to pay for included attributes are revealed.

2.3.3. Attributes in airport preference

Discrete choice models (DCM) studies in air transport and in the context of airport preference have been included to understand and reveal the behaviour of passengers globally. The purpose in understanding airport preference of passengers provides the estimation of situational choice of passengers in a scenario where multiple airports are operating within the catchment area of the relative passenger. Regions where there are multiple airports are operating are called multiple airport regions (MARs). Skinner (1976) introduces the study on the airport preference as one of the pioneers where the author studies the Baltimore region in Washington, US. **Table 2.2** presents different attributes investigated in a variety of selected studies in different geographical locations.

Table 2.2. *Selected choice model studies in airport choice*

	Ashford and Benchemam (1987)	**Thompson and Caves (1993)**	**Windle and Dresner (1995)**	**Hess et al. (2007)**	**Gelhausen (2011)**	**Marcucci and Gatta (2011)**	**Jung and Yoo (2016)**	**Usami et al. (2017)**
Location	Central England	North England	Washington, USA	San Francisco, USA	Germany	Central Italy	Seoul, South Korea	Tokyo, Japan
Access Time	●	●	●	●	●	●	●	●
Access Cost					●			
Flight Frequency	●	●	●	●	●	●	●	
Fare	●	●		●			●	
Number of seats		●						
Previous Experience			●			●		
Waiting Time				●		●		
Airlines					●	●		●

Major attribute included in airport preference studies in choice models is the accessibility to the airport followed by the flight frequency from the selected airport (Harvey, 1987; Ashford and Benchemam, 1987; Ozoka, 1987; Innes and Doucet, 1990; Monteiro and Hansen 1996; Basar and Bhat, 2004; Hess and Polak, 2006). Ticket price (fare) has also been included in the airport preference studies when understanding the passengers' choices (Cohas et al., 1995). Other attributes when estimating the passenger preference include airlines operating from the airport, knowledge of the airport and/or previous experience and operational efficiency (on-time performance) (Windle and Dresner, 1995; Moreno and Muller, 2003; Marcucci and Gatta, 2011).

Through the literature search, multinomial logit model is found to be the most common logit model used in studies. Harvey (1987) conducts a study in San Francisco area in USA to reveal airport preference in the region. He uses a multinomial logit model (MNL) with two sample groups; resident business travellers and resident non-business travellers. The findings of the study show that the choice depends on the trade-off between time and frequency of flight. While the study presents no significant importance of additional direct flights to a specific destination, passengers are found more likely to choose a direct

service option over a connecting and commuter flight services from an airport. In addition, the findings show that the value of access time decrease as the length of flight increases.

Another early study was conducted for Central England region by Ashford and Benchemam (1987). Authors investigated the airport preference in order to assist with effective planning of an airport system using the data collected between 1975 and 1978. As within many studies, variables included are access time, frequency of flights and ticket price (fare). The study utilised a multinomial logit model (MNL) to reveal the passenger preferences within four different categories; domestic, international business, international leisure and international inclusive holiday. As the authors emphasise the ability and usability of multinomial logit models (MNLs), the findings reveal that while access time is important for business travellers, in addition to access time, fare is found to be significantly important for leisure travellers. Similar study was applied to Nigeria by Ozoka (1987) where the findings includes the access time as the significant factor while flight frequency and ticket price (fare) are not found to be important for passengers. In addition, Innes and Doucet (1990) investigates the airport choice for New Brunswick in Canada. In the study, findings show the strong preference of passengers on jet aircraft while choosing an airport. In other words, passengers are willing to travel further to an alternative airport to the closest airport to fly in a jet aircraft. Moreover, flight-time difference and direct flight service proves to be important factors for airport choice.

Thompson and Caves (1993) analyses passenger behaviour models in order to estimate the demand for the addition of an airport in Sheffield, England based on the market share. The analysis showed that, at least for business passengers, fare and the size of aircraft are not significant. In contrast Cohas et al. (1995) researches three existing MASs (San Fransisco, New York, Washington/Baltimore) in the USA to estimate the airport market share based on the ticket price (fare) and flight frequency. Findings include the significance of ticket price and flight frequency in the study. Overall, authors emphasise the impact of choices made by airlines in particular MAR. In another study, Windle and Dresner (1995) develops a logistic model to estimate airport preference in Washington/Baltimore MAR. As similar to other studies, the results show that access time and flight frequency are significant in airport selection. The difference between business passengers and non-business passengers are presented where the significance of

shorter access time and increased flight frequencies prove more for business passengers. Additionally, the previous experience at the airport variable is included where it was found significant suggesting passengers who have used an airport are more likely to use the same airport.

In more recent studies, Gelhausen (2011) studied the region of Stuttgart in Germany as a case study to analyse the limited capacities with RP data using nested logit model. The authors states that passenger choices depend on flight frequency and accessibility of the airport. Key findings include that airports in depend on each other in limited capacity. In other words, a limited capacity at an airport causes problems in other airports in the region as it may even cause capacity constraints. Marcucci and Gatta (2011) utilised a stated preference study to effects of different attributes for airport choice behaviour of passengers. Usami et al. (2017) investigates airport choice preference of passengers between Haneda and Narita airports in Tokyo, Japan. Authors state the importance of connectivity for passenger preferences. In relation with connectivity, Haneda airport is found to be more ideal for passengers for international flights considering the domestic connectivity in the region.

Mixed logit models are also developed in airport choice modelling. Hess et al. (2007) investigates the preference of airport for passengers departing from San Francisco. The authors develop a mixed multinomial logit model for the random distribution of preferences among decision makers. Data included in the study is obtained from an airline passenger survey that was conducted in 1995. Three different airports in San Francisco are included in the study. The research concluded significant influences of access time, air fare, and frequency of services. Also, the importance of mixed multinomial logit models in achieving modelling accuracy is emphasised.

In terms of nested logit model utilisation in choice modelling for airports, Pels et al. (2000) developed a model to investigate both airport competition and airline competition in a MAR. The study includes optimal air fares, flight frequencies, and passenger charges in a MAR. Authors state that the model can be used to estimate optimal passenger charges, based on the airlines. Jung and Yoo (2016) conducted an empirical study to reveal passenger preferences in airport choice in Seoul, South Korea. The study uses a two-level nested logit model to investigate the effects of factors on choice. The findings suggest

that fare, flight time, frequency, access time, access cost and airport accessibility are significant factors for passengers when making a decision.

2.3.4. Attributes in airline preference

The literature, in terms airline choice models, is extensive with variety of attributes included in different research. **Table 2.3** shows different attributes included in variety of selected studies with different characteristics and markets.

Table 2.3. *Selected choice model studies in airline choice*

	Espino et al. (2008)	Balcombe et al. (2009)	Caussade and Hess (2009)	Collins et al (2012)
Flight Duration (h)	2.75	4.5-5.5	Variable	23.5
Route	Spain-Domestic	UK-International	Latin America	Australia-International
Travel Time				●
Connection				●
Seat allocation			●	●
Seat pitch	●	●		●
Seat width	●	●		
Additional legroom		●		●
Food Levels	●	●		
IFE		●		●
Bar		●		
Frequent Flier Program		●	●	

Since the earlier studies, using logit models, fare has been found to be a significant factor (Kanafani and Ghobrial, 1985; Ashford and Benchemam, 1987; Alamadari, 1991). Collins et al. (2012) conducts an interactive SP experiment with an ability of performing search activity similar to online travel agencies. Preliminary findings from the study show that the dominant sorting criteria used for searching flights is fare by decision makers. Conversely, in various instances the attribute failed to be significant due to the small differences in airfare presented for passenger choices from airlines (Alamadari and Black, 1992). For the most part, when analyzing airline choice behavior, fare is always included to reflect the real-world situation within the SP survey. In this case, fare can become a

variable for the estimation of willingness to pay for different attributes that are found significant.

Seat related factors in the literature mainly includes seat dimensions (seat pitch, seat width, and additional legroom). While seat width is the distance between the two sides of the individual seat, seat pitch refers to longitudinal dimensions of individual seats. In addition, seat allocation is included in Caussade and Hess (2009) in Latin America based on an online survey. In general, seat dimensions and seat allocation are found relatively significant for passengers when making choice as found in relative studies. Collins et al. (2012) conducted their studies on a long-haul route (Sydney to London and Paris) and showed in their estimations the importance of seat allocation and seat pitch along with the legroom. In addition to seat dimensions and allocation, IFE systems are included. In some studies, IFE is found as a significant factor for passengers (Balcombe et al., 2009; Collins et al., 2012).

Another aspect of airline travel investigated in literature is food service. Two main studies included food service as a factor in SP survey and discrete choice model (Espino et al., 2008; Balcombe et al, 2009). While one study includes economy and business or first class with drinks, the other study does not consider different cabin classes nor drinks. However, the attribute levels included for food factor are similar. Espino et al. (2008) differentiates economy and business class in a domestic route in Spain for a short-haul route with a flight duration of 2.75 hours. In business class or first class, the food levels include (0) cold sandwich and drink, (1) hot meal and drink, and (2) a la carte. For economy class, the respective levels are (0) no food service, (1) sandwich and drink, and (2) hot meal and drink. In Balcombe et al. (2009) relative food levels are (0) sandwich, (1) hot meal, and (2) a la carte. Both studies found food levels significant enough in certain models to estimate willingness to pay.

The literature presents a useful utilization of choice modelling techniques on passenger choices in air travel. In all of the research included, the choice models prove successful estimates in terms of revealing passenger preferences and willingness to pay.

2.3.5. Estimating willingness to pay

Willingness to pay (WTP) is the value that passengers are willing to pay for a service (factor) (Breidert, 2006). Willingness to pay is often regarded with willingness to accept

which is the value for accepting an existing service or lack of service (Balcombe et al., 2009). While these values are psychological estimation of passenger choices based on the regression of results, they offer a valuable content for analyzing and forecasting demand. The estimation framework for WTP is the ratio of the coefficient for the respective attribute divided by the coefficient for the price.

$$\mathrm{WTP}_i = \frac{\Delta\beta_i}{-\Delta\beta_p} \qquad \textit{Eq. 2.4}$$

where willingness to pay for attribute *i* is the ratio of the marginal change in the coefficient of attribute *i* divided by the marginal change negative coefficient of price (*p*). In most cases, as price would have negative impact on the overall utility, the coefficient of price denominator is multiplied by -1. In some cases, the coefficient for the price is assumed to be a constant rather than a random variable (Revelt and Train, 1998; Scarpa et al. 2008)

WTP depends on various aspects included in scenarios. These aspects could be carrier segmentation and route (Carlos Martín et al., 2008). In addition, another important aspect is the geographical discrepancies such as country and culture (Hoyos et al., 2009). As willingness to pay can only provide scenario specific results, it is difficult to generalize the results for common understanding. While the individual results cannot be compared between studies including different geographies, the valuation of factors by passengers can provide useful directions.

Based on the existing literature, several studies present willingness to pay for various attributes included in their respective studies (**Table 2.4**). The results from different models in individual research are averaged for commonality. Four selected studies are presented in **Table 2.4**. Espino et al. (2008) and Balcombe et al. (2009) are the primary studies that includes food services in their estimation of willingness to pay. Both studies utilized mixed logit (ML) model in their analysis and found similar results (on average $6.37 and $6.70 respectively) for level 1 food service which was defined as the minimum level of food service. However, there is a noticeable difference between level 2 food service provided with $11.46 in Espino et al. (2008) for short-haul domestic travel in Spain and $34.10 in Balcombe et al. (2009) for medium-haul international flight originating from the UK. Caussade and Hess (2009) includes services that can be purchased during the booking process which include seat allocation, reservation changes,

and frequent flier program (FFP) miles. They estimated that passengers in Latin America are willing to pay $2.24 to select their seats for every additional hour in the air. Collins et al. (2012) presented an analysis with scaled multinomial logit model (SMNL) and estimated WTP for the factors included in the study.

Table 2.4. *Willingness to pay estimates from selected studies*

	Espino et al. (2008)	Balcombe et al (2009)	Caussade and Hess (2009)	Collins et al (2012)
Flight duration (h)	2.75	4.5-5.5	Variable	23.5[1]
Route	Spain-Domestic	UK-International	Latin America	Australia-International
Travel time (h)	-	-	-	$ 10.90
Avoid connections (per)	-	-	-	$ 64.90
Seat allocation	-	-	$ 2.24[2]	$ 73.94
Seat pitch (inch)	-	$ 26.40	-	$ 2.24[2]
Seat width (inch)	-	$ 34.80	-	-
Additional legroom	$ 29.10	-	-	$ 26.88[2]
Food level 1	$ 6.37	$ 6.70	-	-
Food level 2	$ 11.46	$ 34.10	-	-
IFE	-	$ 40.70	-	$ 3.35
Bar	-	$ 34.10	-	-
FFP (/km)	-	-	$ 0.56	-

[1]Including connections with return ticket
[2]per hour estimates
Note: For standardisation, values from Espino et al. (2008) and Balcombe et al.(2009) are exchanged to USD with EUR1=USD1.20

Based on the findings while results are relatable there are variabilities among different studies. Looking at the characteristic and focus of these studies, these variabilities can be the result of different duration of flights and different geographies included in respective research.

2.4. Culture-specific preferences

In order to understand passenger preferences and trends in Japan, cultural and social aspects are investigated. In some cases, choice can be reflected by the culture difference among decision makers (Yamagishi and Hashimoto, 2008).

When culture-specific differences are discussed, this culture difference can be a result of varying aspects. Culture, as defined by the Cambridge Dictionary (2016), is "the way of life, especially general customs and beliefs, of a particular group of people at a particular time". However, there are different but common definitions of culture in the literature. Kroeber and Kluckhohn (1952) presents a critical review of various definitions of culture in terms different disciplines with authors from different backgrounds. The logical construct from the review is that culture is a result of "behaviour or behavioural products". Although it is acknowledged that culture is not behaviour, one part of culture entails customs and standards while the other part involves ideologies rationalising some specific ways of behaviour. While culture is a big range of a topic to investigate, understand and analyse, the logical construct derived from Kroeber and Kluckhohn (1952) and the specific definition provided by Hofstede (2011) are the baseline for the definition and understanding of culture in this research. Hofstede (2011) defines culture as "the collective programming of the mind that distinguishes the members of one group or category of people from others". More specifically in this research, "a group" as stated within the definition is identified as a nation, which in this case, Japan.

Inkeles and Levinson (2008) investigates national character in terms of modal personality. The study of national character is simply defined in Benedict (1946) as the study of learned cultural behaviour. Inkeles (1951) further identifies this relation of culture to character as relation of culture to itself. It is accepted that basic personality must be common in the society and the modal personality can reflect the national character based on the distribution of personality variations in the respective society (Inkeles and Levinson, 2008). With this, Hofstede (2008) focuses on national character when developing the initial dimensions identifying a national culture excluding cultural differences that exists within a nation.

The first four dimensions proposed by Hofstede was a result of "developing a commonly, acceptable, well-defined, and empirically based terminology to describe cultures" (Hofstede, 2008). These dimensions proposed can be measured using systematically collected data with theoretical reasoning and multivariate statistics (i.e. factor analysis). A fifth dimension was added by Minkov (2007) through the analysis of the World Values Survey along with a six dimension through the research by Hofstede et al. (2010). While these dimensions are particularly utilised in management sciences, they reflect a

definition of the national culture which reveals important aspects in sociological values. Six dimensions, as presented in Hofstede (2011), are

1. Power distance: the presence of inequality and reaction to inequality
2. Uncertainty avoidance: the reaction to uncertain or unexpected occurrences
3. Individualism versus collectivism: the measure of integration into a group at societal level
4. Masculinity versus femininity: the extent of distribution of values between genders
5. Long term versus short term orientation: the value of importance for short (past and present) versus long (future) term decisions or occurrences
6. Indulgence versus restraint: the amount of control or limitation on personal happiness by society

In more detail, these dimensions are defined by definitive values to describe to which extent a nation stands in respective dimension. In case of power distance, nations with smaller power distance tend to expect the use of power to be legitimate with a clear distinction of moral values (i.e. good and evil). In other words, this dimension reflects the relation of less powered individuals with high powered individuals or authorities.

For uncertainty avoidance, lower uncertainty avoidance means higher tolerance to uncertain events and higher uncertainty avoidance means lower tolerance which relates to knowing what to expect. As an example, this dimension can be reflected in decision making process for planning a journey as researched by Money and Crotts (2003) and Litvin et al. (2004).

In individualism versus collectivism, consequences are reflected on an individual or individual's immediate family (individualism) or on the group of people such as the society, extended family, or an organisation (collectivism). In this dimension, decision making or preferences can be assumed to be made as a group or as an individual.

Masculinity versus femininity is a comprehensive dimension to understand as it defines more than just gender equality. In more feminine nations, the distinction between genders are minimised and more emotional values are revealed such as sympathy for weak, balance between work and family, and an overall modest and caring approach by all genders (Hofstede, 2011). On the other hand, traditionally, masculine nations tend to be

more rational (i.e. admiration for strong, and more of an ambitious approach) with defined roles for all genders such as boys don't cry and girls don't fight or fathers deal with facts and mothers with emotions (Hofstede, 2011). This dimension, in some ways, reflects how competitive, perfectionist, or achievement oriented the people are.

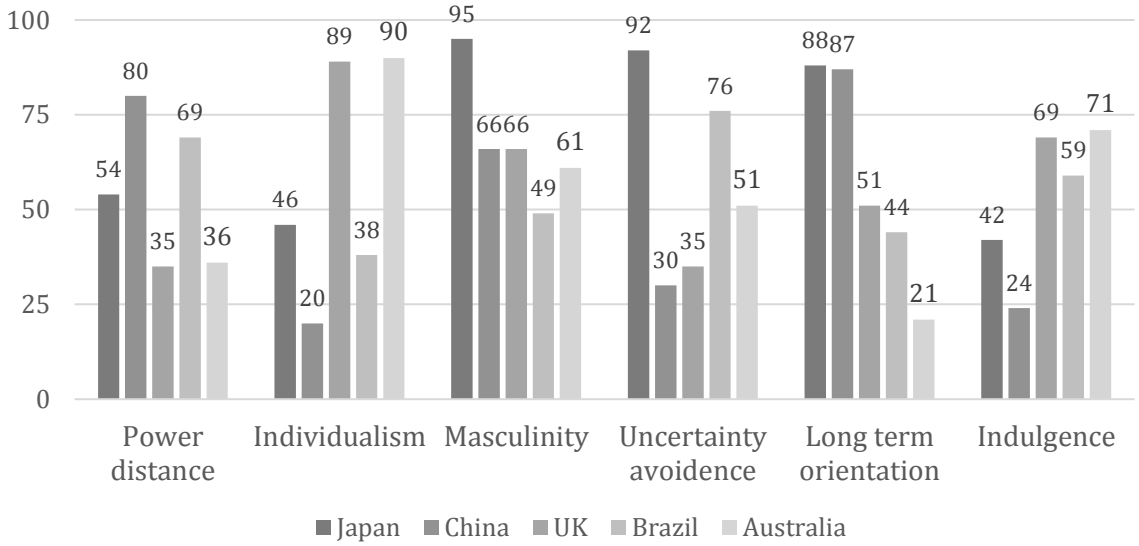
In case of long term versus short orientation, the importance of past and present relative to future is the main distinction. Furthermore, it indicates how adaptable the people are in terms of improving circumstances by changing traditions or learning from other countries. Cultures with short term orientation are likely to focus on what has happened and what is happening with a lower tendency to save for future or change their circumstances. Long term oriented nations are adaptable to changes with long term goals. As an example, this dimension reflects on the economic growth of countries where nations with long term orientation tend to show a faster economic growth while short term oriented nations show a slower trend in economic growth (Hofstede, 2011).

The last dimension, indulgence versus restraints, defines to what extend the individual emotions and feeling are constrained. Individuals in a nation with higher indulgence can be defined to have more freedom over their life in terms making decision without judgemental views of others. On the contrary, individuals in a restrained culture have less freedom due to the society's constraints. The result of this dimensions can be reflected in many ways such as having more police enforcement officers in a restraint nation or higher importance of freedom of speech in indulgence nations (Hofstede, 2011).

Reflection of these dimensions on Japan is presented in Hofstede Insights (2018) based on the findings in Hofstede et al. (2010). In **Figure 2.3**, scoring for different dimensions are shown for Japan with comparison to China, the United Kingdom, Brazil, and Australia for a clear representation of the standing of Japan among other nations.

In a brief summary, power distance score for Japan is intermediate compared to other countries. While there is a hierarchical system in place both at individual and at organisational level, a strong concept of equality is taught through the Japanese education system (Hofstede Insights, 2018). As seen, power distance score of Japan (54) is between China (a high power distance) and UK (low power distance). In the case of individualism, Japan is scored 46, again a median between the west (89) and the east (20). In this case, Japan is elaborated as a collectivist nation in terms of Western standards, and an

individualist nation in terms of Asian standards as presented in the graph when compared to China and the UK.



Data: Hofstede Insights (2018)

Figure 2.3. *Scores of Japan, China, UK, Brazil, and Australia based on Hofstede model*

On the other hand, for masculinity, Japan has the highest score of 95 within the comparison followed by China and Brazil with a score of 66. This means that people are achievement oriented with reference to excellence in their tasks with high competition compared to the west. However, within the collectivist understanding, the competitive environment is not as obvious (Hofstede Insights, 2018). As in masculinity, for uncertainty avoidance, Japan has the highest score of 92 with Brazil having the closest score of 76 when compared to other countries in the data. This reflects in the daily life such that every action has an unspoken rule where everyone knows what to expect as a result. In addition, organisation and planning are important as Money and Crotts (2003) found, in terms of travel behaviour, for a specific case that Japanese travellers have high uncertainty avoidance compared to German travellers. Litvin et al. (2004) extended the respective research and confirmed the findings, stating that culture has an important role in vacation planning of travellers and has an effect on travel patterns. In relation to uncertainty avoidance, for long-term orientation, Japan and China have the highest two scores (respectively 88 and 87) compared to UK, Brazil, and Australia (respectively 51, 44, and 21). It is reflected in Hofstede Insights (2018) that Japanese people consider their life as a short moment in all history of humankind and they strive to do the best they can do within that time. Overall, Japan, in particular, appears to be characterised by a strong

masculine identity, avoidance of uncertainty, and long-term orientation with the highest scores in the sample. This suggests a general assumption for rational and risk adverse approach to decision making, which may have impacts in terms of travel preference of Japanese passengers. In terms of indulgence, Japan has a relatively more restraining society with a score of 42, suggesting that people do not state their opinions freely when compared to the UK, Brazil and Australia with scores of 69, 59 and 71 respectively. However, in Eastern world standards considering China, Japan scores higher than China, which has a score of 29.

Considering the potential impact of national culture with different dimensions on perceived quality, preferences and expectations, Gilbert and Wong (2003) and Kim and Prideaux (2003) have investigated different characteristics and traits of different cultures in two different cases involving tourism and travel. Looking at Chinese, North American, Japanese, and Western European nationalities, Gilbert and Wong (2003) presented the passenger expectations in terms of airline service travelling through Hong Kong. Similarly, Kim and Prideaux (2003) included, American, Australian, Japanese, and Chinese travellers in terms of tourism activity in South Korea. In both research, the findings highlight the different level of expectations and preferences for services and activities based on nationality. In terms of air travel, relatively higher expectation of Japanese passengers for services and products provided by airlines when compared to other passengers with different nationalities is presented.

2.5. Summary

The literature review presents the sensitivity and volatility of the air transport, more specifically the airline industry. The importance of passenger comfort and satisfaction to achieve airlines' main goal, improved profitability, is examined. Through the review of past and present knowledge, the impact of passenger-oriented decision making and the analysis of the factors involving passengers' preferences is found to be crucial for the future of airline industry with the growing market and competition.

The passenger comfort and satisfaction are found to be vague and difficult terms to distinguish and define. However, the understanding of the concepts are clearly present. While, these terms depend on different variables, such as internal and external factors from passenger and service provider perspectives, the correlation between these terms are

revealed. From the passenger perspective, passenger characteristics such as demographical, economic, physical, cultural, and previous experience are among the factors affecting passenger satisfaction and comfort, while from the service provider perspective, quality of service provided in terms of physical attributes, operational efficiency, and service quality are among the factors affecting passenger satisfaction and comfort. In addition, factors from both perspectives and expectation of passengers should be balanced based on the price the service provided for which also relates to the difference between LCC and FSC services.

Considering the inflight experience of passengers, related advancements in cabin technology for services and products are also presented with a thorough study. Possible impact and improvement strategies for passenger experience with different cabin technologies are explored. Finally, to understand and apply the knowledge to geography specific focus, Japan is investigated to create a baseline in terms of demographical, economic, as well as the market dynamics in general and air transport industry.

Related to passenger comfort and satisfaction, important attributes and factors for airlines within the changing passenger requirements and expectations are investigated. The literature provides different aspects in services and products that are provided by the air transport industry. In terms of inflight experience and cabin attributes, different strategies and approaches implemented by airlines are investigated with resources from both the industry and the academia. Emerging technologies in cabin context are also presented with a reflective purpose into the future on what to expect.

For the quantitative analysis, there are various studies and research presented in discrete choice models (DCMs) with the application in air transport. These studies are categorised in two main topics for attributes; choice models in airport preference and choice models in airline preference. While airport preference studies include the estimation of passenger preference in multi-airport region (MARs) and airport demand, airline preference studies include airline demand and passenger preference for different services and products provided by the airlines. In airport preferences, the top attribute included is access time which is the time it takes for passengers to get to the airport by ground access. In addition, flight frequency, and price are also included in most studies. In airline preferences, booking class, fare, and flight frequency are among the most included attributes for

estimation of demand and airline preference. In addition, there are literature on airline preference through discrete choice model including distinct cabin features and attributes applied. Through the literature, DCMs are shown to be viable in assessing choice probabilities and estimating willingness to pay.

Lastly, the culture-specific understanding of passenger trends and preferences are explored. Cultural aspects are defined in terms nationality. Hofstede model for national culture is researched on why and how it can apply in characterising different passenger perception or experience for cabin features and services. Six dimensions are analysed for four different country. The distinction among different nations are presented with different characteristics and scores on defined dimensions.

Overall, the air transport is an important aspect of the daily life has become a commodity more than a luxury. However, the air transport industry is extremely competitive, limiting new competition and differentiation, and challenging profitability. As it is difficult to make money in the airline industry, improving passenger satisfaction through improving comfort and providing passenger-oriented inflight cabin services and products can help boost the profitability. This can be achieved through additional revenue from well-targeted ancillary services and products in addition to increased brand image and loyalty with improved comfort and quality of service. Therefore, it is important to reveal the key factors and preferences of passengers in terms of inflight cabin experiences. The literature gives a definition and understanding of comfort and satisfaction for customers where in this case applied to airline passengers. In addition to the understanding of comfort and satisfaction, discrete choice models that are applied and studied in the literature suggests the appropriate use of the methodology in estimating demand for airline passenger preferences and behaviour for inflight cabin experience.

In addition to the focus on the inflight cabin experience of passengers, the literature review presents the importance and the potential impact of national culture in terms of passenger preferences and experience perceived. Through the review, Japan, in particular, shows distinct traits in terms of defined dimensions in Hofstede's model in addition to the literature presenting the different characteristics and preferences of various national cultures. As there is lack of research looking into a culture-specific aspect in the context of discrete choice models for inflight experiences and preferences, it is motivating both

in terms social and commercial values to focus on Japanese passengers in this research to investigate culture-specific passenger preferences, as Japan being a major air transport market in the region with distinct national culture traits.

While there are literature on discrete choice model studies in airline preference with included cabin features, this study aims to add to the body of knowledge and understanding the use of discrete choice model for a specific region and a national culture to understand and reveal cabin preferences of passengers to assist a more passenger friendly cabin design. With the methodology using multinomial logit (MNL) and mixed logit (ML) models, this research integrates and applies the knowledge to Japan. More specifically, the idea of achieving passenger friendly cabin design with culture specific factors is explored with a discrete choice model through passenger preferences. The current literature, in general, aims to estimate demand for airline preferences, and there are no literature where a culture specific passenger behaviour is investigated to reveal passenger preferences in cabin features and attributes for an improved cabin design. While there are no similar study, the included literature in various parts proves to be constructive and presents a baseline for the research. In order to understand and rightly reflect the passengers' expectations on aircraft cabin interior and service, a comprehensive survey study is required using discrete choice models.

With the presented knowledge in the literature review through different sections, the introduction of Japan and relative air transport market in the region is explored in the next chapter.

CHAPTER 3 - AIR TRANSPORT MARKET IN JAPAN

In this chapter, the air transport industry of Japan is presented with the country-specific briefing. Through the chapter, domestic and regional market corresponding to Japan are explored.

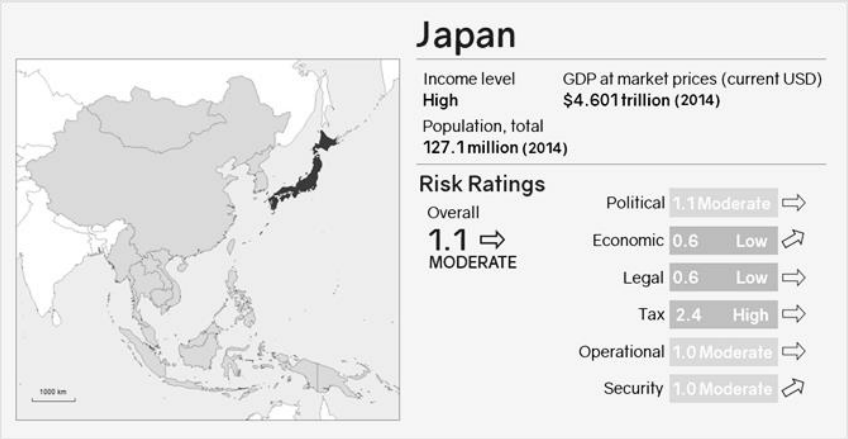
Japan, as the main geographic focus of this research, is explored in several aspects. As it is important to understand the region, country and the overall air transport situation, Section 3.1 includes a descriptive overview of key demographic, soci-economic, and the air transport in Japan in terms of infrastructure and geography.

In Section 3.2, domestic air transport market is analyzed including passenger traffic and challenges for air transport. Similarly, in Section 3.3, the regional market and the impact of international routes in terms of connectivity are explored in terms of traffic capacity of airlines. Lastly, in Section 3.4, airlines in Japan are analyzed in more detail with a focus on two major carriers in Japan dominating the air travel market share.

Through the presentation of the air transport market, future potential of air transport in Japan and in the relative region is explained providing a basis for the research.

3.1. Overview of Japan

Japan is an island nation in the Northeast Asia neighboring with Russia, Korean peninsula, and China. Japan has a relatively large population ranking 11th in the world. Despite suffering from an aging population, Japan is currently very stable in terms of politics and has a positive economic outlook for the next 5 years from 2016, ranking third in the world in nominal GDP in 2015. Japan is assigned a risk score of 1.1/10 from IHS Connect (2016), which means the country is relatively stable and safer for investors (**Figure 3.1**). Risk score definition is explained in Appendix A.

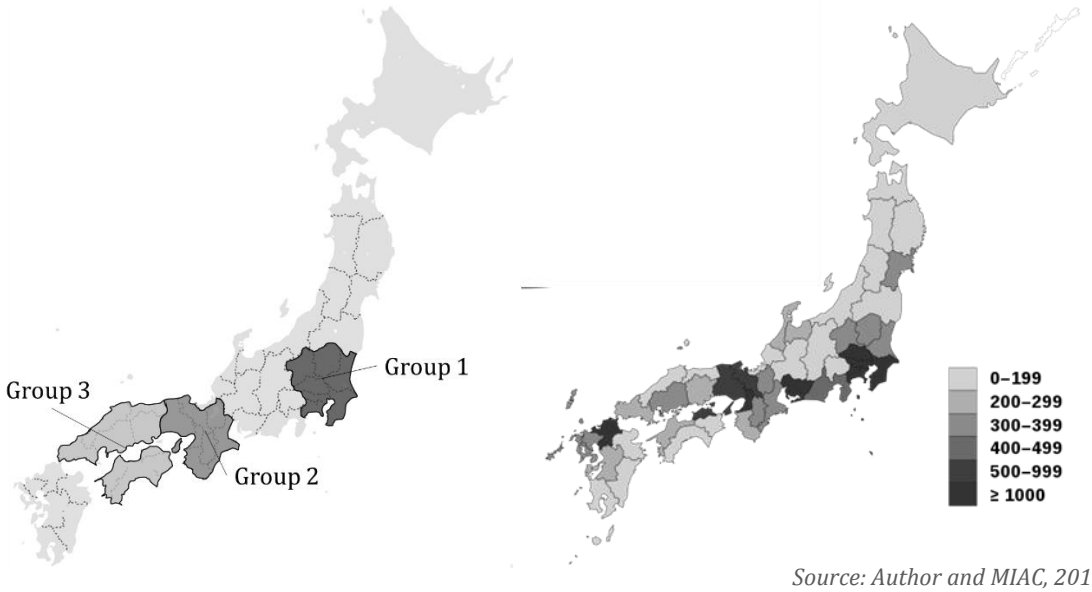


Source: IHS Connect (2016)

Figure 3.1. *Risk level of Japan as of 2016*

3.1.1. Demographics

Japan has 47 prefectures that are segmented for the purpose of this research in four main groups demographically and geographically; (1) Tokyo area (Tokyo Metropolitan area, Ibaragi, Chiba, Gunma, Saitama, Tochigi and Kanagawa), (2) Kansai area (Osaka, Kyoto, Hyogo, Nara, Wakayama, Mie, and Shiga), (3) Sub-Kansai area (Tottori, Shimane, Okayama, Hiroshima, Yamaguchi, Kagawa, Ehime, Tokushima and Kochi), and (4) others (**Figure 3.2**).



Source: Author and MIAC, 2018

Figure 3.2. *Prefectures grouped in the study (Group 1, 2, and 3 are labelled, Group 4 is the rest) (left) and the population density among prefectures per km^2 (right)*

Japan has the 10th largest population in the world with 127 million in 2015 (**Figure 3.3**). In the future forecast published by United Nations (2015) the population shows a negative

trend for next 80 years (**Figure 3.4**). Population data shows an aging population with the majority of the population over 45 years old. The population is expected to be less than 50 million by 2110, if the current reduction rate continues, according to the Statistics Bureau of Japan, Ministry of Internal Affairs and Communications in Japan (SBJ, 2016). This problem contributes to a stagnating economy and increased health costs for the government. The priority is set by the government to boost the birth rate from 1.4 children per woman to 1.8 (BBC, 2016).

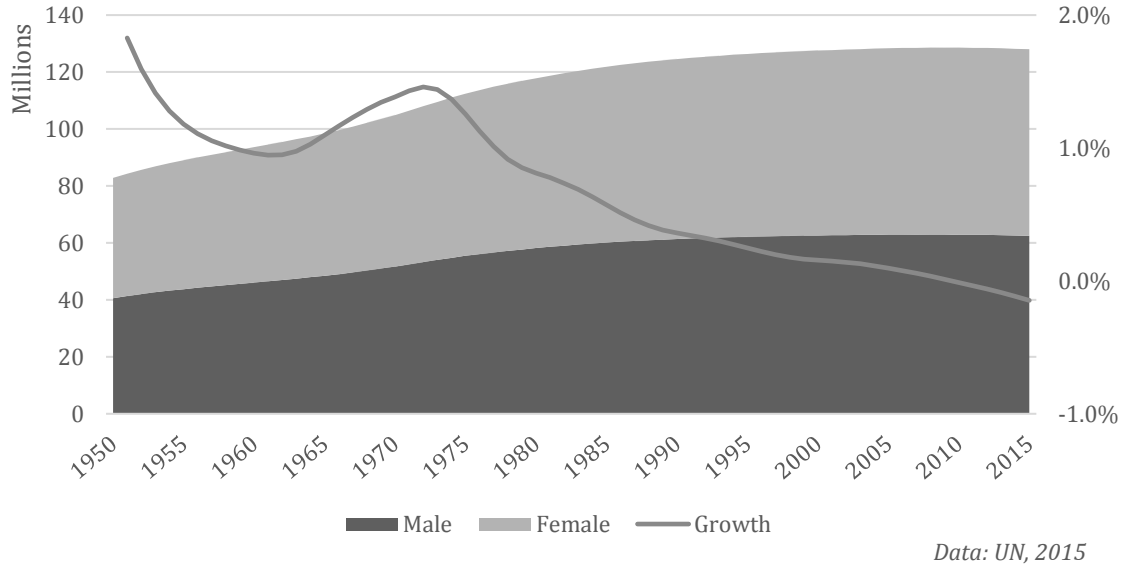


Figure 3.3. *Population and population growth rate of Japan between 1950 and 2015*

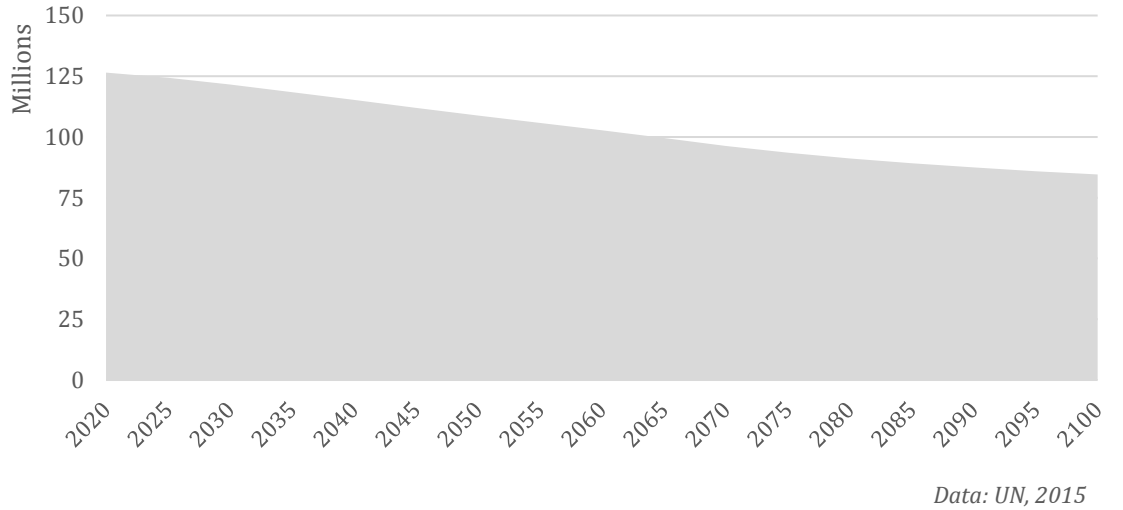


Figure 3.4. *Projected population in Japan*

As of 2015, forty percent of the population is older than 50 years old while 22% is younger than 25 years old and 33% is aged between 25 and 50 years old (**Figure 3.5**). The falling

birth rate and the aging population have been serious issues. The impact of these changes, especially the negative effects of the lost decade syndrome, seems to largely affect Group 4 of the prefectures as defined. Generally, the population of those between 15 and 24 years old, who were born during 'the lost decade'[3] is extremely small. Although, later, a population increase in Group 4 is observed from 2006 to 2011, this is explained as simply because of the large increase in the Okinawa and Fukuoka prefectures (SBJ, 2016). In fact, other areas in Group 4 have experienced significant population decreases. However, in Group 2 and 3 (Kansai and Sub-Kansai areas), a significant change cannot be observed as in other groups.

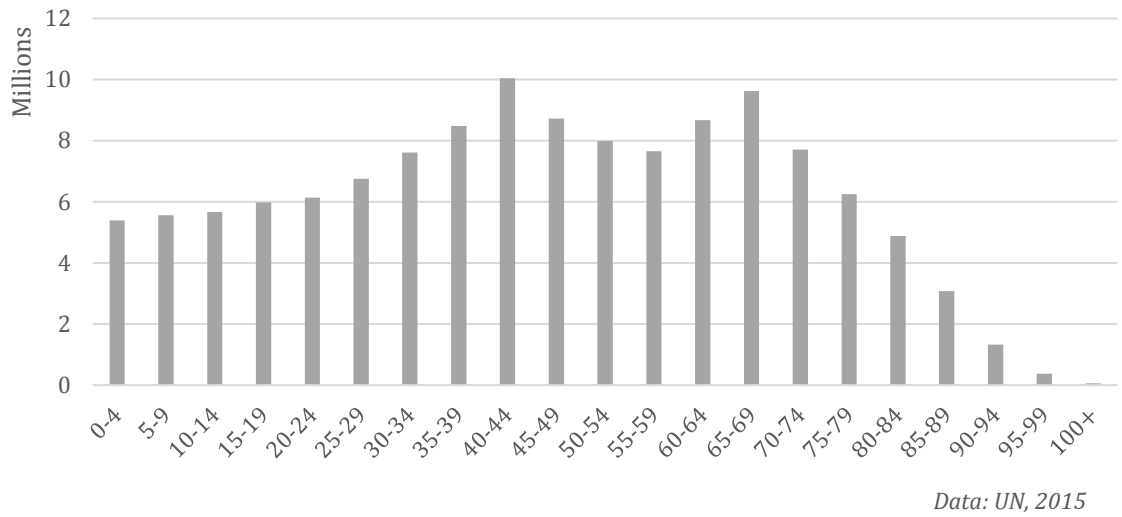


Figure 3.5. *Age distribution of the Japanese population*

Even though there is a decline in population of Japan, it is observed that the non-Japanese population is increasing through travel and immigration (SBJ, 2016). Approximately more than 72% of non-Japanese entries to the country were from Asian countries, such as Korea (27%), Mainland China (19%), and Taiwan (14.6%) (SBJ, 2016). These figures are likely to change drastically due to the government's policy change and its implementation for immigration (Deguchi, 2018). For instance, the non-Japanese travellers and workers will increase as a result of the 'Open Sky' policy and the deregulation of the immigrant working visa.

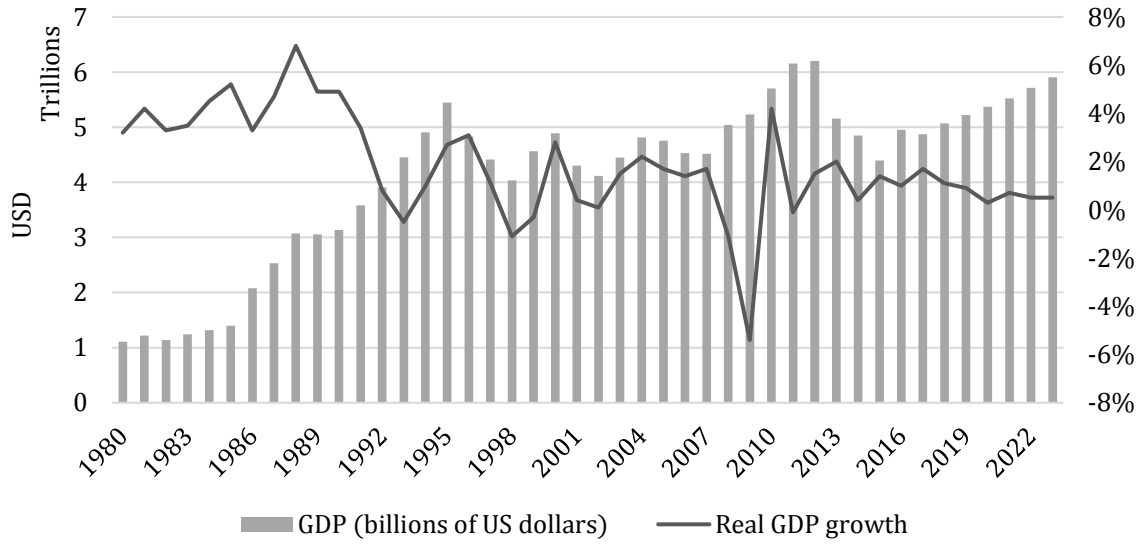
While the population is aging, it is very educated with a large middle-class portion with an income inequality score of 0.34 where 0 is complete equality and 1 complete inequality

[3] Term referring to the period that is after the Japanese bubble economy collapse in late 1991 which lasted until 2001.

based on the Gini coefficient (OECD, 2016). The secondary level education enrolment percentage was average of 97.5% between the years of 2003 and 2016 (The World Bank, 2018). In addition, Japan has the second largest higher education system in the developed world and an improving graduate education system (Ellington, 2005).

3.1.2. Economy

The Japanese economy has ranked third in terms of nominal GDP in 2018 (IMF, 2018a) with $5,167.05 billion after China with $14,092.51 billion. This equates to 5.9% share in the world's GDP. Although the nominal GDP per capita in Japan has recorded growth, any significant change cannot be observed in the real domestic GDP by region in Japan (OECD, 2016). Tokyo area (Group 1) is accounted for 37 % of the real prefecture GDP change. Kansai area (Group 2) contributed with 17%, Sub-Kansai (Group 3) with 8%, others (Group 4) with 37%. This situation has been stable for the past ten years. **Figure 3.6** presents the GDP and the real GDP growth in Japan from 1980 to 2018 with forecasts in to 2023.



Data: IMF (2018a) and World Bank (2018)

Figure 3.6. *GDP of Japan and the relative real GDP growth in percentage*

The income per capita in Japan was JPY 275,400 in 2011, an eight percent increase compared to the previous year. Regarding the evolution of the income per capita by region, reduction in the value of year 2000 to 2011 is observed. However, the reduction ratios in the Kansai and Sub Kansai regions (Groups 2 and 3) were less than the national average.

The consumer trend by region can be assessed by the value of a household's consumer expenditure divided by the household's disposable income. The result of the Kansai region (Group 2) is much higher than the outcome of the Tokyo region (Group 1). When only transportation expenditures are evaluated, the national average becomes higher than the averages of Groups 1 and 2 (Tokyo and Kansai). This fact could indicate that the accessibility in the local areas, such as in Groups 3 and 4 (Sub-Kansai and Others), are not as good as it is in the large city regions, like Tokyo and Kansai, in terms of transportation costs (Mäkinen et al., 2017).

3.1.3. Air transport in Japan

Geographically, Japan is located in a fast growing and competitive air transport environment in Northeast Asia. Within the region, Japan has a sustained a strong presence in the regional and international air transport market while domestic routes are in high competition with high speed rail line network (Shinkansen). The catchment area from Tokyo, as illustrated in **Figure 3.7** with different ranges for various flight hours, spans across Northeast Asia to Southeast and Central Asia. As seen, major destinations in Northeast Asia are within four hour flight time while destinations in Southeast Asia are within seven hours flight time. In a more global context, the geographic location enables Japan to be a connection hub between Asia and Americas along with major competitors China and Republic of Korea (South Korea).

Japan has two major FSC carriers; Japan Airlines (JAL) and All Nippon Airways (ANA) serving domestic, regional, and international routes. In addition, there is a growing number of LCCs in operation even though most of them owned by the major carriers JAL and ANA. List of airlines has operated in 2018 years are presented in **Figure 3.8** according to their total (international and domestic) ASK values. As seen, 82% of the market share is dominated by JAL and ANA as of 2018.

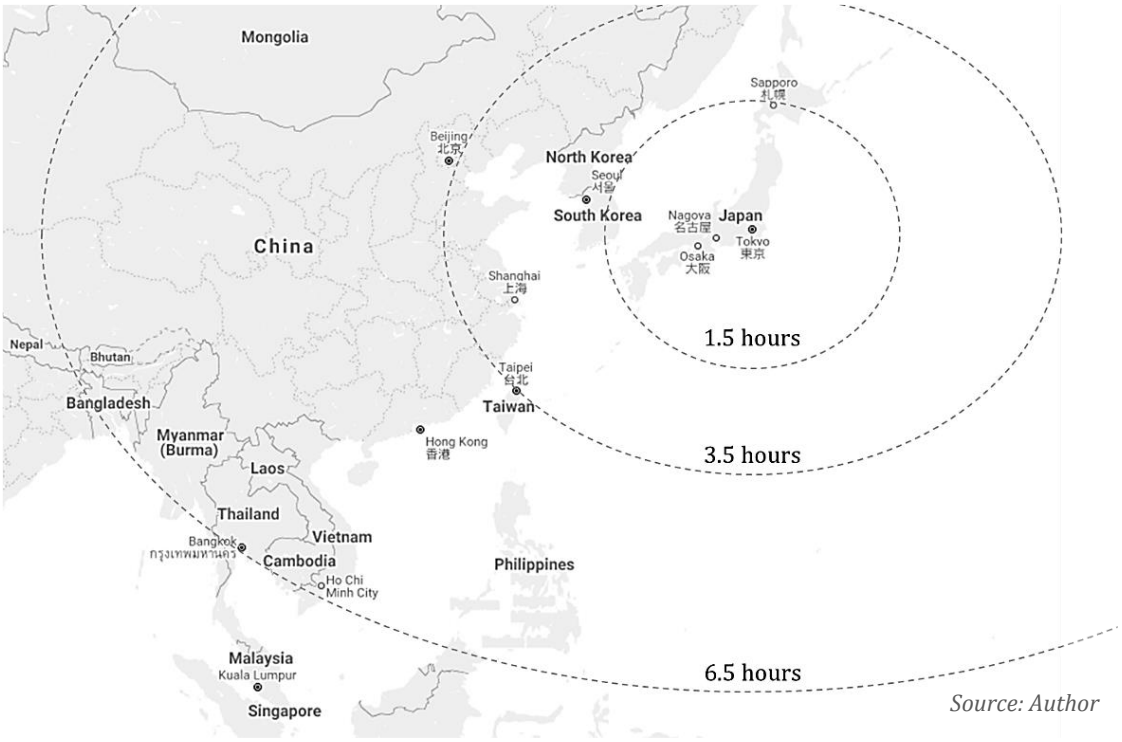
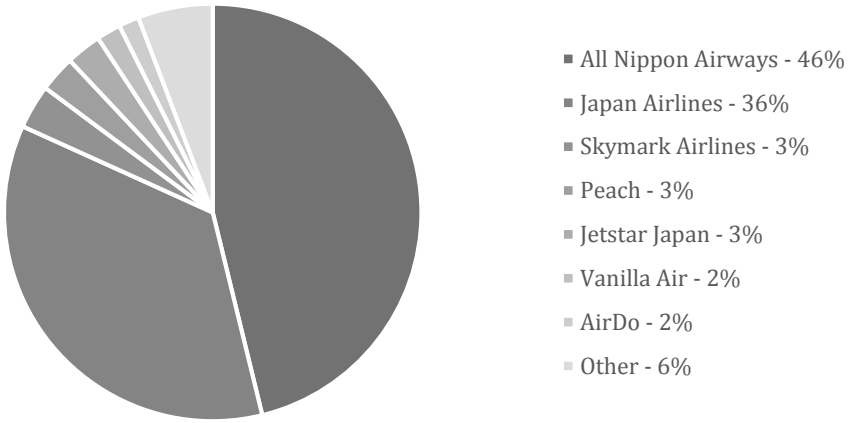


Figure 3.7. *Map showing routes within 1.5, 3.5, and 6.5 flight hours of Tokyo*



Data: OAG (2018)

Figure 3.8. *Distribution of total market share among Japanese airlines based on ASK*

While this is the case, **Figure 3.9** shows the growing infiltration of LCCs into the market in terms of ASKs over time with an average of 35% growth per year while there is only two percent growth for the FSCs. This can be interpreted as most of the growing passenger traffic is handled by LCCs decreasing the overall share of FSCs in Japan by almost 12% over the presented time (2010-2018).

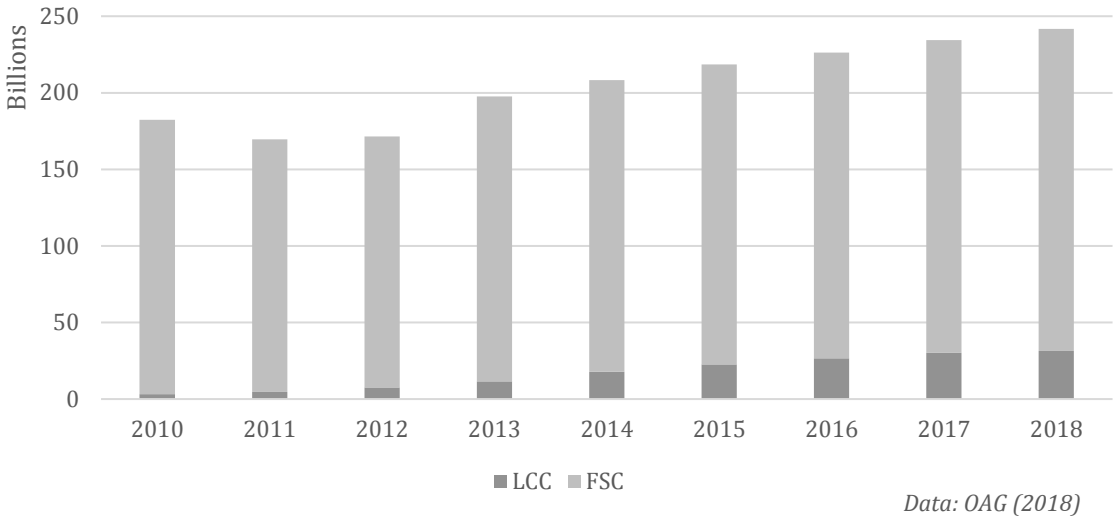


Figure 3.9. *Change of total ASKs of LCCs and FSCs between 2010 and 2018*

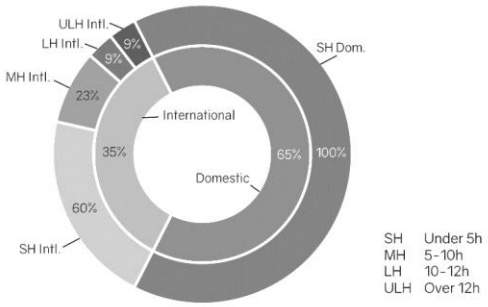
In terms of air travel infrastructure, there are total of 97 commercial/public airports in variety of sizes. **Table 3.1** shows different airports with different purposes and administration in Japan (MLIT, 2009). Overall, Japan proves to have a highly regulated market with limited flexibility (Miyoshi, 2015). Even though, the deregulation of air transport in Japan has started in 1980s and an almost complete deregulation was achieved by 2000, all of the airports in service are owned by the national and local governments. In addition, almost all of them are financed and operated by the national and local governments with the exception of four. In **Table 3.2**, the top 20 airports operating in Japan in terms of passenger numbers are presented based on the data provided by Airports Council International (ACI, 2018). It is noted that all of the airports listed in the table observed considerable growth compared to the previous year.

Table 3.1. *Number of different category airlines in Japan and respective administration and purpose*

Airport category	Administration	Main purpose	In service
Class 1	MLIT Narita International Airport Co. Kansai International Airport Co. Central Japan International Airport Co.	Major international and domestic	5
Class 2 (A)	MLIT	Major domestic	19
Class 2 (B)	Local governments	Major domestic	5
Class 3	Local governments	Local domestic	53
Others	Joint-use (military and civil) Local governments	-	15

Data retrieved from Ministry of Land, Infrastructure, Transport and Tourism (MLIT, 2009)

There are two nodes of air transport in Japan; domestic and international. The domestic network in Japan is well-developed and comprised of all short-haul (SH Dom.) flights while it is in competition with Shinkansen as mentioned. Also, the international network is very comprehensive and Japan includes some of the most important and busiest airport hubs in the world. The international flights from Japan are 60% short-haul (SH Intl.), 23% percent medium-haul (MH Intl.), 9% long-haul (LH Intl.), and 9% ultra-long-haul (UHL Intl.) while all domestic flights are short-haul flights (**Figure 3.10**). Overall, 86% of all flights are short-haul.



Data: OAG (2018)

Figure 3.10. *Japanese traffic network segmented by seat share in 2016*

Table 3.2. *Top 20 airports in Japan in terms of passenger numbers in 2016 and 2017*

Airport Name	IATA Code	Passengers		% change
		2016	2017	
Tokyo International (Haneda) Airport	HND	80,223,775	85,408,975	6%
Narita International Airport	NRT	38,995,784	40,631,193	4%
Kansai International Airport	KIX	25,236,705	27,985,516	11%
Fukuoka Airport	FUK	21,901,591	23,796,849	9%
New Chitose Airport	CTS	21,312,287	22,717,980	7%
Kalaeloa Airport	OKA	19,671,854	20,973,087	7%
Osaka-Itami International Airport	ITM	14,923,678	15,597,777	5%
Central Japan International Airport	NGO	10,858,617	11,445,672	5%
Kagoshima Airport	KOJ	5,372,961	5,618,140	5%
Sendai Airport	SDJ	3,110,363	3,370,450	8%
Kumamoto Airport	KMJ	2,986,686	3,303,242	11%
Miyazaki Airport	KMI	3,074,788	3,170,368	3%
Nagasaki Airport	NGS	2,967,421	3,165,385	7%
Kobe Airport	UKB	2,696,167	3,109,042	15%
Matsuyama Airport	MYJ	2,894,786	3,028,693	5%
Hiroshima Airport	HIJ	2,851,514	2,975,119	4%
Ishigaki Airport	ISG	2,421,529	2,505,886	3%
Takamatsu Airport	TAK	1,844,518	1,992,951	8%
Oita Airport	OIT	1,812,639	1,900,229	5%
Hakodate Airport	HKD	1,744,680	1,791,083	3%

Data retrieved from ACI (2018)

While the mature air transport market Japan helps with a sustainable growth, even though a mediocre growth, over time, the market faces several distinct constraints as described by Miyoshi (2015); (1) a highly regulated air transport, (2) dominance of JAL and ANA in the market, (3) well-developed high-speed rail network, (4) weak LCCs, (5) high costs

for airlines, (6) public ownership and management of airports. These constraints can be further investigated in terms of domestic and international market below.

3.2. Domestic air transport market

Domestic air travel market of Japan is very limited for airlines in terms geography. Similar to the overall market, the domestic market is dominated by two major carriers; JAL and ANA (**Figure 3.11**). In addition to an almost 70% of the domestic market share in Japan, these two major carriers of Japan, JAL and ANA, fully or partly owns most of the LCCs and other regional airlines in Japan (Flightglobal, 2018). Furthermore, the Japanese government has been in support for JAL and ANA which eases the competition in the domestic market (Miyoshi, 2015).

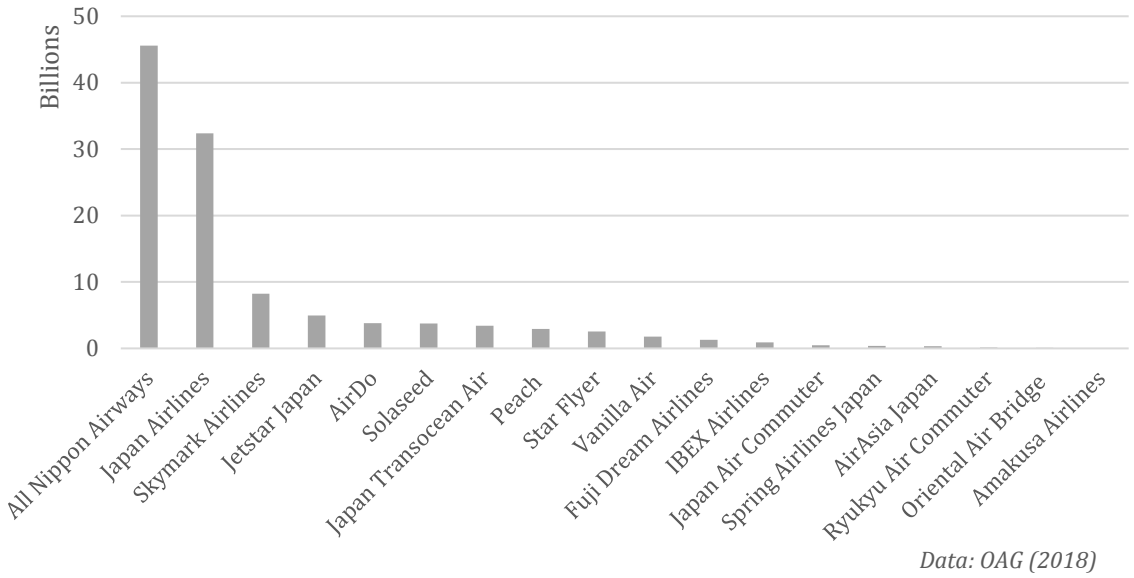
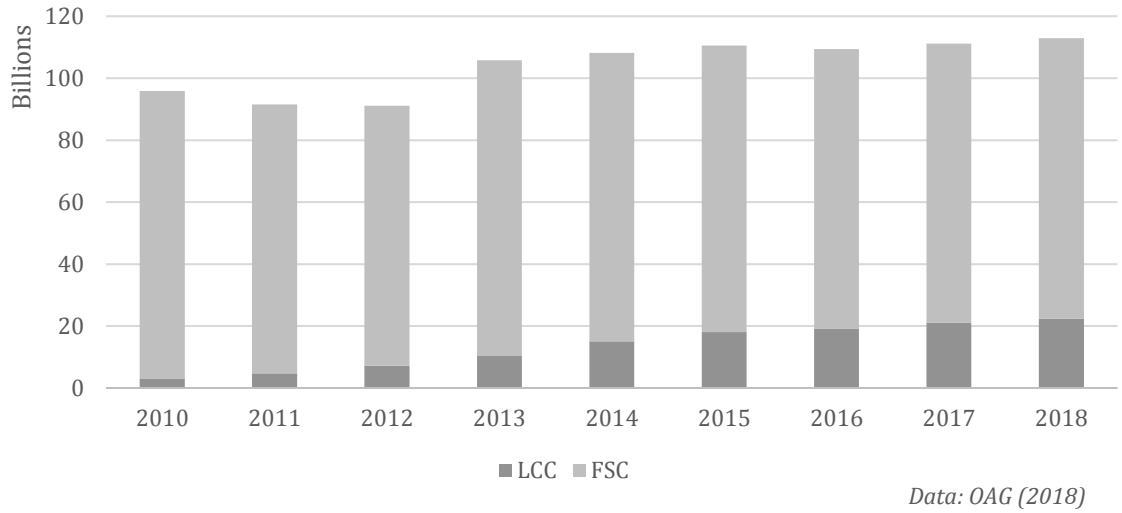


Figure 3.11. *ASKs of Japanese airlines on domestic routes in Japan for 2018*

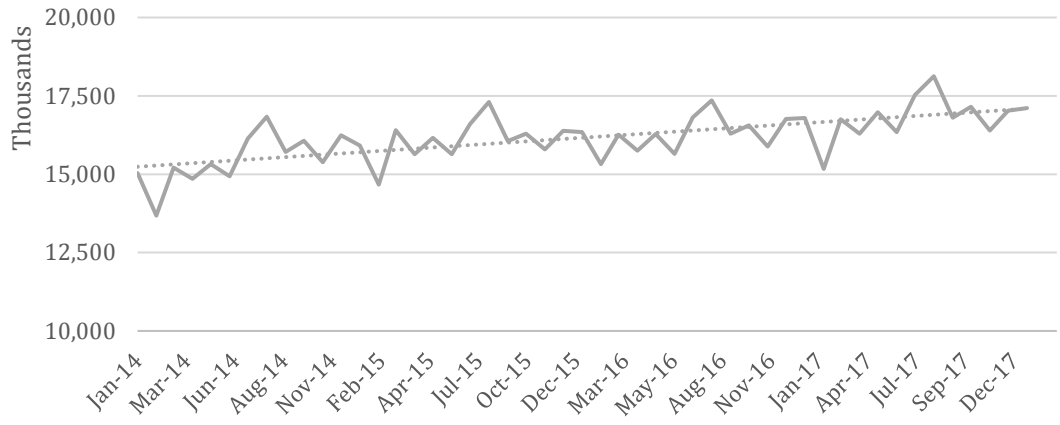
In line with the overall market growth, LCCs present an average of 30% growth per year between 2010 and 2018 while FSCs doesn't provide a substantial growth, if any (**Figure 3.12**). Relatively, as operating airlines, this decreased the domestic market share of FSCs by almost 17% between 2010 and 2018.



Data: OAG (2018)

Figure 3.12. *Change of ASKs of LCCs and FSCs on domestic routes between 2010 and 2018*

The Japanese air travel has been growing steadily in terms of seats offered since 2014. Despite of being progressively reduced over time, **Figure 3.13** clearly shows the seasonality in the Japanese air travel. August is the peak month due to the summer holiday (mainly mid-August) in addition to a traffic increase between April 27th and May 5th which is called 'Golden Week' in Japan.

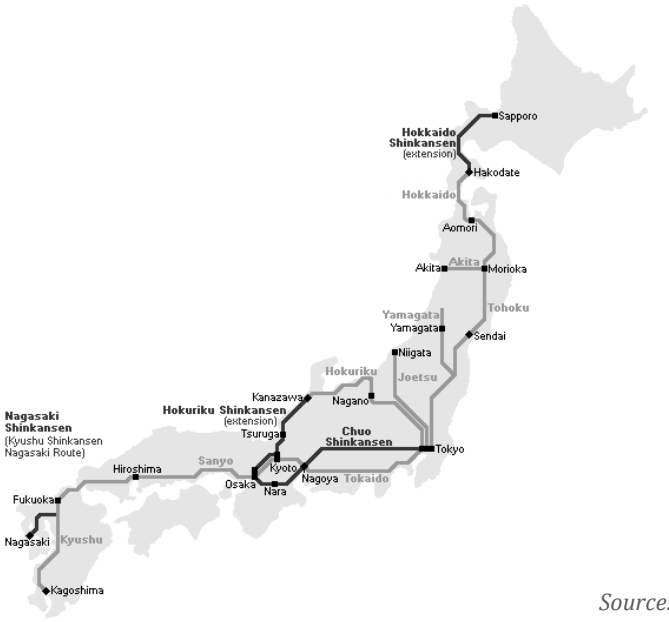


Data: OAG (2018)

Figure 3.13. *Seasonality shown with ASK volume in the Japanese air travel in 2016*

In any case, the airline industry faces a very strong competitor as an alternative method of travel. Shinkansen, a well-developed high-speed rail network as presented in **Figure 3.14**, in Japan provides a relatively convenient travel for passengers for distances which can be considered a short-haul flight in air transport (up to 1,200km). The range of the competition between air travel and rail travel is much wider in Japan compared to other countries with a similar situation as Shinkansen's distance and accessibility in Japan is

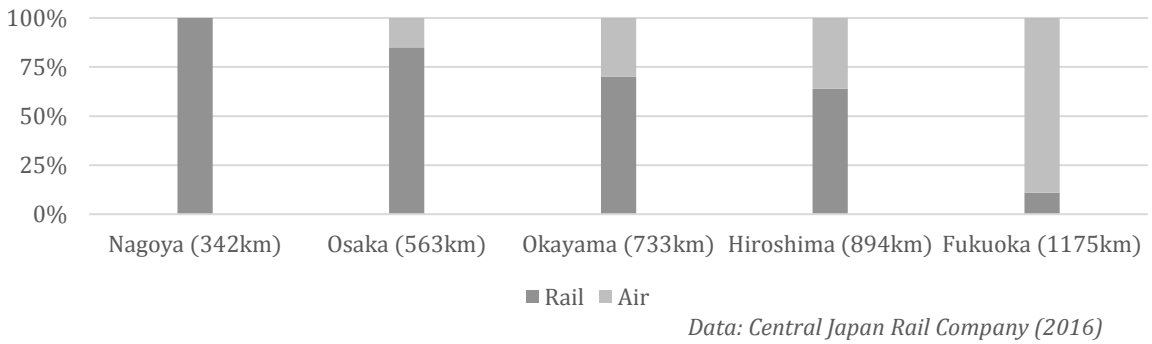
highly developed with a total length of 2,388km. Hokkaido Shinkansen started its operation in March 2016 which enables Hakodate link to Tokyo in four hours while offering competitive fares to LCC's. The Osaka - Kumamoto and Osaka- Kagoshima routes are expected to be the next competition stage (Mäkinen et al., 2017).



Source: Japan-guide (2018)

Figure 3.14. *Map of Shinkansen in Japan (planned developments in dark)*

The trade-off between air travel and rail travel is clearly reflected **Figure 3.15** for departures from Tokyo. As of 2016, according to Central Japan Rail Company (2016), the total share of air travel increases as distance travel is increased for journeys from Tokyo to Nagoya, Osaka, Okayama, Hiroshima, and Fukuoka. In addition, in **Table 3.3**, details of five destinations from Tokyo are presented with respective fare prices as of 2016.



Data: Central Japan Rail Company (2016)

Figure 3.15. *Market share of air travel and rail travel on different destinations from Tokyo*

Table 3.3. *Comparison of air and rail travel for destinations from Tokyo in 2016*

	Osaka	Okayama	Hiroshima	Hakodate	Fukuoka
Distance (km)	563	733	894	843	1175
Time (Shinkansen)	2h 25min	3h20min	3h47min	4h	4h50min
Time (Flight)	1h05min	1h10 min	1h15min	1h20min	1h30min
Time (Flight & estimated access)	2h40min	3h	3h20min	2h10min	2h40min
Average Fare* (Shinkansen)	$122.09	$146.11	$161.71	$203.39	$195.41
Average Fare* (Flight)	$181.96	$324.49	$331.66	$280.52	$328.48
Frequency (per day) (Shinkansen)	250	128	99	11	67
Frequency (per day) (Flight)	106	24	34	8	122

**Exchange rate (average of the last five years) of $1=JP¥111.56 is used (IMF, 2018b)*
Note. Data retrieved from Central Japan Rail Company (2016)

Table 3.4 presents the top ten route pairs in terms of ASK value on domestic traffic in Japan. Tokyo Haneda International Airport (HND) is observed as a key hub in the domestic route structure of Japan with top seven route pairs. Based on the data, majority of traffic in the domestic market is dominated by Tokyo area possibly feeding regional and longer international connecting routes in addition to accessing domestic destinations as a final stop.

Table 3.4. *Top 10 domestic route pairs in Japan in 2018*

Rank	Route Pair Code	Route Pair	ASKs
1	HND-OKA	Tokyo Haneda-Okinawa Naha	1.18E+10
2	HND-CTS	Tokyo Haneda-Sapporo New Chitose	1E+10
3	HND-FUK	Tokyo Haneda-Fukuoka	9.8E+09
4	HND-KOJ	Tokyo Haneda-Kagoshima	3.36E+09
5	HND-ITM	Tokyo Haneda-Osaka Itami	2.87E+09
6	HND-KMJ	Tokyo Haneda-Kumamoto	2.5E+09
7	HND-NGS	Tokyo Haneda-Nagasaki	2.44E+09
8	OKA-FUK	Okinawa Naha-Fukuoka	2.24E+09
9	CTS-NGO	Sapporo New Chitose-Nagoya Chubu Centrair	2.12E+09
10	OKA-NGO	Okinawa Naha -Nagoya Chubu Centrair	2.01E+09

Data retrieved from OAG (2018)

In addition, Mäkinen et al. (2017) conducts interviews with two major airlines in Japan. These interviews include thematic discussions and open ended questions directed at respondents from different departments within the airlines. These departments include product services, engineering (interiors and cabin systems, maintenance, digital design), procurement (corporate planning), marketing (cabin products, customer services), and airport planning and coordination. Through the interviews, one key point revealed by the industry members in terms of air transport market is the decrease in domestic market. As discussed previously, while established, there is little room for expansion in the domestic market of Japan. On the contrary, also pointed in interviews, traffic in international, especially in Southeast Asia, routes has more room for expansion.

3.3. Competition in the regional and international market

As China starts leading the economic development in the world, a large population of prospective travelers is becoming an important source of potential passengers for the air travel market mainly in the region but also globally. While demand increases, the supply options are also widely increasing (**Figure 3.16**). The competition of international networking in Asia is very challenging. There are several international hubs in Asia which are connection points globally. The main competitor in the market can be identified as China. Additional airport development and expansion are ongoing in China with increased demand for domestic market along with international growth. According to Airbus (2016), China is to become the world's leading country for passenger air traffic and that nearly 50% of all Airbus aircraft in the world are flown by a Chinese airline as of mid-2015.

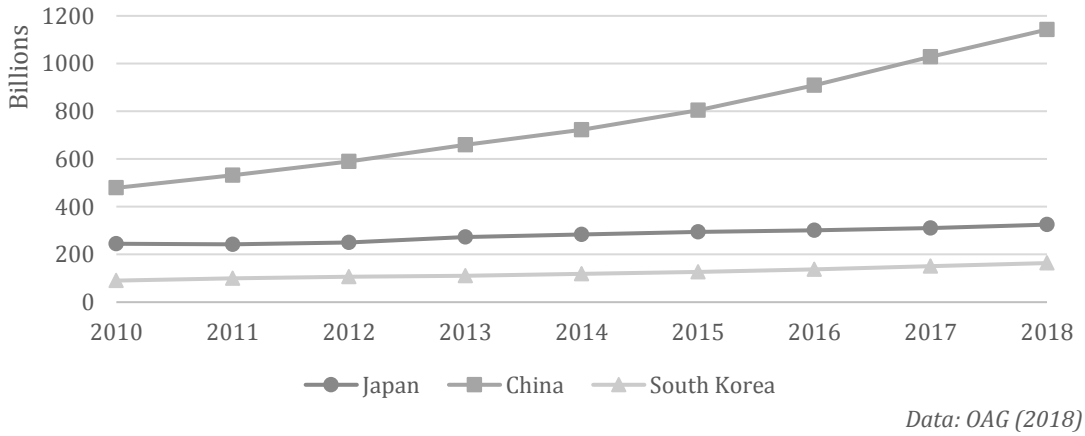
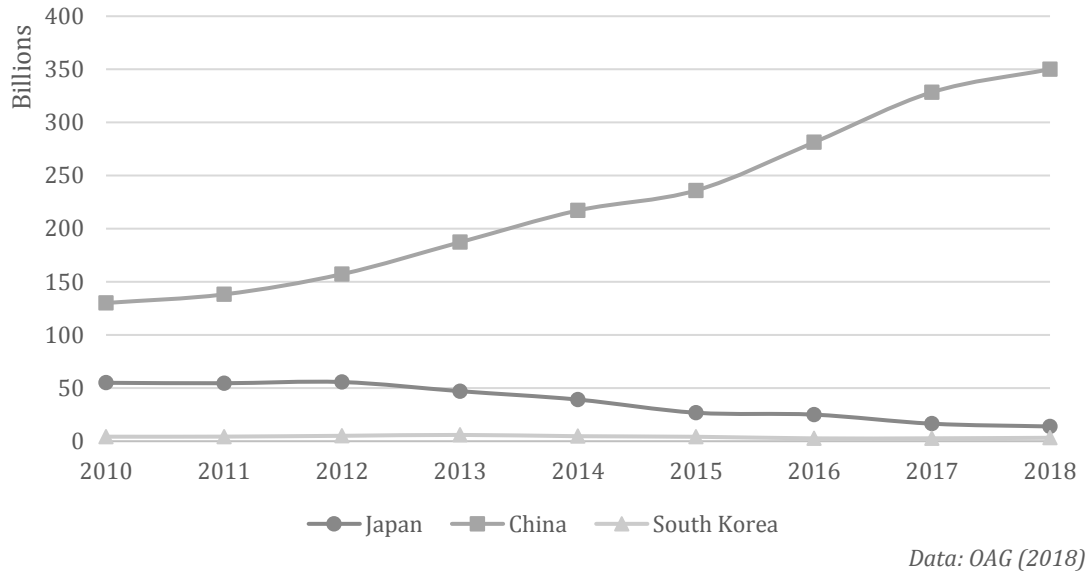


Figure 3.16. *ASKs departing from Japan, China, and Republic of Korea (South Korea)*

The Chinese market with Japan has been developing extensively starting from 2003, but it dropped after experiencing the political friction between Japan and China (The Guardian, 2012). A bilateral open skies agreement is place between the countries with the exceptions of airports in Beijing, Shanghah, and Tokyo (Narita and Haneda airports) (Routesonline, 2012). However, as Miyoshi (2015) discusses that an open skies agreement can both prove to be an opportunity to increase traffic or a risk with a possible loss of traffic. In case of Japan, the latter proved to be the case.

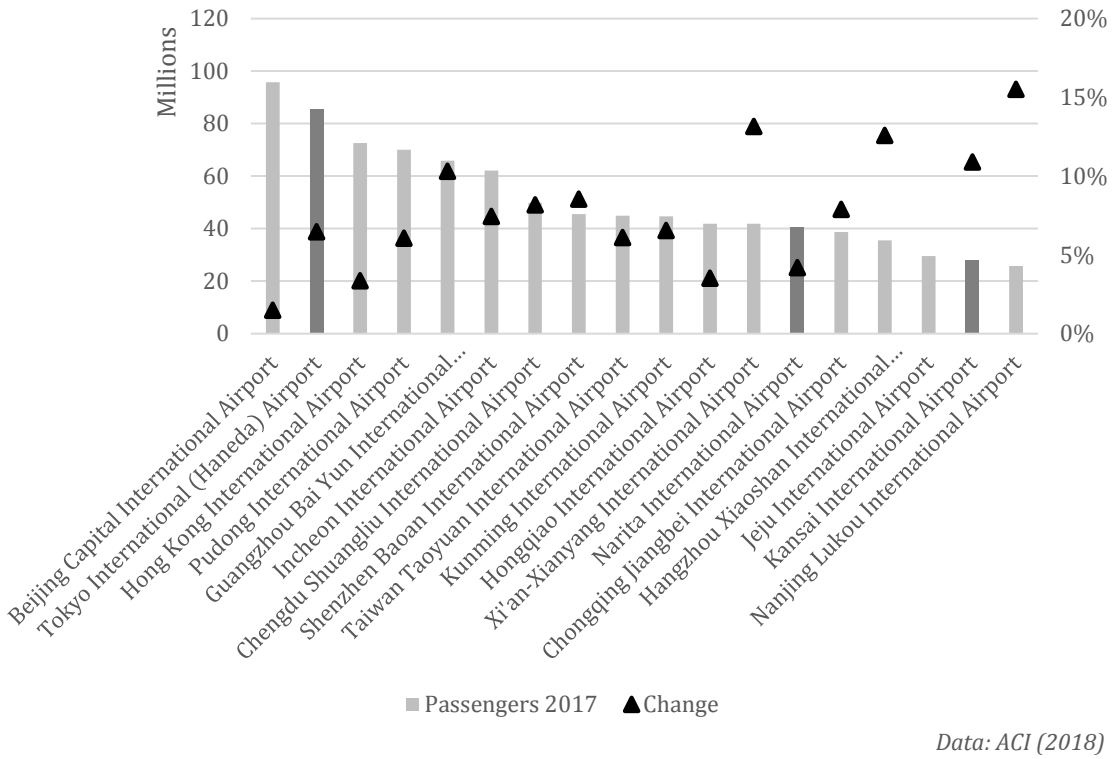
The Pacific Ocean routes between North America and Asia have been the most successful businesses and competitive air transport markets. Due to the strong economic power in Japan and to Tokyo's convenient geographical location, being the closest to the North American continent, Japanese airports has enjoyed the market power that has enabled them to charge the one of the highest landing charges in the world to large aircrafts like Boeing B747s by connecting from the US to Asia (Blair, 2015). As per the location, not only American carriers, but also other Asian carriers such as Singapore Airlines, Cathay Pacific, and Thai International Airlines, have been required to stop over at Narita Airport for their connecting flights to the North American market. However, technological advancements in the aircraft performance in terms of range and fuel efficiency has enabled direct flights. In fact, Singapore Airline has been offering non-stop flights from Singapore to Newark, New Jersey, a distance of 15,345km (BBC, 2018).

Despite the long economic stagnancy in Japan for the last two decades, Japan has still shown a large presence in Asia in terms of the air traffic volume (Miyoshi, 2015). However, Japanese airports are struggling in the competition with other Asian hubs connecting east and west. While, specifically, China have strengthened their positions by improving their services and their operating efficiency as shown in **Figure 3.17**. On the other hand, Tokyo Haneda International Airport (HND), the busiest airport in Japan that is the aerial gateway of Japan, managed to be ranked second in the Northeast Asia among the busiest airports in 2017 (**Figure 3.18**).



Data: OAG (2018)

Figure 3.17. *ASKs of connecting flights in Japan, China, and Republic of Korea (South Korea)*



Data: ACI (2018)

Figure 3.18. *Passenger numbers in 2017 and percent change compared to previous years for airports in Northeast Asia*

After Tokyo airports and Kansai International Airport (KIX), Fukuoka International Airport shows an interesting position as the fourth largest airport in Japan. This airport, with only one runway, has been operating very efficiently by serving in both short-haul international (South Korea, China, and Hong Kong) and medium-haul international

markets (south-east Asia, Hawaii, and Guam). Furthermore, the extremely high demand for domestic routes (TYO-FUK) and other domestic markets has significantly contributed to Fukuoka's strong position.

Compared to competitors in Asia, Japanese airports have maintained expensive airport charges and expenses by keeping the same ground-handling companies, and other related providers. The government has protected two incumbent Japanese airlines (ANA and JAL) as airports have heavily relied on those airlines to develop the routes, and those airlines depended on outbound demand, as well, which are a high yield market (Miyoshi, 2015). As a result, some relatively low-yield markets for ANA and JAL have been operated by Korean Airline or Asiana for feeding Incheon International Airport (ICN) from many regional airports in Japan. More than 95% of the international outbound traffic at the regional airports has taken to other hubs and carriers in Asia. Below, the top 5 medium-haul routes out of Japan in 2014 are presented with the dominant carrier and the main competitor with relative shares on the route which shows the decreased power of Japanese carriers in the segment (**Table 3.5**).

Table 3.5. *Top 5 city pairs on MH international routes from Japan*

City Pair	Seats	Main Carrier	Market Share	Main Competitor	Market Share
Bangkok – Tokyo	2,417,955	Thai Airways	43.5%	JAL	19.5%
Singapore – Tokyo	2,409,607	Singapore Airlines	44.9%	JAL	23.3%
Honolulu – Tokyo	1,416,579	Japan Airlines	45.1%	ANA	20.6%
Jakarta – Tokyo	847,390	Garuda Indonesia	35.4%	ANA	32.4%
Bangkok – Osaka	800,488	Thai Airways	74.7%	JAL	21.8%

Data retrieved from OAG (2018)

3.4. Carriers of Japan

During the last 5 years, the air travel industry in Japan has grown significantly and almost reached 200 million seats offered. There are 11 main air carriers with 80% market share in Japan. **Table 3.6** shows the main Japanese carriers and their available seat kilometers (ASKs), seats and their compound annual growth rate (CAGR).

Table 3.6. *Japanese carriers and respective data as of 2016*

Airline	ASKs	CAGR	Seats	CAGR
ANA	31.0 billion	18.80%	20,133,964	3.10%
Japan Airlines	22.0 billion	-5.60%	12,261,567	-1.20%
Skymark Airlines	1.8 billion	-18.20%	1,986,825	-24.40%
Jetstar Japan	1.7 billion	30.80%	1,578,960	-1.10%
Peach	1.3 billion	18.20%	1,230,660	9.00%
Solaseed Air	1.0 billion	16.00%	1,150,560	18.50%
Air Do	948.8 million	5.70%	1,124,010	1.10%
StarFlyer	583.4 million	-2.60%	781,350	-2.30%
Fuji Dream Airlines	255.6 million	15.60%	403,408	20.90%
Vanilla Air	667.3 million	9.60%	394,914	11.20%
Spring Airlines Japan	114.5 million	31.20%	117,558	0.30%

i) Data retrieved from Hashim (2016)

3.4.1. Japan Airlines

It is the second largest airline operating in Japan and connecting hubs at Tokyo Haneda, Tokyo Narita, Nagoya and Osaka Kansai with domestic and international destinations. It is 100% owned by the Japan Airlines Group and serves an extensive domestic network jointly with its subsidiary carriers. Japan Airlines and its group are a member of the global Oneworld alliance and enjoys several codeshare agreements with major European, American and Asian carriers (Fightglobal, 2018).

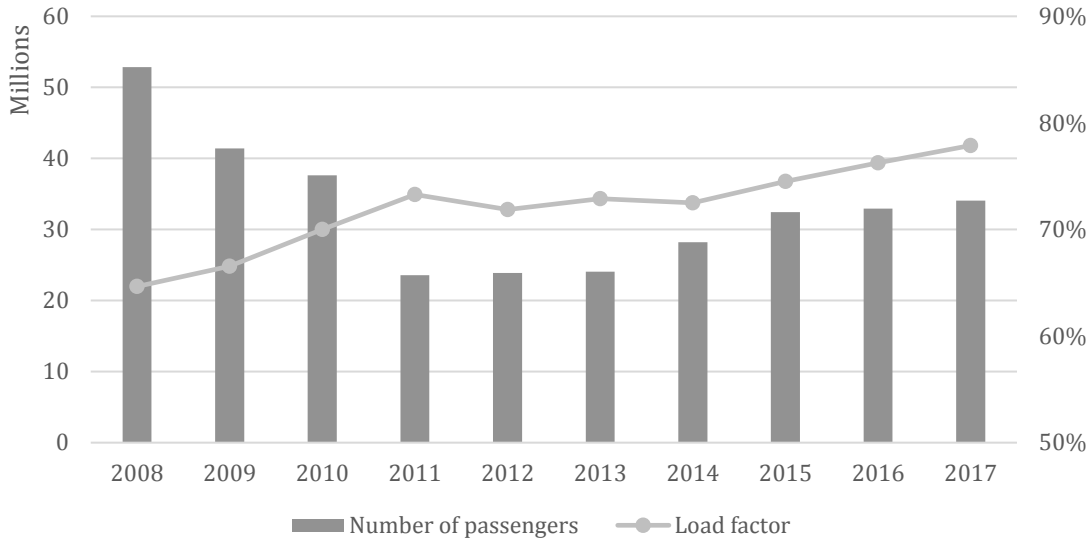
Japan Airlines operates a relatively young Boeing fleet with an average age of 8.9 years after the restructuring in 2012. In 2014, an order of 49 Airbus A350s was placed for replacing their Boeign 777s. Overall, the average number of seat per aircraft in 2017 is 198 based on the frequency of the operations.

A more clear representation of the change in number of seats provided is shown in **Figure 3.19**. The weighted average of number of seats based on ASK has been decreasing while the average distance has increased compared to 2011. This reflects that, over time, smaller aircraft (narrow-body) are utilized for longer routes which can prove more flexibility for the airline.

Source: Author based on data from OAG (2018)

Figure 3.19. *Change in the weighted average number of seats based on ASK and the average distance flown per sector for JAL*

Since 2013, JAL has seen a noticeable increased in a number of passengers. However, its load factor is lower than ANA's and its growth has been varying from positive to negative on yearly basis.



Data: Flightglobal (2018)

Figure 3.20. *Passenger numbers and load factor of JAL between 2008 and 2017*

Japan Airlines was struggling financially with negative total revenue change since 2010. Per year basis, Japan Airlines managed to change a trend of six consecutive negative terms to achieve a slightly positive results in the end of 2015 (Flightglobal, 2018). The carrier has benefited from an increase in the number of visitors to Japan. In addition, the

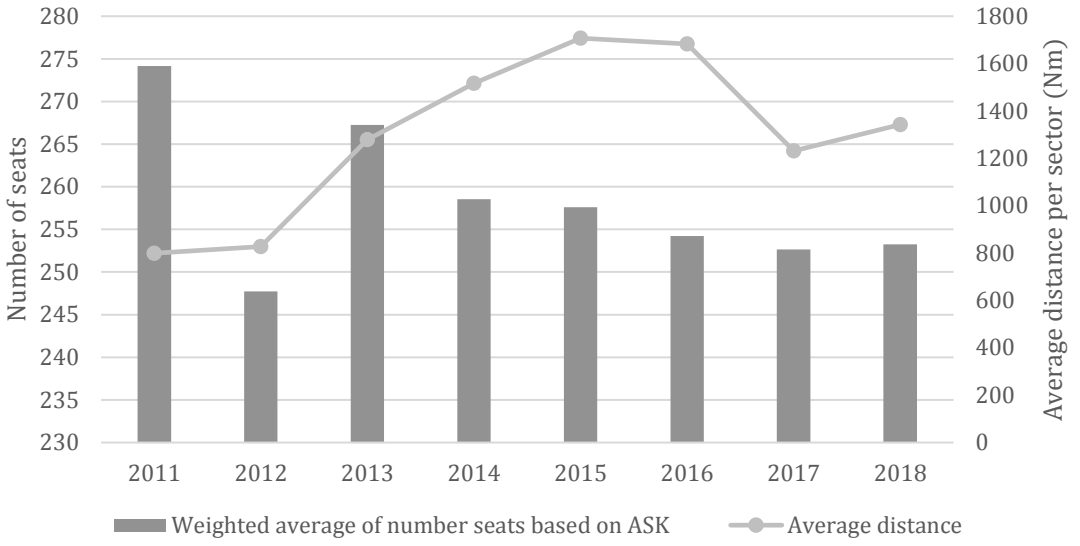
low fuel price was largely offset by the Japanese yen's weakness against the US Dollar (Hashim, 2016).

3.4.2. All Nippon Airways

ANA is the largest carrier in Japan and ranked 13th in the world in terms of passengers carried in 2015 (IATA, 2018). ANA is an FSC with an extensive scheduled network mainly focusing in Asia-Pacific and North America routes. ANA is a member of Star Alliance with transpacific joint businesses with United Airlines (Flightglobal, 2018). ANA is the main subsidiary of ANA Group. The group also owns Peach, Vanilla Air, Solaseed Air, Air Japan, ANA Wings, and Asian Blue which is in the start-up phase. ANA Group has also 16.5% stake in Skymark Airlines that is the largest LCC in Japan operating domestically.

ANA switched their main fleet from Airbus to Boeing in 2006, after 11 years of operating an A320 single fleet. The carrier has 117 aircraft on order in 2016, both from Airbus and Boeing, with a clear focus on wide-body aircraft. In terms of aircraft sizes operated in ANA, the average seat capacity provided based on frequency was 226 in 2017.

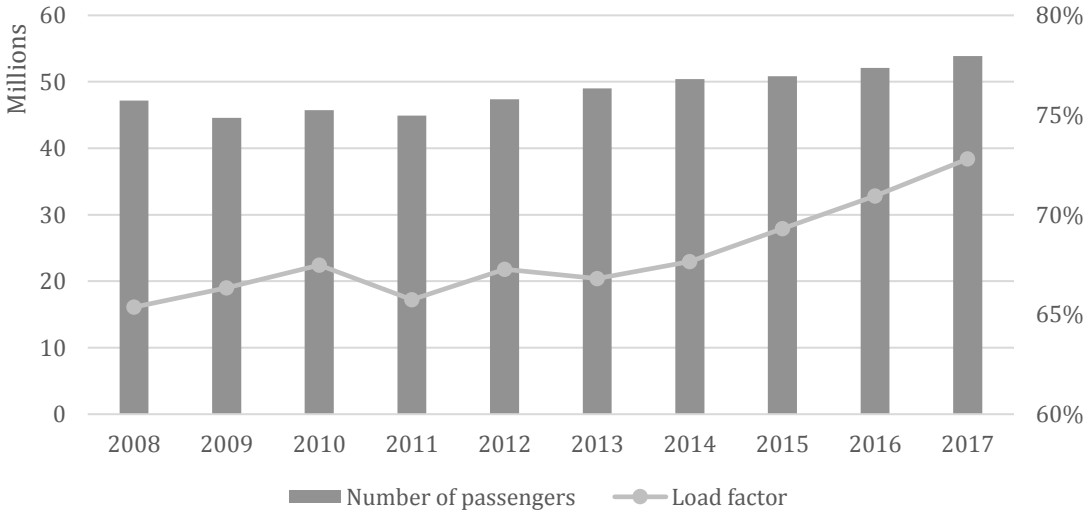
Looking at the change in weighted average of number of seats based on ASK, similar to Japan Airlines, the average number of seats based on ASK shows a decrease over time while the average distance per sector has been increasing compared to 2011. The unordinary change in the average number of seats in 2012 can be explained with the merger of Air Nippon with ANA introducing the smaller fleet of Air Nippon into ANA (ANA, 2018).



Source: Author based on data from OAG (2018)

Figure 3.21. *Change in the weighted average number of seats based on ASK and the average distance flown per sector for ANA*

ANA has a positive trend in terms of passenger growth and load factor. Since 2011, ANA is recording growth both in passenger numbers and the load factor. The growth over the past years prove a sustainable increase in passenger numbers (**Figure 3.22**)



Data: Flightglobal (2018)

Figure 3.22. *Passenger numbers and load factor of ANA between 2008 and 2017*

After the strong financial growth in 2010 and 2011 in Japan, the carrier has experienced 4 years in a row with a negative total revenue change (Flightglobal, 2018). However, ANA Holdings reported a 49% increase in operating profit in March 2016, primarily

driven by strong inbound demand for travel to Japan, but impacted by the terrorist attacks in Paris and Brussels in the European market (Hashim, 2016).

3.5. Summary

Through the chapter, overview of Japanese air transport market with relative regional air transport market with addition of detailed analysis of two major airlines, the domestic market and the competition in the region.

While domestic air transport market is quite limited to expansion with the constraint of the geography and the competition from the high speed rail system (Shinkansen), the regional routes and the international traffic proves good potential for expansion especially considering the significant economic growth in Asia-Pacific.

More in depth, based on two major airlines operating in Japan, the trend shows that number of seats are decreasing per sector while the average distance is increasing. This trend reflects the decrease in the number of wide-body aircraft while the number of narrow-body and relatively small wide-body (twin-aisle) aircraft increase. This is especially important as the cabin environment differs from bigger aircraft to smaller aircraft.

Overall, the Japanese air transport market offers a good potential for growth for both passenger numbers and for international hub operations. LCCs are emerging in the market for short-haul and medium-haul flights serving the regional Asian market which can also boost the importance of international hubs currently located in Japan. The systematic growth of the air market in Japan and the planned expansion strategies in right locations can improve the geographical and economic importance of Japan in the Asian market through balanced competitive strategies with policies advocating the Open Skies agreement.

As Japan is explored and a basis for the focus of this study is established with the literature review, methodologies utilised in this study, with respect to the findings so far, are presented in the next chapter with a clear research design in place.

CHAPTER 4 - RESEARCH METHODOLOGY AND DESIGN

In this chapter, the methodological approach and overview followed in this research study and the design adopted are presented. The purpose of this chapter is to explain and further examine the methodologies related and used in the study. The framework for the research and methodology is also provided to reflect the progress of the study.

In order to address the research problem, a clear understanding of research design and methodological approach are investigated and presented in Section 4.1 through research philosophy, research approach, research strategy, methodological approach, time horizon, and techniques and procedures. Based on the adopted research design, progressive steps and layers included in the development of the research are identified. After the establishment of the research design, in depth knowledge on the qualitative and quantitative studies are presented and explained in Sections 4.2 and 4.3. Finally, the conclusion is presented based on the contents of this chapter.

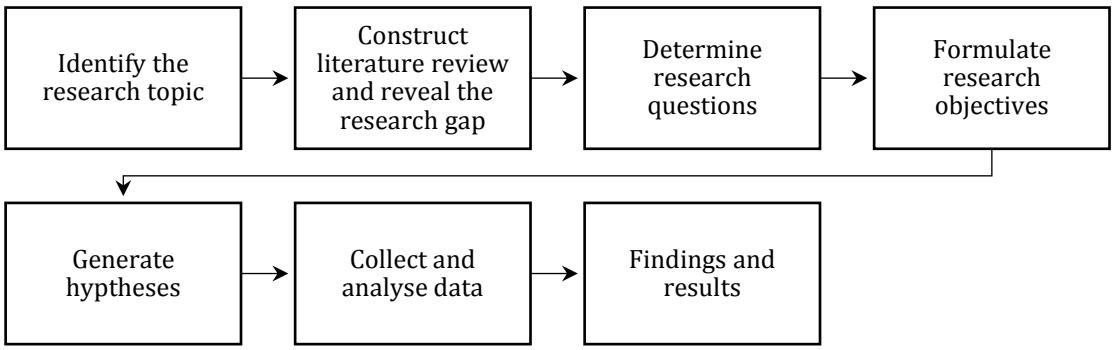
As the main focus of this study is to identify the preference of Japanese passengers for cabin design in short to medium haul flights, through the passenger preferences, key aspects of an ideal cabin design are identified and defined. In order to properly address the problem, a variety of approaches in qualitative research are included in Section 4.2. In Section 4.3, the quantitative part of the study is discussed. The methodology followed with the design and execution are presented. A clear understanding of the approach on the analysis is established. After the exploration of each definition and theory of selected methodologies, the execution of the methodology in terms of the properties of this research are discussed. In Section 4.4, before the summary, the quantitative pilot study is presented and discussed.

Lastly, in Section 4.5, the chapter is summarised. Overall, the aim of this chapter is to present an understanding to the methodology implemented in addressing the research objectives.

4.1.Research design

An appropriate research design is key to a successful and robust study. The research design determines the ‘path-way’ for conducting the research by identifying the research

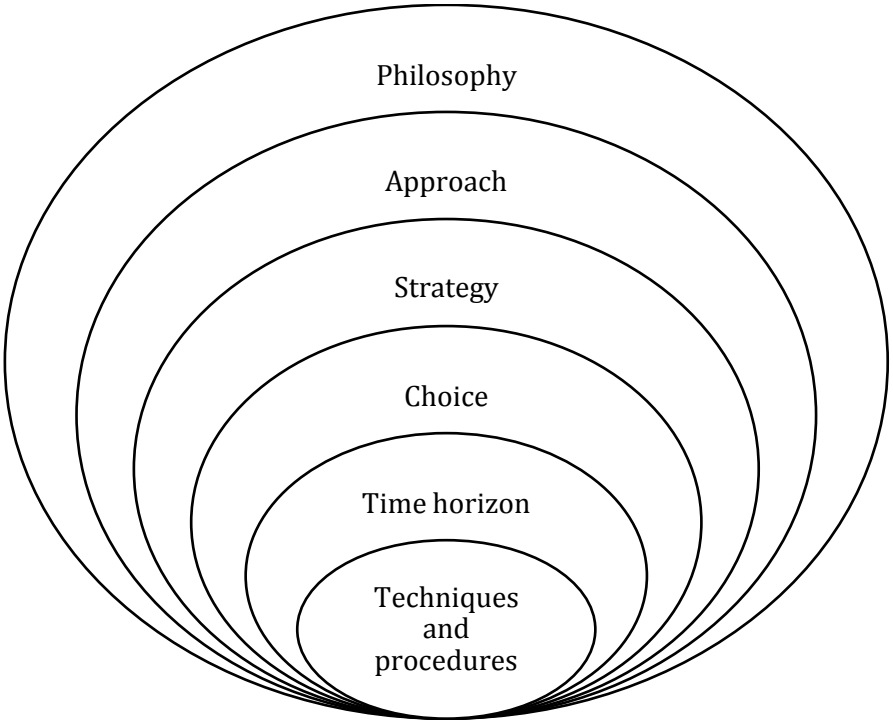
topic, research gap, research questions, the research objective, hypothesis formulation, data collection and analysis, and conclusion based on the results and findings (**Figure 4.1**). Based on the research question, a descripto-explanatory research is conducted in this study. Descripto-explanatory research involves utilising descriptive research findings in explanatory research (Saunders et al., 2009).



Source: Author

***Figure 4.1**. Research design flowchart*

Saunders et al. (2009) proposes a concept for the research design process which includes different layers of decisions making, which in turn determine the overall approach for the research in terms of data collection and analysis. There are six defined layers in this concept, starting from the outer layer followed by the very inner layer which can be illustrated as a cross-sectional view of an onion (**Figure 4.2**). From outer level to inner layers, these decisions involve research philosophy, approach, strategies, methodological choice, time horizon of the study, and techniques and procedures for data collection and analysis.



Source: Author based on Saunders et al (2009)

Figure 4.2. *Layers of research "onion"*

4.1.1. Research philosophy

Research philosophy is the outermost layer of the research design concept adopted in this research. Based on the practical implications and how the research will be studied, the philosophy justifies the nature of knowledge and its application (Flick, 2011). There are different philosophies that define the nature of a particular research methodology. These philosophies include positivism, realism, interpretivism, and pragmatism (Saunders et al., 2009).

Positivism is a philosophy that accepts the factual nature of the subject that is studied where the definitions and meanings are consistent (Newman, 1998). In positivism, usually deductive methods are incorporated with a detailed structure. Realism includes a scientific approach to develop a knowledge which can be independent from current knowledge. In this philosophy, mostly past historical data is utilised for analysis. Interpretivism mostly relates to social studies which assume the meaning of the understanding differs based on characteristic attributes (Östlund et al., 2011). Pragmatism, as the name suggests, is a pragmatic approach which accepts that there are different perspectives in interpreting and undertaking a study where there may be multiple

realities (Saunders et al., 2009). Pragmatic research can have multiple research approaches and strategies to represent the multiple realities that may exist.

This research adopts the research philosophy of positivism. The characteristics of positivism which is defined by Pizam and Mansfeld (2009) are listed in **Table 4.1**. Positivism is related to rational and cognitive models of consumer behaviour. In estimating decision-making processes, which requires a logic of reason (a rule), positivism is the most suitable philosophy to adopt while sustaining objectivity (Pizam and Mansfeld, 2009).

Table 4.1. *Assumptions and relative characteristics of positivism*

Assumptions	Characteristics
Reality	Objective, tangible, single
Goal of research	Explanation, strong prediction
Focus of interest	What is general, average and representative
Knowledge generated	Laws absolute (time, context, and value free)
Subject/researcher relationship	Rigid separation
Desired information	How many people think and do a specific thing, or have a specific problem

Retrieved from Pizam and Mansfield (2009)

This research, in principle, follows the characteristics shown below in positivism. With the goal of explaining passenger behaviours and revealing the estimated willingness to pay for different attributes within the cabin context, this study transforms any input collected into numbers while including supplementary qualitative data for further analysis.

4.1.2. Research approach

The research approach is the procedure which determines how to reveal the knowledge. There are two main types of research approach; deductive and inductive approach. Deductive generally includes quantitative data to test a hypothesis or hypotheses based

on an existing theory (Silverman, 2013). This approach is particularly well suited for the positivist philosophy of research which includes statistical-testing and estimation (Sneider and Larner, 2009). Through the deductive approach, general knowledge is pre-established and specific knowledge is retrieved from the study for testing (Kothari, 2004). On the other hand, with the inductive approach, specific knowledge is gained through observations and general knowledge is then formed and presented through analysis (Beiske, 2007; Bryman and Bell, 2011). This approach is used to generate new theories or to fit knowledge to an existing one and it is normally deployed in qualitative research (Bryman and Bell, 2011). Different characteristics of the two approaches as discussed by Saunders et al. (2009) are listed in **Table 4.2**.

These two distinct approaches (deductive and inductive approaches) can also be combined to offer a more robust and comprehensive scope of research (Saunders et al. 2009). As stated, while the deductive approach commonly utilises quantitative data, inductive approaches use qualitative data. As Creswell and Clark (2017) points out, the adoption of only one distinct approach in terms of quantitative or qualitative data raises the risk that not all important and relevant phenomena. Therefore, using qualitative and quantitative techniques together can strengthen and help to address the different research questions.

Based on the objectives and research questions of this research, inductive and deductive approaches are both adopted. This research follows rigid scientific principles and includes a highly structured framework for quantitative analysis while integrating a qualitative study for supplementary analysis that are further explained in Section 4.2 and 4.3.

Table 4.2. *Characteristics of deductive approach and inductive approach*

Deductive approach	Inductive approach
• Scientific principles	• Gaining an understanding of the meanings human attach to events
• Moving from theory to data	• A close understanding of the research context
• The need to explain casual relationships between variables	• The collection of qualitative data
• The collection of quantitative data	• A more flexible structure to permit changes of research emphasis as the research progresses
• The application of controls to ensure validity of data	• A realisation that the researcher is part of the research progresses
• The operationalisation of concepts to ensure clarity of definition	• Less concern with the need to generalise
• A highly structured approach	
• Researcher independence of what is being researched	
• The necessity to select samples of sufficient size on order to generalise conclusions	

Retrieved from Saunders et al. (2009)

4.1.3. Research strategy

Research strategy defines how the researcher plans to execute the study (Saunders et al., 2009). Different strategies in this context can include experiments, surveys, case studies, action research, grounded theory, ethnography, and archival research. Experiments are conducted to reveal the relationship between two or more independent variables and the dependent variable. The effects of different independent variables on the dependent variable are compared to a control group based on a hypothesis. The survey strategy is common in business and management studies and addresses who, what, where, how much

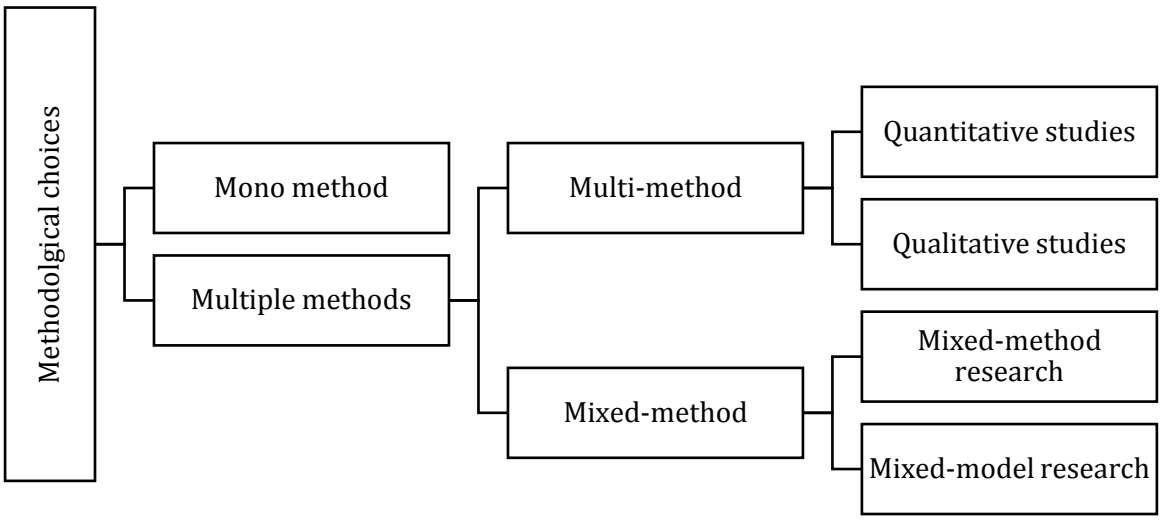
and how many questions (Saunders et al., 2009). This strategy is usually adopted for quantitative data and uses sampling to represent a proportion of a population (Bryman and Bell, 2011). Case studies involve researching a specific example of occurrence and draws conclusions for generalisation (Bryman, 2012). Action research, while there are various understandings in the literature, is generally considered a practical approach to address a research question by actually implementing change through reflective evaluation over time (Saunders et al., 2009; Bryman, 2012). Grounded theory strategy is often used with qualitative data in which a theory is developed through the research as data is generated through observations rather than forming an initial theoretical framework (Saunders et al., 2009). Ethnography is utilised within an inductive approach where close observation of subjects are practiced to describe the social world from the subjects' perspective (Saunders et al., 2009; Bryman, 2012). Archival research involves examining and analysing existing administrative records, documents, reports and other material (Saunders et al. 2009; Flick, 2011).

The primary research strategy adopted is the survey strategy based on the set of research questions outlined in Chapter 1. In order to reveal and understand passenger preferences through who, what, how much and how many questions, a survey strategy has been developed to sample the overall population in the specified region. The analysis of the survey needs to address the relationship between different variables investigated in terms of inflight experience and cabin context and to produce a model based on data collected from subjects (passengers). Compared to case study research, archival, and action research, survey strategy allows the research to have a flexible and unique approach in retrieving the data when research questions are considered. Therefore, the survey strategy is the most suitable form of descriptive research for this study. A stated preference survey is developed in this study for discrete choice modelling of passenger preferences for inflight experience and cabin features in Japan. The survey strategy adopted in this research is explained in detail in Section 4.3.

4.1.4. Methodological approach

In order to deliver the objectives of a research successfully, it is important to follow an organised system of methodology. Through the research, the data collection and data analysis techniques need to be identified in terms of quantitative and qualitative studies. In a brief explanation, the purpose of quantitative data collection and analysis is to

generalize the analysis to a population while qualitative data collection and analysis aims at developing a knowledge from a small number of subjects (Creswell and Clark, 2017). There are two main choices in methodological approach; mono method and multiple methods (Saunders et al., 2009). As shown in **Figure 4.3**, there are different types of multiple methods.



Source: Author based on Saunders et al. (2009)

***Figure 4.3**. Methodological choice tree (Saunders et al., 2007)*

Mono method involves utilising a single form of data collection and analysis technique (Saunders et al., 2009). The data collected and included in the analysis can either be a qualitative or quantitative. On the other hand, multiple methods enables the research to have more than one form of data collection and data analysis technique through two main sets of alternatives. The first set is the multi-method where more than one only quantitative study or qualitative study can be included in the research (Saunders et al., 2009). The second set of options is the mixed-method. In mixed method, the research can include different techniques while making use of both quantitative and qualitative data collection and analysis (Saunders et al., 2009). Within mixed-methods, there are two different choices as categorised by Saunders et al. (2009). First is the mixed-method research which enables the use of quantitative and qualitative data collection and analysis techniques simultaneously. This means that quantitative and qualitative data are collected

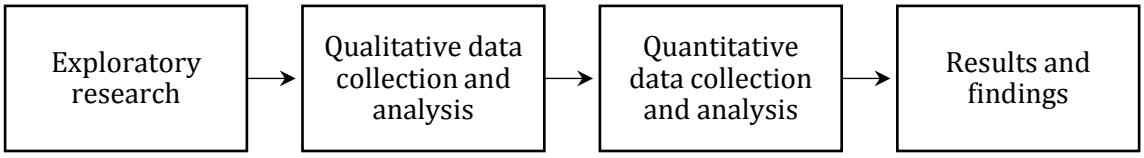
and analysed separately. The other choice is mixed-model research where the research may integrate qualitative and quantitative analysis within a single data set (Flick, 2011).

In this research, a mixed methodological approach is adopted. Based on the definition of mixed method of study, according to Creswell and Clark (2017), mixed methodology includes the collection and analysis of both qualitative and quantitative data with a priority over one or both forms of data in a single study or in multiple stages within one research project. The procedures involved in the research are combined into specific research designs to direct the research. While the integration and implementation of mixed methods can be challenging, mixed methods research neutralises the weaknesses that can be a result of using only quantitative or qualitative analysis while providing more evidence for the study (Creswell and Clark, 2017). In addition, mixed multiple methods are especially useful if the methods provide better opportunities to answer research questions by further evaluating the findings or supplementing the research by providing greater levels of confidence (Tashakkori and Teddlie, 2003).

As investigated by Bryman (2006), the integration of qualitative and quantitative research can be warranted for several reasons. Based on the classification scheme they provide, three most common integrations are a result of, in order of frequency of practice (actual uses of the integration), enhancement, triangulation, and illustration. Enhancement means that qualitative and quantitative research are integrated for the purpose of improving the findings. The triangulation rationale refers to the greater validity provided by combining qualitative and quantitative research as they may correlate. The illustration rationale means that qualitative research is undertaken to illustrate quantitative findings. In this research, it can be stated that qualitative and quantitative research are integrated for the instrument development purpose. Instrument development rationale is based on qualitative research being undertaken to develop, improve and confirm the survey design and contents (Bryman, 2006).

In this research, qualitative analysis is used to reflect passenger trends in the selected geography for this study. Furthermore, passenger satisfaction and comfort are investigated in terms of inflight experience. Quantitative analysis is then integrated to investigate market trends in the region, define key passenger preferences in terms of cabin attributes, and to evaluate the economic impact of these attributes for end-users.

Different stages followed in this descriptive and explanatory research is presented in **Figure 4.4**. The initial stage includes the exploratory research which helps define the methodological approach to improve the main research (Shields and Rangarajan, 2013). In this case, exploratory research consists of an extensive literature review on passenger comfort and satisfaction, air transport market research and analysis, and a pilot study. The second stage is the construction of qualitative research to develop a lead user characteristic for Japanese passengers by utilising a qualitative research synthesis. The third stage is the quantitative data collection and analysis to estimate passenger behaviours and the economic valuation of products and services by passengers. The final stage includes the overall integration and interpretation of results and findings.



Source: Author

***Figure 4.4**. Different stages in the research*

4.1.5. Time horizon

Based on different research questions, different time horizons can be used. Independent from the adopted research strategy and/or the choice of method to follow, time horizon defines the timeline of the data collection (Saunders et al., 2009). There are two types of time horizons that a research can have; cross-sectional studies and longitudinal studies (Bryman, 2012). Cross-sectional studies are undertaken for research when time is not a concern. This means that the data is collected and analysed for at one point in time. On the other hand, longitudinal studies are undertaken where the data is collected over a set period of time. Longitudinal studies are important when a studied subject is dependent on time which changes over a period (Goddard and Melville, 2004).

In this study the time horizon is cross-sectional. Cross-sectional studies are commonly used in survey studies (Robson, 2002; Easterby-Smith et al., 2008; Saunders et al., 2009). In this research the data is collected in one instance and analysed respectively instead of being collected over a set period of time.

4.1.6. Techniques and procedures

Depending on the methodological approach, techniques and procedures define the specific process for data collection and analysis (Saunders et al., 2009; Bryman, 2012). In terms of data collection, there are two types of sources; primary data and secondary data. Primary data includes any kind of information that is collected first hand such as in the form of surveys, interviews, and observations (Bryman, 2012). Secondary data, on the contrary, involves information sourced from other research and relative available data sets in any industry, government or academic resources (i.e. censuses, statistical reports) which can be raw or manipulated (Saunders et al., 2009).

In this research, a mixture of primary and secondary data is used and analysed with different techniques to satisfy the different research objectives. While primary data is the source of the quantitative analysis through a survey, secondary data is also obtained to reveal the air transport market dynamics and to establish a background. The methodological techniques used to address each research objective are listed in **Table 4.3**, and are discussed in the following sections.

***Table 4.3**. Techniques and tools for relative research objectives*

Research Objective	Technique	Data source
1	Descriptive analysis of demographic, economic, infrastructure aspects of Japan	Secondary data using official sources
2	Descriptive statistics of air transport market in Japan	Secondary data using official sources
3	Definition of national culture and descriptive analysis of national culture in Japan	Secondary data using findings from previous research
4	Literature review of present and future cabin concepts and strategies	Secondary data using previous research
5	Literature synthesis of satisfaction and comfort in changing business environment	Secondary data using findings from previous research
6	Taxonomic analysis of different attributes related to cabin features and services	Secondary data using official sources and findings from previous research
7	Literature review of methodologies for choice models	Secondary data using previous research
8	Statistically efficient design of the stated preference data	Secondary data from pilot study and previous research
9	Statistical regression models to reveal choice probabilities and estimation of WTP	Primary data collected through the survey study
10	Synthesis of findings from parts of the research for conclusion	Primary and secondary data

4.2. Qualitative study

In order to provide a baseline for the understanding of passengers and air travel market in Japan, a qualitative analysis is conducted. Qualitative data collection and analysis seeks to develop deep insights using narrative, written information, as well as visual data. In literature, qualitative research includes a wide variety of research methods in terms of social research. As discussed in Bryman (2012), commonly used research methods in

qualitative research are ethnography/participant observation, qualitative interviewing, focus groups, and the qualitative analysis of collected texts and documents. Based on the research strategy, one or more of these research methods can be adopted to address the research questions. The first method discussed, ethnography/participant observation, involves the collection of data through observation in a selected social setting (Bryman, 2012). Qualitative interviewing is a method of data collection through the utilisation of various interviewing styles (Saunders et al., 2009; Bryman, 2012). Focus groups include data collection through a discussion of a specific topic in a group (Bryman, 2012). Language-based approaches involve methods including discourse analysis and conversation analysis (Bryman, 2012).

As these methods discussed are applicable in utilising and analysing primary and secondary data, this research is engaged in integrating findings from other research and further analysing them as primary data. In contrast to reviews, this approach entails a rigid scientific analysis as qualitative methods are employed systematically to integrate findings. In addition, this approach differs from a secondary data analysis since the findings are the focus of the analysis and the data collected or used in the respective research is excluded and not re-analysed. Based on these criteria, a qualitative research synthesis is conducted to address the relative research question in this study.

Qualitative research synthesis is a scientific approach on systematically analysing and integrating findings from completed qualitative research (Sandelowski and Barroso, 2007; Major and Savin-Baden, 2012). According to Sandelowski and Barroso (2007), there are two categories within qualitative research synthesis including various methods; qualitative metasummary and qualitative metasynthesis. While qualitative metasummary involves integrating the summary of findings from research, qualitative metasynthesis involves interpretive integration derived from the findings of respective research (Sandelowski and Barroso, 2007). Qualitative research synthesis is beneficial in terms of minimising "information anxiety" and the research findings are improved with more tangible output provided for the relative research (Sandelowski and Barroso, 2007). In addition, qualitative research synthesis establishes connections between existing research and makes room for improvement of evidence-based practice and policy (Major and Savin-Baden, 2012). Although, this approach is especially utilised in disciplines such as nursing, medicine, and education, there is a growing trend in social science research to

conduct qualitative research synthesis (Sandelowski and Barroso, 2007; Major and Savin-Baden, 2012).

In qualitative metasummary, it is important to first identify target findings in order to establish a relatable content for analysis (Sandelowski and Barroso, 2007). Based on the target findings, further analysis can take place to separate, edit, group and abstract findings. Each of these techniques is utilised to refine the findings for desired analysis and clarify to provide an eloquent output without replication or redundancy. While the findings from the research can be summarised, compared, or criticised for better understanding with qualitative metasummary, these findings can be further analysed by undertaking an approach within qualitative metasynthesis. Qualitative metasynthesis is comprised of several methods and techniques (Sandelowski and Barroso, 2007). These methods and techniques are implemented to provide interpretive synthesis of research findings through conceptual or thematic descriptions or interpretive explanations (Sandelowski and Barroso, 2007). As for qualitative metasummary, it is important to identify target findings for the scope of the analysis. In this context, qualitative metasummaries can prove beneficial by acting as an empirical foundation, or as a bridge to qualitative metasynthesis (Sandelwoski and Barroso, 2007).

In this research, qualitative research synthesis is employed primarily through the findings obtained from preliminary work conducted by the author and colleagues as part of the FUCAM project, Deliverable 2.3 - Trend report and detailed requirements, see Mäkinen et al. (2017). In addition to this study, a systematic literature search is conducted to find studies with findings in the related topic. Within the scope of the FUCAM project, a literature review is conducted as well as a variety of qualitative interviews with the industry members to identify user trends and culture. User preferences, trends and culture are revealed through various sources identified both within the academic literature and commercial publications. In addition, interviews with cabin crew are conducted to reflect practitioner views on the specified user profile (Mäkinen et al., 2017).

4.2.1. User trends and culture

An understanding of Japanese passengers in terms of national culture is explored through a qualitative research synthesis with the findings obtained from Mäkinen et al. (2017) and Gilbert and Wong (2003). In addition, the Hofstede model for national culture (as

discussed in Section 2.4) is included for further analysis of the findings. Mentioned literature are analysed with qualitative metasummary and qualitative metasynthesis techniques. This analysis is constructed to answer the relative research question presented in the introduction of the research "How do Japanese passengers perceive and approach inflight experiences and services?". Through this analysis, behaviour, needs, problems, and patterns of Japanese passengers are investigated to reveal a generic passenger profile for this group, which is particularly useful in identifying key important factors in cabin context.

As mentioned, Mäkinen et al. (2017) investigates Japanese, Korean, and Chinese passenger behaviour and trends through a systematic review and interviews. In the systematic review, card tagging and categorisation is utilised to identify trends and cultural factors within different sets of cards for Japan, China, and overall Asia (Mäkinen et al., 2017). The contents of these "*culture cards*" are the results of the analysis of several literature and online sources which include and not limited to Wang et al. (2005), Bailery et al. (2007), Lu and Lu (2008), Bo (2009), Hays (2009), Morrison (2009), Salsberg (2010), Eagan and Weiner (2011), Eväsoja (2011), Cheng et al. (2011), Nelson (2011), Strittmatter (2012), Liu et al. (2013), Ipsos MORI (2014), The Economist (2014), APEX (2015), Chen and Chao (2015), EU SME (2016), Garcia (2015), Haw (2015), Singapore Tourism Board (2015), Skift (2015), Trendwatching (2015), Biswas (2016), JTB Tourism Research & Consulting Co (2016), and Kallonen (2016). Within the sets of cards for Japan, there are 52 individual cards identified which are presented in Appendix B. The topics of different cards vary widely including traditional characteristics, holiday and vacations, technology interests, and also cabin preferences in terms of seating and inflight entertainment. **Figure 4.5** presents two examples of these "culture cards" as presented in the relevant study.

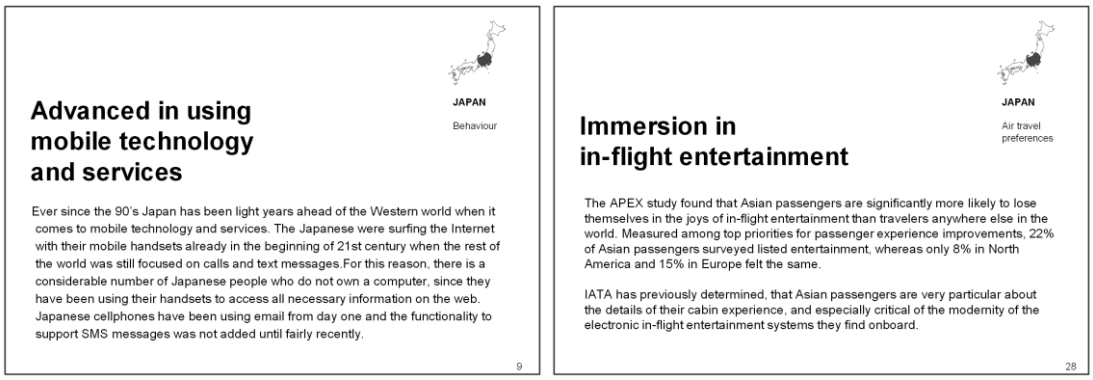


Figure 4.5. *Two examples of culture cards from Mäkinen et al. (2017)*

In addition to the cards developed in Mäkinen et al. (2017), the researchers conduct and analyse interviews with cabin crew working on international and domestic Japanese and Chinese routes and representatives from different departments of two major FSCs from Japan.

Airline cabin crew involvement is included in Mäkinen et al. (2017) with the justification that they have a major impact on customer experience in addition to their unique point of view from observing passenger needs and behaviour during the flight. Eight face-to-face interviews are conducted with eight highly experienced cabin crew with an average year of experience of 23.3 years on long-haul routes between Finland and Northeast Asia (including Japan and China) and domestic and regional routes within Asia. Among eight cabin crew, four are Japanese, three are Finnish, and one is Chinese with three of these people based in Helsinki, Finland, three are based in Osaka, Japan, one is based in Narita, Japan, and one is based in Chongqing, China (**Table 4.4**).

Interviews include open ended questions within six different topics; first assumptions, behaviour, common problems, needs, own solutions and practices, group travels. Mäkinen et al. (2017) transcribes the responses and searches for themes within the transcripts. A thematic analysis approach is employed through the qualitative analysis. The analysis includes 468 rows of insight within 18 different categories defined through the FUCAM project in addition to the categories suggested by the collected reflecting Japanese, Korean, and Chinese passengers.

Table 4.4. *Details of respondents interviewed in Makinen et al. (2017)*

Respondent	Gender	Nationality	Years of experience	Route Experience
1	Male	Finnish	34	HEL – Northeast Asia
2	Female	Japanese	34	NRT – HEL
3	Male	Finnish	32	HEL – Northeast Asia
4	Female	Japanese	30	KIX – HEL
5	Female	Japanese	11.5	KIX – HEL
6	Female	Japanese	9	KIX – HEL
7	Male	Chinese	4.5	CKG – HEL
8	Female	Finnish	1	HEL – Northeast Asia

Retrieved from Mäkinen et al. (2017)

In addition to Mäkinen et al. (2017), through literature search, although there are relatively few studies, Gilbert and Wong (2003) is found to be the most suitable research for the qualitative research synthesis to understand and identify Japanese passengers in cabin features and services context. In Gilbert and Wong (2003), authors examine cross-cultural differences in terms of nationality among Japanese, Korean, Chinese, and American airline passengers through a questionnaire directed at cabin crew of Korean Air with experience working on regional and international routes. The final questionnaire is developed based on structured interviews with eight cabin crew and a further pilot study involving 20 cabin crew. The questionnaire includes 12 items with a 7-point Likert scale for four different nationalities. Overall, the questionnaire is distributed to 250 cabin crew who had more than two years of experience and 84.8% response rate is achieved. In Gilbert and Wong (2003), instead of data collected by cabin crew, authors collect data directly from the passengers departing from Hong Kong airport and analyse it to reveal the service dimensions that are most relevant to passengers. They study includes passengers from China, Japan, North America, and West Europe with a clear identification of travel purpose. SERVQUAL, which is a research instrument to estimate service quality, is used to collect and analyse the data through the research.

Through the qualitative research synthesis, findings from included research, in form of cards and findings from the interviews, are integrated for interpretation within a taxonomic analysis to simplify the results and to identify key user profile of Japanese passengers in cabin features and services context in terms of culture. Key user profile is then analysed along with the Hofstede model which includes six dimensions of national cultures (Hofstede, 2011). With the implementation of the qualitative research synthesis, the findings from sources identified, **Figure 4.6** presents the framework of the process.

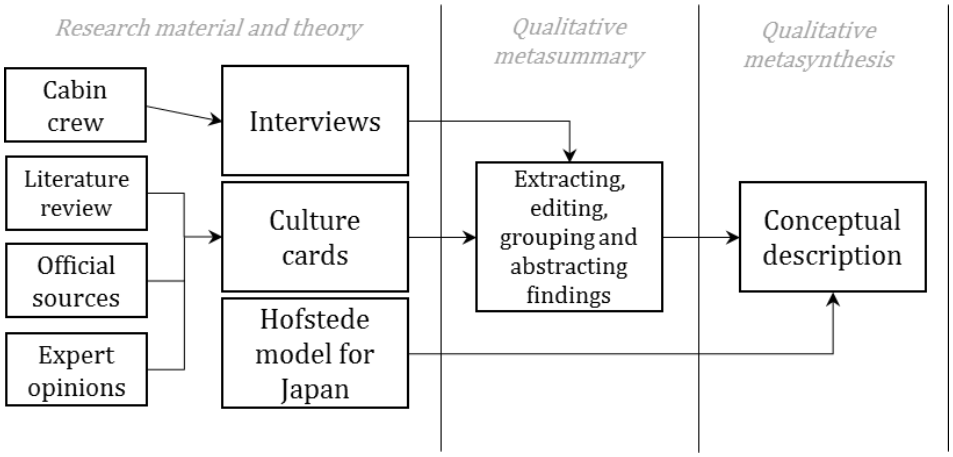


***Figure 4.6**. Qualitative research synthesis flowchart*

In the second stage of the analysis, metasynthesis techniques are utilised to provide a conceptual description of the findings. The findings from the qualitative metasummary are established as the groundwork (empirical foundation) for this stage of the analysis. In this research, taxonomic analysis approach is employed to develop an understanding of Japanese passengers within different topics related to cabin features and services. Taxonomic analysis is similar to axial and selective coding in theory development (Strauss and Corbin, 1998). As this approach is useful in providing conceptual descriptions and models, taxonomic analysis is the applied approach in the context of this qualitative metasynthesis (Sandelowski and Barroso, 2007).

Overall, the proposed methodology for the qualitative study allows for research to establish an understanding of Japanese passengers in terms of cabin features and services. The resulting conceptual description provides clear definition on the characteristics of Japanese passengers. In addition to the pilot study and literature review which is established to understand and investigate key cabin attributes (features and services), the output from the qualitative analysis enables further insight into relative culture-specific

features in terms of nationality. The findings from this analysis provides the supplementary basis and justification for the survey study which is conducted as part of the quantitative analysis.

4.3. Quantitative study

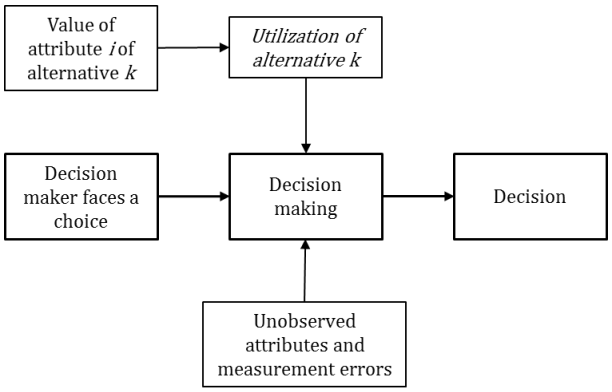
Quantitative studies principally provide numerical measurement to a research problem or set of questions. In this section, quantitative data collection and analysis techniques used in this research are explained while giving an insight into alternative methods. Often, data collection techniques in a quantitative study include experiments and surveys (Bryman, 2006). As discussed previously, experiments are designed to test the relationship between two or more independent variables and the dependent variable whereas surveys are designed to reveal a question from the data collected from subjects. In this research, a survey, as part of the data collection technique, is employed based on the descriptive part of this research to reveal passenger preferences in relation to cabin features and services. Quantitative analysis methods involves statistical techniques. These techniques include but are not limited to descriptive statistics (i.e. finding mean and variance), correlation or regression analysis, discriminant analysis, and cluster analysis.

In this research, for the purpose of revealing and understanding passenger preferences, discrete choice analysis is used. Discrete choice analysis is able to support the evaluation of the research questions relating to passenger preferences in cabin. It is considered the most appropriate method for an economic analysis (estimation of willingness to pay) for these preferences (CIE, 2001). In order to create a discrete choice model for a respective population, parameters were obtained from a stated preference survey.

4.3.1. Choice modelling

As briefly discussed in Chapter 2, discrete choice analysis seeks to model and predict the consumer choice behaviour. The underlying assumption (decision rule) in consumer choice behaviour, which is embedded in discrete choice models (DCMs), is the utility maximisation as stated by Ben-Akiva and Lerman (1985). It is assumed that in any given scenario, the decision maker, when presented with set of choices, will choose an alternative that yields the highest utility. With this rule, decision making process comprises the following sets; (1) decision maker faces a choice set, (2) decision maker evaluates attributes based on a choice rule , (3) decision maker makes a decision (**Figure**

4.7). While this process captures the assumed observed attributes of each alternative, it lacks in understanding unobserved attributes. In this case, the results or the estimations are theoretical idealizations rather than representations of reality (Ben-Akiva and Lerman, 1985).



Source: Author

***Figure 4.7**. Basic decision making process with the principle of maximum utilisation*

In this section, discrete choice modelling is explained in detail to construct the model at the analysis stage of the research. Discrete choice models predict the choice probability of an alternative for a decision maker over a finite choice set of "*mutually exclusive and collectively exhaustive*" alternatives as explained below (Garrow, 2010). In order to understand the background of discrete choice models, different choice theories and assumptions utilised in their development are explained. Furthermore, different choice models for different applications are explored. Before moving on to the survey studies, key statistical tests and properties involved in the model are also described.

4.3.1.1. Choice theories and assumptions

There are various choice theories in the literature that try to give a meaning to human behaviour. As Ben-Akiva and Lerman (1985) explain, while discrete choice analysis eventually aggregates the demand of a large population, this demand is a result of behaviour at the individual level. The following choice theories are explored to establish an understanding of the discrete choice analysis; rational behaviour, consumer choice theory, discrete choice theory, and the random utility assumption in probabilistic choice theory.

Rational behaviour

As the name suggest, rational behaviour implies that all choices made by decision makers are rational. This means people calculate the likely costs and benefits of any action prior to making a decision (Scott, 2000). This structured and consistent decision making process assumes that a respective decision maker would make the same decision over a choice set under identical conditions (Ben-Akiva and Lerman, 1985). Simply, there is no allowance for the fact that a decision maker may act differently, for example, making choices based on non-rational or emotional influences. Rational choice theory can prove useful in developing predictive behaviour models. Understanding of rational behaviour provides a baseline for the economic consumer theory where a mathematical approach is developed at an individual level in order to explain what, why, and how consumers choose.

Consumer choice theory

Consumer choice theory provides a framework to explain the behaviour of humans as economic agents with the assumption that relative behaviour is rational (Mas-Colell et al., 1995). Included as a theory in microeconomics, consumer choice theory is a result of two leading factors in decision making; preferences and ability (Browning and Zupan, 2014).

Although, consumer preference as the first factor differs from person to person, based on the theory, typical consumer preferences can be defined with four rational assumptions. The first assumption defining consumer preferences is completeness. This refers to the idea that the consumer will always have a preference when faced with two or more choices (Mas-Colell et al., 1995; Levin and Milgrom, 2004; Salvatore, 2008; Browning and Zupan, 2014). In any given scenario with two or more choices, the consumer would prefer one alternative over another or they would be indifferent for them which means all alternatives are equally important or satisfactory based on the consumer's taste or requirements. Assume that a consumer chooses among two consumption bundles (alternatives) , *x* and *y*,

$$x = \{q_1, \dots, q_L\} \text{ and } y = \{w_1, \dots, w_L\} \qquad \textbf{\textit{Eq. 4.1}}$$

where l=1,2,…,L are designated to q and w, each of the commodities and services as the only attributes defining an alternative. In this case, based on the assumption, the consumer would have a preference on the consumption bundle when two or more of these bundles are given

$$x \succcurlyeq y \text{ or } y \succcurlyeq x \text{ or both} \qquad \textit{Eq. 4.2}$$

where $\succcurlyeq$ denotes at least as good as. The second assumption states that consumer preference is transitive. Transitivity defines the idea that consumer preference is successive over different alternatives (Mas-Colell et al., 1995; Levin and Milgrom, 2004; Browning and Zupan, 2014). For example, if a consumer prefers product A over product B and product B over product C, transitivity assumes the consumer would prefer product A over product C. This assumption proves the rational nature of the theory (Mas-Colell et al., 1995). Assume z is added to the consumption bundles in **Eq**. 4.1, the transitivity relationship is then

$$\text{if } x \succcurlyeq y \text{ and } y \succcurlyeq z, \text{then } x \succcurlyeq z \qquad \textit{Eq. 4.3}$$

The third assumption is the nonsatiation. This implies that the consumer always prefers more in quantity (Mas-Colell et al., 1995; Levin and Milgrom, 2004; Salvatore, 2008; Browning and Zupan, 2014). The fourth and final assumption included is convexity. Convexity is part of a concrete hypothesis in economics which can be interpreted with diminishing marginal rates of substitution (Mas-Colell et al., 1995). With this assumption, it is accepted that consumer needs larger quantities of an alternative in case of a loss in quantities of another (Mas-Colell et al., 1995; Levin and Milgrom, 2004; Salvatore, 2008; Browning and Zupan, 2014).

Under these assumptions, with the introduction of a choice rule, which is the maximum utilisation in this case, utility set of L number of alternatives (q) based on the assigned attributes is defined as

$$U = U(q_1, \dots, q_L) \qquad \textit{Eq. 4.4}$$

where U denotes the utility function, then the statement $x \succcurlyeq y$ in **Eq**. 4.2 can be represented as

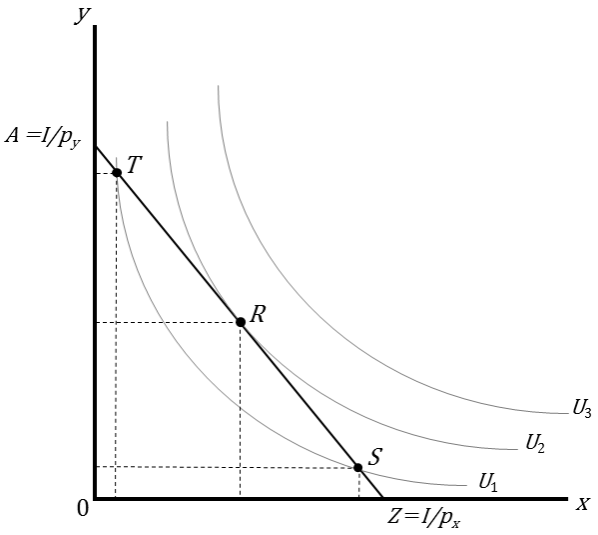
$$U(x) \geq U(y) \qquad \textbf{Eq. } 4.5$$

The second factor in consumer theory is the ability of consumers to acquire goods or services. This acts as a constraint on consumer preferences. This economic constraint can be considered as a budget constraint (Browning and Zupan, 2014). While it is assumed that the consumer will opt for their preferred choices, the budget constraint deeply affects the choice set the consumer has access to. The budget constraint can be defined as

$$\sum_{l=1}^{L} p_l q_l \leq I \qquad \textbf{Eq. } 4.6$$

where I is the fixed income of the consumer and p_1 to p_L are the fixed prices for each alternatives q.

The integration of the two factors explained define consumer theory. In consumer theory, nonnegative continuous variables are assumed in the model. In order to show the ordinal measure of preferences with the objective of maximizing the utility as the choice rule, indifference curves are employed. The curved lines represent the utility achieved by different combinations of consumption bundles. Indifference curves must be negatively sloped based on the consumer preference assumption of convexity (Salvatore, 2008). The budget line is then represented as a negatively sloped straight line. **Figure 4.8** shows the indifference curve graphs for x and y with the budget constraint. In the graph, there are three indifference curves tagged as U_i (i=1, 2, 3) defined by the utilisation level of the combination of different quantities from x and y. As the position of the curve moves towards right, the amount of utilisation increases (i.e. $U_1<U_2<U_3$). This can be explained by the nonsatiation assumption on consumer preferences.



Source: Author based on Salvatore (2008) and Browning and Zupan (2014)

***Figure 4.8**. Optimal choice graph with budget constraint*

In **Figure 4.8**, the budget line is indicated by the slope function of p_x/p_y. Points *A* and *Z* respectively represent the maximum amount of only *y* or only *x* the fixed income *I* of a consumer can afford based on the fixed prices of *y* and *x*. In this case, the optimal consumption bundle with *x* and *y* for maximum utilisation is at the point *R* where the budget line and U_2 intersect.

Overall, consumer choice theory presents a rational ideology in an effort to explain consumer behaviour and estimate demand mathematically. The theory reflects the behaviour of consumers at an individual level whose preferences and choices are contained and defined with values of the parameters in the choice rule which is based on the utility function. As stated earlier, consumer preferences within these parameters varies from person to person. Therefore, the socio-economic characteristics of the consumer can be included especially for empirical studies. (Ben-Akiva and Lerman, 1985). There exists different extensions of the consumer choice theory which implement further assumptions or restrictions on demand functions (Strotz, 1957, 1959; Becker, 1965; Lancaster, 1966; Muth, 1966). In any case for consumer choice theory, it is expected that there are differences between the actual observation and the estimated or predicted choices which is explained as a random error (consumer optimization and measurement error).

Discrete choice theory

Discrete choice theory is fundamentally similar to consumer choice theory. However, as explained previously, consumer choice theory is based on non-negative continuous variables. Discrete choice theory does not follow this assumption as the value of one or more alternatives or commodities can be zero which the utilisation maximization would yield corner solutions. Assume the utility function in **Eq.** 4.4 with three alternatives (q_1, q_2, q_3) to choose

$$U = U(q_1, q_2, q_3) \qquad \textit{Eq. 4.7}$$

where alternatives (q_1, q_2, q_3) can have values of 1 or 0 (respectively chosen and not chosen)

$$q_1 = \begin{cases} 1 & \text{if } q_1 \text{ chosen} \\ 0 & \text{otherwise} \end{cases}$$

$$q_2 = \begin{cases} 1 & \text{if } q_2 \text{ chosen} \\ 0 & \text{otherwise} \end{cases}$$

$$q_3 = \begin{cases} 1 & \text{if } q_3 \text{ chosen} \\ 0 & \text{otherwise} \end{cases} \qquad \textbf{\textit{Eq. 4.8}}$$

Among these three alternatives (q_1, q_2, q_3), it is allowed that only one alternative can be chosen

$$q_1 q_2 = q_1 q_3 = q_2 q_3 = 0 \qquad \textit{Eq. 4.9}$$

With the assumptions listed, the utility function can have only three different solutions with corner values of $U(1, 0, 0)$, $U(0, 1, 0)$, and $U(0, 0, 1)$. Under these circumstances, as Ben-Akiva and Lerman (1985) explain that with discrete choice theory, it is not possible to estimate a demand function as it is the case with the consumer choice theory. Instead, discrete choice theory adopts different mathematical properties with the discrete depiction of the choice sets working directly with the utility functions (Ben-Akiva and Lerman, 1985).

Working directly with the utility function means that the theory focuses on attributes defining an alternative and the parameters defining the individual consumer preferences

for those attributes. Assume the utility functions of three alternatives U_i (i=1, 2, 3) and three attributes defining the alternatives (k_i, l_i, m_i)

$$U_1 = \beta_1 k_1 + \beta_2 l_1 + \beta_3 m_1$$

$$U_2 = \beta_1 k_2 + \beta_2 l_2 + \beta_3 m_2$$

$$U_3 = \beta_1 k_3 + \beta_2 l_3 + \beta_3 m_3 \qquad \textbf{Eq.}\ 4.10$$

where β_1, β_2, and β_3 are the parameters expressing the consumer preferences for the relative attribute. These values are predicted and the estimation approach is defined as revealed preference. With the values defining the utility of each alternative, the relationship between the utilities of each alternative is used to conclude the choices. In this case, when ties are ignored, it is assumed if

$$U_1 \geq U_2 \qquad \textbf{Eq.}\ 4.11$$

and

$$U_1 \geq U_3 \qquad \textbf{Eq.}\ 4.12$$

then alternative 1 is chosen. This relation is further extended to differences between the values of attributes with their β values. Assume β_3=0 and **Eq.** 4.10 is divided by β_2 without changing the ranking

$$U_1 = \beta_1 k_1 + l_1$$

$$U_2 = \beta_1 k_2 + l_2$$

$$U_3 = \beta_1 k_3 + l_3 \qquad \textbf{Eq.}\ 4.13$$

Considering that alternative 1 is chosen over alternative 2 in the first observation, it implies

$$\beta_1 k_1 + l_1 \geq \beta_1 k_2 + l_2 \qquad \textbf{Eq.}\ 4.14$$

which equates to

$$\beta_1 (k_1 - k_2) \geq l_2 - l_1 \qquad \textbf{Eq.}\ 4.15$$

assuming

$$k_1 - k_2 > 0 \qquad \textbf{Eq.}\ 4.16$$

and

$$l_2 - l_1 > 0 \qquad \textbf{Eq.}\ 4.17$$

giving the boundry

$$\beta_1 \geq \frac{l_2 - l_1}{k_1 - k_2} \qquad \textbf{Eq.}\ 4.18$$

In the second observation, assume alternative 3 is chosen over alternative 1. With the same deduction from **Eq.** 4.14 to **Eq.** 4.15, this observation implies

$$\beta_1(k_3 - k_1) \geq l_1 - l_3 \qquad \textbf{Eq.}\ 4.19$$

again assuming

$$k_3 - k_1 > 0 \qquad \textbf{Eq.}\ 4.20$$

and

$$l_1 - l_3 > 0 \qquad \textbf{Eq.}\ 4.21$$

giving the bound

$$\beta_1 \geq \frac{l_1 - l_3}{k_3 - k_1} \qquad \textbf{Eq.}\ 4.22$$

These bounds are then used to estimate the value of β_1. More observations will prove beneficial as more inequalities are produced to further narrow the range of possible values for β_1 (Ben-Akiva and Lerman, 1985). On the other hand, cases of equalities through the observations show the indifference attributes for consumers when making a decision.

On top of this basic understanding of the discrete choice theory, in general, the budget constraint is included as vector of the socio-economic characteristics of individuals. This can be represented as

$$U_{in} = U(z_{in}, S_n) \qquad \textbf{Eq. } 4.23$$

where utility *U* of an alternative *i* is based on the vector of attribute values for alternative *i* for individual n, z_{in} and the vector of individual attributes such as age, gender, income, and education of individual *n*, S_n (Ben-Akiva and Lerman, 1985; Garrow, 2010).

Overall, the discrete choice theory provides a useful framework to understand consumer choice behaviour. This theory, while retaining the concept of rational behaviour and consumer preference assumptions discussed in consumer choice theory, differs with the discrete approach to decision making process or consumer choices. Examination of different attributes based on different characteristics of consumers or individuals can help to estimate and predict the choices of consumers. Based on the given description and understanding of the discrete choice theories, consumer behaviour and choices can be modelled and revealed through utility observations in given scenarios.

Random Utility

Random utility is an approach in probabilistic choice theory (Luce and Suppes, 1965). Probabilistic choice theory tries to explain the inconsistencies in choice behaviour by capturing the effects or unobserved attributes or error. Additional to discrete choice theory, the random utility approach in probabilistic choice theory acknowledges that the utility values are not known therefore are assumed as random variables (Manski, 1977). This reflects on the choice probability as

$$P(i|C_n) = \Pr[U_{in} \geq U_{jn}, \forall\, j \in C_n \wedge j \neq i] \qquad \textbf{Eq. } 4.24$$

where *i* and *j* are two alternatives in the choice set C_n and *n* is the decision maker. Four different sources for randomness are (1) unobserved attributes, (2) unobserved taste variations, (3) measurement error and imperfect information, and (4) instrumental variables (Manski, 1973). Assuming a joint probability distribution, these error are then represented with term ε *in*

$$\{\varepsilon_{in}, i \in C_n\} \text{ and } \{\varepsilon_{jn}, j \in C_n\} \qquad \textbf{Eq. } 4.25$$

When integrating random error into the choice probability of *i* in **Eq.** 4.24 with *J* (*i*=1, 2, …, *J* and *j*=1, 2, …, *J*) number of alternatives and without any assumptions on the random error distribution then becomes

$$P_n(i) = \Pr(V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn}, \forall\, j \in C_n \wedge j \neq i)$$

$$= \Pr(\varepsilon_{jn} \leq V_{in} - V_{jn} + \varepsilon_{in}, \forall\, j \in C_n \wedge j \neq i)$$

$$= \int_{\varepsilon_i=-\infty}^{\infty} \int_{\substack{\varepsilon_j=-\infty \\ \forall\, j \neq i}}^{\infty} f(\varepsilon) d\varepsilon_J, \ldots, d\varepsilon_{i+1}, d\varepsilon_i \qquad \textit{Eq. 4.26}$$

While the decision rule is clear on assuming the decision-maker chooses the alternative with a greater utility, this is not always the case when the utilities are not known in which inconsistencies occur. Through the integration of random utilities, inconsistencies in observation are considered as an error. This is useful as it considers the inconsistencies while remaining true to the rational consumer choice theory.

4.3.1.2. Discrete choice models

Discrete choice models are developed to estimate and reveal consumer preferences and choices. There are different choice models such as binary and multinomial choice models. While a multinomial discrete choice model is developed in this research, listed models are investigated in order to provide a broader perspective on the application of discrete choice models.

In any case, discrete choice models are constructed on top of four elements based on discrete choice theory and the framework developed by Domencich and McFadden (1975); (1) a decision maker, (2) alternatives, (3) attributes, and (4) a decision rule (Ben-Akiva and Lerman, 1985; Garrow, 2010). All these elements are explained based on the definitions provided by Ben-Akiva and Lerman (1985) in the following discussion. The decision maker within a choice model is the subject focus whose decisions are modelled. The decision maker can be an individual person, a group of people (e.g. family, department), or an organisation (e.g. company, government). It is accepted that each decision maker will have a different background, behaviour, and preferences. In other words, specific decisions by a decision maker can be a result of personal circumstances or socioeconomic characteristics. The second element is the alternative. Alternatives are

the options that a decision maker can choose. The alternatives should have the same basic service or product with similar or same purpose. This means they should be in the same choice set which is a subset of the universal set defined by the decision maker. The third element is the attribute. Attributes are vectors defining a given alternative with ordinal or cardinal values assigned (e.g. big/small or $1/$2). Finally, the fourth element is the decision rule. The decision rule describes the decision-making criteria or the process.

As stated, a decision maker within a discrete choice model is the individual, group of people, or an organization. In this research, the decision maker is an individual defined by the requirements of the research. It is important to identify individual difference among decision makers even though the estimations are aggregated. There can be different characteristics implemented to identify and estimate various behaviours. These characteristics and requirements for the decision maker are explained in the next section (Section 4.3.2).

Alternatives are the options that a decision maker can choose. In this research, alternatives included are naturally discontinuous. Alternatives can include a same product or services by different manufacturers or service providers or they can include similar products or services that satisfies the same objective. In any case, alternatives must be distinguishable from each other while being similar enough for comparison. Different alternatives types that can be included are explained in the next section (Section 4.3.2).

Alternatives in the determined choice sets are defined by the respective attributes. The values of attributes in the utility function are assigned by the individuals (decision makers). In this research, included attributes are heterogeneous which means the description of alternatives by attributes are not vectors of quantity. Different categories of attributes are further discussed in the next section (Section 4.3.2).

The decision rule or choice rule explains the decision process. In this research, utility maximisation is adopted as the decision rule for the discrete choice model developed. Along with the utility, different decision rules in the literature include dominance, satisfaction, and lexicographic rules. The dominance rule assumes that an alternative with at least on better attribute and others not any worse is dominant compared to another alternative in the decision process. Chosen attributes are assumed to be the only factors influencing the individual, thus eliminating the possibility of a unique choice (Ben-Akiva

and Lerman, 1985). The satisfaction rule prioritises the comfort and satisfaction level of the individual which may not even lead to a choice while the lexicographic rule assumes that the choice is based on the ranked importance of attributes. In this research, the utility rule is adopted. The utility rule assumes that the desirability of alternatives is based on a vector of attributes which is defined by a single objective function (Ben-Akiva and Lerman, 1985). In this case, the objective function is the maximisation of utility. The comparison of utilities of different alternatives then reveals the choice (i.e. alternative with the highest utility is chosen).

These core elements are part of any discrete choice model. As mentioned, there are different discrete choice models for different circumstances. These circumstances depend on the numbers and the dimensions of the alternatives included. For a decision maker to face a choice scenario, at least two alternatives must be presented. Therefore, discrete choice models can estimate any choice set (C_n) with two or more alternatives or options.

Binary choice models

When the choice set (C_n) includes two alternatives, then a binary choice model is developed. This is the simplest form of discrete choice models and provides a clear understanding of the utilisation of discrete choice models for more complex applications. Assume two alternatives in a choice set $C_n=\{i, j\}$, then in binary choice models, the choice probability of individual n choosing alternative i is ultimately the probability of the utilisation of the alternative i being greater than or equal to the utilisation of the other alternative j which is

$$P_n(i) = Pr(U_i \geq U_j) \qquad \textbf{Eq. } 4.27$$

The choice probability of an individual n choosing alternative j is

$$P_n(j) = 1 - P_n(i) \qquad \textbf{Eq. } 4.28$$

As discussed in random utility theory, it is assumed that the utilities U_i and U_j are random variables with observed values (systematic component) and the random error part

$$U_{in} = V_{in} + \varepsilon_{in}$$

$$U_{jn} = V_{jn} + \varepsilon_{jn} \qquad \textbf{Eq. } 4.29$$

where

$$V_{in} = \sum_{k=1}^{K} \beta_k x_{kin}$$

$$V_{jn} = \sum_{k=1}^{K} \beta_k x_{kjn} \qquad \textbf{Eq. } 4.30$$

where x is the attribute and k are the number of attributes with k=1, 2, …, K with the parameter β. Then the probability of an individual n choosing i is

$$P_n(i) = Pr(V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn}) \qquad \textbf{Eq. } 4.31$$

The systematic component in the model is integrated with the random error. This is done by considering $\varepsilon_{jn} - \varepsilon_{in}$ (ε_n) instead of focusing on the individual elements. The mean values from the distribution of these disturbances are then added as a constant to the systematic component. The most convenient assumption in any case is that the mean of disturbances is zero. Based on the distribution assumed for the disturbances there are different models developed to estimate the choice probabilities. That is, if the distribution for disturbances is uniform, then a binary linear model is developed

$$P_n(i) = \begin{cases} 0 & \text{if } V_{in} - V_{jn} < -L \\ \int_{-L}^{V_{in}-V_{jn}} f(\varepsilon_n) d\varepsilon_n & \text{for } -L \leq V_{in} - V_{jn} \leq L \\ 1 & \text{if } V_{in} - V_{jn} > L \end{cases} \qquad \textbf{Eq. } 4.32$$

where $-L$ and L are the fixed values defining the uniform distribution. If the distribution is normal, then a binary probit model is developed

$$P_n(i) = \Phi\left(\frac{V_{in} - V_{jn}}{\sigma}\right) \qquad \textbf{Eq. } 4.33$$

where Φ denotes the normal distribution and σ is the variance which is usually assumed as 1. And finally, if the distribution is logarithmic, then a binary logit model is developed.

$$P_n(i) = \frac{1}{1 + e^{-\mu(V_{in} - V_{jn})}} \qquad \textbf{Eq. } 4.34$$

where μ is the scale parameter which is generally assumed to be 1.

In any case, the estimation of the coefficients β_k is utilised through deployment of a maximum likelihood technique amongst other estimation procedures such as ordinary least squares regression. Maximum likelihood estimation procedures are widely used in choice models (Ben-Akiva and Lerman, 1985). The maximum likelihood function is given as

$$\mathcal{L}^*(\beta_1, \beta_2, \dots, \beta_K) = \prod_{n=1}^{N} P_n(i)^{y_{in}} P_n(j)^{y_{jn}} \qquad \textbf{Eq. } 4.35$$

where $\mathcal{L}^*$, the maximum likelihood function with β_k parameters, is the product of the likelihoods of N number of individual observations with indicator variables of y_{in} and y_{jn}. In the case of a binary probit model, the maximum likelihood function of $\mathcal{L}$ is

$$\mathcal{L} = \sum_{n=1}^{N} \left\{ y_{in} \log\left(\frac{e^{V_{in}}}{e^{V_{in}} + e^{V_{jn}}}\right) + y_{jn} \log\left(\frac{e^{V_{jn}}}{e^{V_{jn}} + e^{V_{in}}}\right) \right\} \qquad \textbf{Eq. } 4.36$$

And in case of a binary logit model, the maximum likelihood function of $\mathcal{L}$ is

$$\mathcal{L} = \sum_{n=1}^{N} \{ y_{in} \log \Phi(V_{in} - V_{jn}) + (1 - y_{in}) \log[1 - \Phi(V_{in} - V_{jn})] \} \qquad \textbf{Eq. } 4.37$$

In cases of more than two alternatives provided, multinomial choice models are developed as explained below.

Multinomial choice models

As mentioned, multinomial choice models are developed for more than two alternatives. While these models follow the same concept of estimating choice probabilities, multinomial choice models assumes joint distributions for disturbances rather than simply including $\varepsilon_{jn} - \varepsilon_{in}$.

In many cases, a decision maker's choice set C_n includes J_n (j_n=1, 2, …, J_n) number of various alternatives for the purpose of the same objective. With this in mind, as discussed before, the selection of feasible alternatives becomes important. As more alternatives are involved in the decision making process, the choice set should be reasonably designed with deterministic rules. With reasonable alternatives in place, the choice probability of alternative *i* in multinomial choice models is derived from the binary choice models in **Eq.** 4.31 is

$$P_n(i) = Pr\left[V_{in} + \varepsilon_{in} \geq \max_{\substack{j \in C_n \\ j \neq i}} (V_{jn} + \varepsilon_{jn})\right] \qquad \textit{Eq. 4.38}$$

where the probability is the probability of the utilisation of alternative *i* being greater than the maximum utility of any of the other alternatives which is defined as the composite alternative *j*.

The multinomial logit model is the most common discrete choice model. The choice probability model is expressed as

$$P_n(i) = \frac{e^{V_{in}}}{\sum_{j \in C_n} e^{V_{jn}}}$$

$$= \frac{1}{\sum_{j \in C_n} e^{[-(V_{in} - V_{jn})]}} \qquad \textit{Eq. 4.39}$$

which is the same as binary logit model if the number of alternaives J_n is two. Within the choice probability, latent error variables are generally assumed to be Gumbel distributed (Ben-Akiva and Lerman, 1985; Garrow, 2010). The Gumbel distribution is beneficial particularly in a case where the two random error variables have the same scale because the difference between the variables produces a logistic distribution (Garrow, 2010). The distribution have two definitive parameters; location parameter η and a scale parameter μ. These parameters define the mean and variance as follows

$$\text{mean} = \eta + \frac{\gamma}{\mu} \qquad \textit{Eq. 4.40}$$

where γ denotes the Euler constant (0.57721) and

$$\text{variance} = \frac{\pi^2}{6\mu^2} \qquad \textit{Eq. 4.41}$$

With the defined parameters, cumulative (*F*) and probability (*f*) distribution functions of error terms are

$$F(\varepsilon) = \exp\left[-e^{-\mu(\varepsilon-\eta)}\right], \mu > 0$$

$$f(\varepsilon) = \mu e^{-\mu(\varepsilon-\eta)} \exp\left[-e^{-\mu(\varepsilon-\eta)}\right] \qquad \textit{Eq. 4.42}$$

Then the choice probability for alternative *i* by individual *n* in the multinomial logit model provided by Domencich and McFadden (1975) with the assumptions that ε is Gumbel distributed and η=0 is

$$P_n(i) = \frac{e^{\mu V_{in}}}{\sum_{j=1}^{J_n} e^{\mu V_{jn}}} \qquad \textit{Eq. 4.43}$$

While multinomial logit models provide a straightforward method for predicting choice probabilities, it is associated with some inherent limitations. Firstly, if the probability distribution scale parameter μ approaches zero ($\mu \rightarrow 0$), then the disturbances ($\varepsilon_{jn} - \varepsilon_{in}$) approaches to infinity. This yields no estimation as the variable range is infinite. On the contrary, if $\mu \rightarrow \infty$, then the disturbances approach zero. In this case, the model becomes a deterministic choice model where no random error is included. Other limitations discussed in the literature is the IIA property (Ben-Akiva and Lerman, 1985; Garrow, 2010). The Independence of Irrelevant Alternatives (IIA) property assumes that the choice probability of an alternative in a choice set for an individual is not affected by any other alternative outside of the choice set. The IIA is further explained with the "red bus, blue bus" problem (Ben-Akiva and Lerman, 1985; Garrow, 2010). This problem is reflected in a scenario where a third alternative is introduced in a model which a decision maker has to make a decision between driving and taking the red bus to work. The introduced third alternative is assumed to have the same attribute values as the red bus but the colour is blue which is assumed to be an irrelevant in the choice dimension. Although, it is expected that it would not change the choice probability of driving to work and the choice probability of taking the red bus to work would be divided between the red bus and the blue bus, the multinomial logit model distributes the choice probability

proportionately from all previous alternatives affecting the choice probability of driving to work. Assume the choice probability of driving to work is 0.50 and taking the red bus to work is 0.50, then the values in the "red bus, blue bus" problem are presented in **Table 4.5** below.

***Table 4.5**. The "red bus, blue bus" problem in IIA property*

Model	Car	Red bus	Blue bus
Original model	0.50	0.50	0
With the blue bus (expected)	0.50	0.25	0.25
With the blue bus (multinomial logit model)	0.33	0.33	0.33

One further step from the multinomial logit model is the mixed logit or mixed multinomial logit models. Mixed logit models allow the decisive parameter β_k to be random in addition to the random error ε. In this case, with appropriate variables and coefficients, estimation involving random taste variation over individuals can be achieved with mixed logit models (McFadden and Train, 2000). This relaxes some of the limitations imposed by utilising a multinomial choice model such as the IIA property since IIA is assumed at individual level (McFadden, 1974; Hess, 2007; Espino et al., 2008). The unconditional choice probability in mixed logit models is given as

$$P_n(i) = \int \frac{e^{V_{in}}}{\sum_{j \in C_n} e^{V_{jn}}} f(\beta|\theta) d\beta \qquad \textbf{Eq. } 4.44$$

where V_{in} and V_{jn} are defined functions of β_k and θ is the set of definitive distribution parameters (i.e. mean and variance). As shown in **Eq.** 4.44, the integral is indefinite with an open form. Therefore, the estimation is achieved through a straightforward simulation for the values of β_k (Train, 2009). According to Train (2009), the framework for a simple accept-reject simulation is as follows

1. Draw from the random set of values in the distribution

2. Calculate the utility of each alternative and identify alternative with the highest utility
3. Repeat steps 1 and 2 several times
4. Calculate the simulated probability for an alternative as the proportion of draws which that alternative has the highest utility

Overall, both multinomial logit model and mixed logit model are useful in developing an estimation method for discrete choice analysis. Mixed logit models can avoid certain restrictions that multinomial logit models have for correlation of alternatives as a result of random taste variation among individuals. In any case, as provided in the last chapter, both are useful and for modelling the choice probabilities in air transport studies.

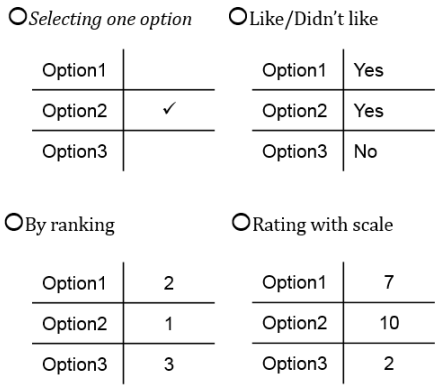
In the next section, the data collection method which is the stated preference survey for the discrete choice model developed in this research is explained. Further explanations and definitions for choice sets, alternatives and attributes are presented in relation to the discrete choice model.

4.3.2. Stated preference data

In order to understand and truly reflect the passengers' expectations and preferences on aircraft cabin interior and service, a comprehensive survey study is required to develop the discrete choice model. It is important to determine and define the parameters of the survey in order to retrieve relevant data for analysis as explained previously. There are various methods in data collection through surveys. In general, with straightforward surveys, the willingness and dependability of respondents are questionable when responding to surveys (Kellet et al., 2003). Especially, for surveys that ask respondents to evaluate and select hypothetical choice sets as the results from the survey can be biased and may not provide robust results.

Straightforward preference surveys include; (1) simply selecting a preferred option, (2) selecting multiple options, (3) ranking options by preference, (4) rating options on a scale based on preference (**Figure 4.9**). These alternative methods are used to answer related research questions. When assessing the preference of respondents, a straightforward preference survey can be useful for the overall understanding of the surface level preference. While there are various alternative survey methodologies in the literature, for the purpose of estimating choice probability of passengers on cabin related attributes with

a discrete choice model (DCM), a stated preference (SP) survey method is adopted to collect stated preference data. Stated preference surveys can eliminate many of the potential problems while minimising biased opinion.



Source: Author

***Figure 4.9**. Straightforward preference surveys*

As explored in the previous chapter, stated preference (SP) data are commonly utilized in the analysis of preferences and behaviors of respondents in air travel. While there is an alternative set of data that is comparable to stated preference data, in this section justification for adopting a stated preference strategy is provided and further insights into the design of stated preference surveys are presented. Later, the specific design strategy developed for this research is explained along with defined alternatives and attributes.

An alternative to stated preferences data to model the choice probability, is the revealed preferences (RP) data. Revealed preferences are used to develop the discrete choice model by utilizing historical data or revealed data. In this case, choice data of respondents are obtained from real life choices of respondents in existing or historical market conditions (Garrow, 2010). For example, airline booking data would be a source for revealed preferences data. These databases include detailed flight and passenger information which are not usually accessible to the public or to researchers (Garrow, 2010). Booking data is generally used by respective airlines for scheduling, revenue management, and route optimizations. However, in air transport there are various sources of data for obtaining revealed preferences based on flight data. Revealed preference data used in developing discrete choice models are commonly included in studies for forecasting with operational focus (Garrow, 2010). The advantages and disadvantages of revealed preference data are listed in **Table 4.6**. Large databases for the revealed preference data in question can span over several years recording the choice made by significant volumes

of individuals. This can be beneficial especially for forecasting studies. On the other hand, a large dataset does not necessarily imply that the data obtained is related to the research or will have all the relevant information needed for estimation purposes. This means that the span of information obtained can be limited. The next advantage is the actual behavior which means that the data obtained represent the real-life choices of respondents. This can be defined as "natural" behavior. However, because the data obtained is historical, there may be a case where the conditions of the market from when the data was collected no longer apply or that the characteristics of individuals have changed. In this case, the revealed preference data can lose its relevance. Another advantage is that revealed preference data is available immediately. There is no waiting for data to be collected or to become available. Although, that is the case, some datasets may be difficult or impossible to obtain based on proprietary accessibility restrictions applied on the source.

***Table 4.6**. Advantages and disadvantages of revealed preferences*

Advantages	Disadvantages
Access to large datasets	Limited information
Actual behavior	Relevance to date
Ready	Accessibility

On the other hand, stated preference data can be collected from real-time surveys where respondents make choices in defined hypothetical scenarios. The advantages and disadvantages of stated preference data are listed in **Table 4.7**. In this case, specific information related to the research is collected through a well-designed survey. Hypothetical scenarios and relative alternatives and attributes are defined according to research requirements. This is especially important in cases where an understanding is needed on how consumers are likely to respond to new products and services. On the other hand, since it is a hypothetical scenario, there may be bias in respondents' preferences. Therefore, it assumed that the preferences indicated by respondents to stated preference surveys actually represent their true preferences. The other advantage of stated preference data is that the data collected is fully relevant to the research as the survey is designed and developed specifically to the needs of the study. However, stated preference surveys by necessity are usually relatively long. Because they can be time consuming and

relatively costly, it is generally difficult to reach to a large sample size, and as a result, stated preference surveys are usually limited in the number of respondents they can include. Another advantage is that the data collected is up-to-date, as it presents the real-time preferences and values of the respondents on the topic in question.

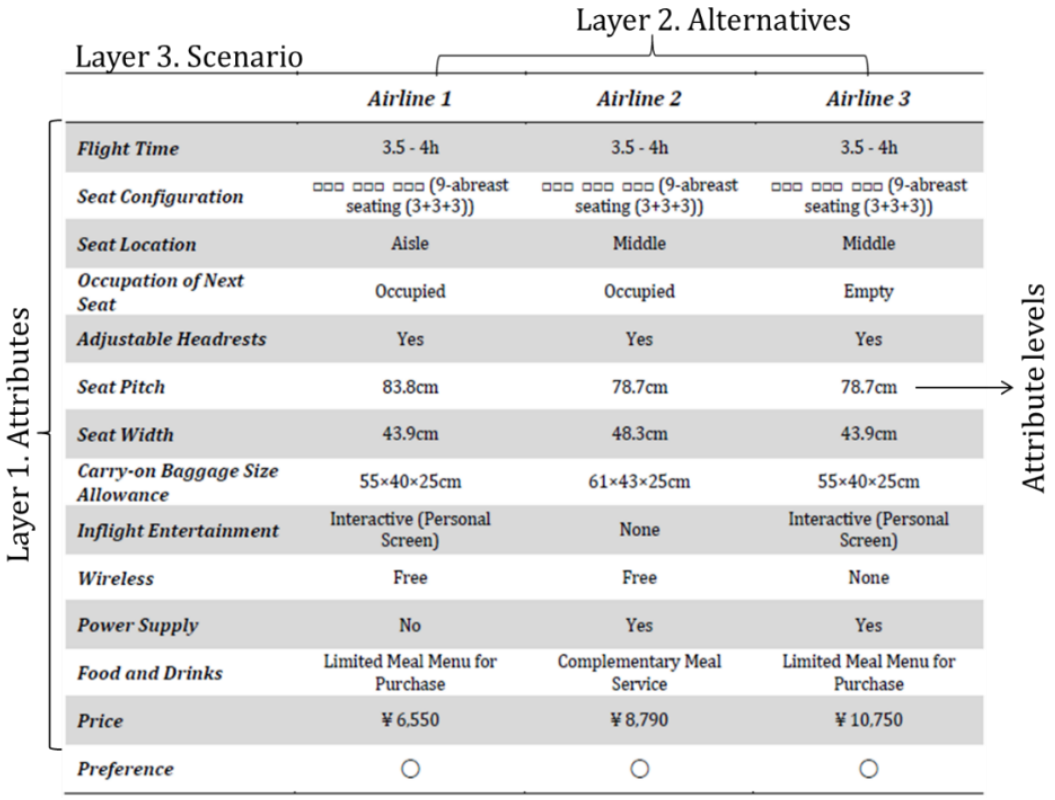
Table 4.7. *Advantages and disadvantages of stated preferences*

Advantages	Disadvantages
Hypothetical scenarios	Bias
Specific information	Limited audience
Up-to-date	Costly

While Garrow (2010) states that revealed preference is more commonly used in air travel studies with limited sociodemographic and socioeconomic information, stated preference data is used in cases with hypothetical scenarios or when specific information is needed. Considering all the advantages and disadvantages of both revealed preference and stated preference data, this research uses stated preference data to develop the discrete choice model. With stated preference data, the research can include specific information related to the research question by introducing a hypothetical scenario for a specific case. In this case, in order to collect relevant information (stated preference data), a stated preference survey is designed and distributed. As presented in the previous chapter, stated preference survey studies are usually included in behavior modelling (airport/airline choice) and willingness to pay in many selected studies (Algers and Beser, 2001; Carlsson, 2003; Adler et al., 2005; Hess and Polak, 2005; Collins et al., 2012).

As explained, stated preference surveys can be implemented to estimate the demand for new services or products. In addition, hypothetical scenarios can be analyzed with existing services or products. Within stated preference surveys, categorical and nominal variables can be investigated together. In an overview, stated preference surveys can be described as a simulation for respondents to make a decision in a particular scenario. In most decision processes, there are several factors that might affect the overall choice. These factors can be internal relating to a specific scenario or can be external unrelated to the situation. In order to successfully analyze the preferences, a stated preference surveys can be divided to three layers; attributes, alternatives, and scenarios (choice sets)

(**Figure 4.10**). Various scenarios throughout the stated preference survey are presented for individuals based on a hypothetical but realistic and relatable situation.



	Airline 1	Airline 2	Airline 3
Flight Time	3.5 - 4h	3.5 - 4h	3.5 - 4h
Seat Configuration	□□□ □□□ □□□ (9-abreast seating (3+3+3))	□□□ □□□ □□□ (9-abreast seating (3+3+3))	□□□ □□□ □□□ (9-abreast seating (3+3+3))
Seat Location	Aisle	Middle	Middle
Occupation of Next Seat	Occupied	Occupied	Empty
Adjustable Headrests	Yes	Yes	Yes
Seat Pitch	83.8cm	78.7cm	78.7cm
Seat Width	43.9cm	48.3cm	43.9cm
Carry-on Baggage Size Allowance	55×40×25cm	61×43×25cm	55×40×25cm
Inflight Entertainment	Interactive (Personal Screen)	None	Interactive (Personal Screen)
Wireless	Free	Free	None
Power Supply	No	Yes	Yes
Food and Drinks	Limited Meal Menu for Purchase	Complementary Meal Service	Limited Meal Menu for Purchase
Price	¥ 6,550	¥ 8,790	¥ 10,750
Preference	○	○	○

Source: Author

Figure 4.10. *A sample of a choice set with alternatives and defined attributes*

The aspect of the analysis of cabin interior and in-cabin services includes identifying specific factors that are important to passengers which are called attributes. These attributes define the variation between proposed alternatives within the scenarios. The attributes can be categorized in three types; (1) physical, (2) functional, (3) perception (Lefkoff-Hagius and Mason, 1993). Physical attributes include the characteristics of the proposed alternatives which can be measured and are meaningful to the individuals (i.e. seat pitch). Functional attributes consist of any attribute related to the alternative based on the effect on the individual (i.e. meal service). Perception consists of sociological aspects which explain the self-image of respondents in which way they think the attribute reflect them. Different categories can be linked in one attribute. In any case, the variation is produced by different levels of the same attribute for different alternatives. In addition, attributes can include alternative-specific or generic factors. While attributes defining the alternative are considered to be generic, the characteristic data of decision makers can be

considered to be both alternative specific and generic since these characteristics (i.e. sociodemographic, socio-economic) can affect the value of attributes (Rose et al., 2008; Garrow, 2010). For a robust data analysis, attributes should be related to the respondent and must reflect the key factors. This can be assured through focus groups, pilot studies, observation, extensive research, or expert opinions. In this research, attributes are determined based on the extensive research, a pilot study, and informal discussions with industry members (expert opinions) as explained in later in the text.

Various scenarios in stated preference surveys include different alternatives to be chosen by individuals. These alternatives are the elements of a defined choice set (scenario) and can be represented in the survey in two types; (1) unlabeled, or (2) labelled. Unlabeled alternatives provide a generic option for respondents (i.e. airline 1/airline 2) without a meaning to the respondent (Rose et al., 2008). Labelled alternatives define alternatives through a specific or recognizable manner (i.e. Ryanair/easyJet) which may carry a meaning or a perception for the respondent. The distinction between the two types depends on the purpose of the data to be retrieved. While labelled alternatives can present a realistic scenario, it may result in biased opinion when the focus is on assessing specific attributes. In this case, the labelled alternatives are treated as alternative specific variables which can change the value of the attribute for different respondents (Rose et al., 2008). Otherwise, labelled alternatives can be included as a generic variable (i.e. brand loyalty) in the study. In this research, unlabeled alternatives are used since the only focus of the study is on the attributes defining the alternative regardless of the brand of the airline. While this is the case, it is accepted that individuals can associate given unlabeled alternatives with a brand in their perception.

4.3.3. Design of the stated preference survey

In this research, there are nine defined attributes in three main categories in this survey study (**Table 4.8**). While the initial design included thirteen attributes, due to the external constraint imposed on the study which are explained later in the text, this number is decreased to nine. Different categories defined for generic attributes include cabin comfort, in-flight services, and price; as the main goal in this survey study is to capture outputs from passengers for the in-flight experience.

Table 4.8. *Defined attributes and attribute levels in the research*

Attribute		Level	Definition	
Adjustable Headrests	x_2	1	None	
		2	Present	
Seat Pitch	x_3	1	73.7cm	
		2	78.7cm	
		3	83.8cm	
Seat Width	x_4	1	40.6cm	
		2	43.9cm	
		3	48.3cm	
Carry-on Baggage Size Allowance	x_5	1	55×40×25cm	
		2	61×43×25cm	
Inflight Entertainment (IFE)	x_6	1	None	
		2	Bring Your Own Device	
		3	Interactive (Personal Screen)	
Wireless Internet (Wi-Fi)	x_7	1	None	
		2	Paid	
		3	Free	
Power Supply	x_8	1	None	
		2	Present	
Food	x_9	1	Limited Meal Menu	
		2	Full Meal Menu	
		3	Complementary Meal Service	
Fare	x_{10}		Short-haul	Medium-haul
		1	¥14990 – ¥17690	¥22390 – ¥32870
			($134 – $159)*	($201 – $294)*
		2	¥16990 – ¥22690	¥44890 – ¥70890
			($152 – $203)*	($402 – $635)*
		3	¥19670 – ¥24790	¥62230 – ¥87770
			($176 – $222)*	($558 – $787)*

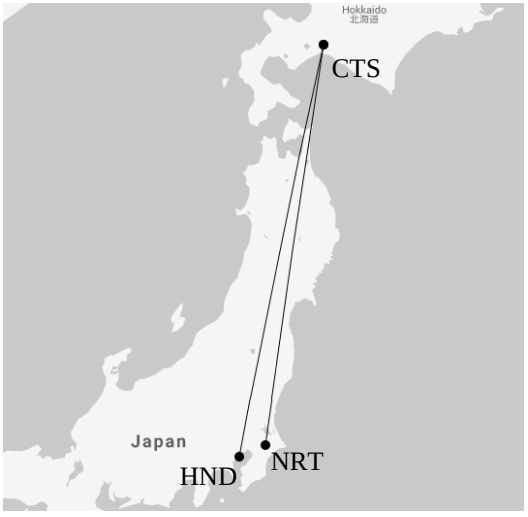
** Exchange rate (average of the last five years) of $1=JP¥111.56 is used (IMF, 2018b)*

The attributes in these categories define the alternatives provided to respondents. There are three alternatives in a choice set with different attributes levels. Respondents are asked to make a choice among the alternatives that best suits their needs and sensibility to each attribute in each choice set (scenario). Along with generic attributes included, other information is collected alongside as alternative specific attributes and supplementary purposes (Appendix C). The information includes basic socio-demographic data and

general travel characteristics of passengers taking part in the survey. Socio-demographic data collected in the study are age, gender, occupation, level of income, level of education, height, weight, and nationality. Supplementary travel characteristics collects information on passengers' travel history as in frequency of travel in a year, usual reason for travel, usual flight length travelled. In addition to travel history, information is collected on activities performed and related comfort level experienced during a flight by passengers. These data are collected with ranges defined for respondents. In addition to the quantifiable data collected with defined answers, one open ended question is included asking passengers what would they expect if there was more space in the cabin. Aside from the rest of the data, answers to this specific question is analyzed with a qualitative analysis including thematic analysis.

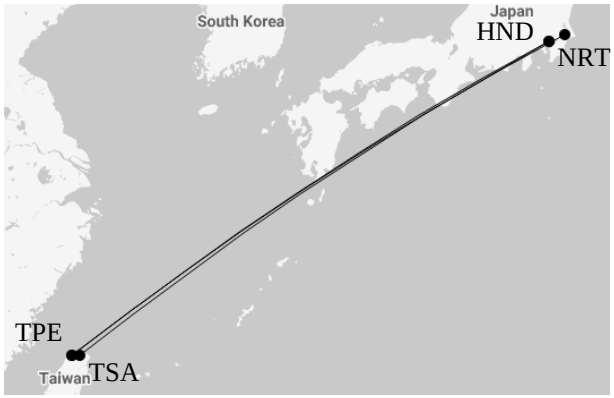
4.3.3.1. Scenario definition

A scenario with defined alternatives in the survey study mimics a set flight with defined O/D and flight time including three alternatives with different level of attributes. For short-haul (SH) scenarios, a direct flight from Tokyo (TYO) to Sapporo (SPK) (818 km, ≈1.5 flight hours) as shown in **Figure 4.11**. And for medium-haul (MH) scenarios, a direct flight from Tokyo (TYO) to Taipei (TPE) (2115 km, ≈4.25 flight hours) are included.



Source: OAG (2018)

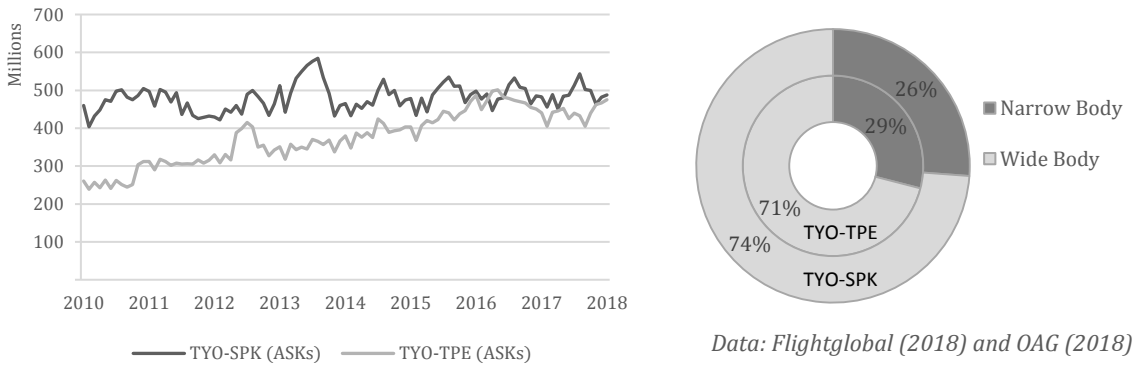
Figure 4.11. *Route map between Tokyo (NRT and HND) and Sapporo (CTS)*



Source: OAG (2018)

Figure 4.12. *Route map between Tokyo and Taipei*

Two routes determined in the hypothetical scenarios are based on both distance (travel time) and traffic capacity. Based on the analysis, both routes have similar capacity supplied in terms of ASK and served by a mixture of LCCs and FSCs while TYO-TPE route has more growth with an annual rate of 9% over the years (**Figure 4.13**). In TYO-SPK route, seasonality is observed based on the regression analysis with higher capacity provided in late summer and beginning of the year. In addition, both routes are utilized with similar aircraft types as of 2018. That is 26% and 29% for narrow body and 74% and 76% for wide body respectively for TYO-SPK and TYO-TPE routes. Majority of the cabin class flown is economy (including premium economy) in both routes; 92.5% on TYO-SPK route and 90% on TYO-TPE route (Flightglobal, 2018).



Data: Flightglobal (2018) and OAG (2018)

Figure 4.13. *ASKs of routes selected in the study (left) and market share of different aircraft categories on relative routes (right)*

As of 2016, there are eight airlines operating on the O/D route of Tokyo to Sapporo with a mixture of FSCs and LCCs. **Table 4.9** present the ranking of these airlines based on reported ASKs on Tokyo-Sapporo route. Similarly, there are ten airlines operating on the O/D route of Tokyo to Taipei. **Table 4.10** present the ranking of these airlines based on reported ASKs on Tokyo-Taipei route.

Table 4.9. *Ranking of airlines operating on TYO-SPK O/D route*

Rank	Airline	Carrier Code	ASKs
1	All Nippon Airways	NH	2.24E+09
2	Japan Airlines	JL	1.74E+09
3	AirDo	HD	7.82E+08
4	Skymark Airlines	BC	4.36E+08
5	Jetstar Japan	GK	3.2E+08
6	Vanilla Air	JW	3.02E+08
7	Peach Aviation Limited	MM	51847560
8	Spring Airlines Japan	IJ	13833099

Data retrieved from OAG (2018)

Table 4.10. *Ranking of airlines operating on TYO-TPE O/D route*

Rank	Airline	Carrier Code	ASKs
1	China Airlines	CI	1.37E+09
2	EVA Airways	BR	8.74E+08
3	Japan Airlines	JL	6.46E+08
4	All Nippon Airways	NH	5.36E+08
5	Vanilla Air	JW	5.26E+08
6	Tigerair Taiwan Co. Ltd	IT	3.26E+08
7	Cathay Pacific Airways	CX	3.15E+08
8	Scoot	TZ	2.99E+08
9	Transasia Airways	GE	2.94E+08
10	Delta Air Lines	DL	1.75E+08

Data retrieved from OAG (2018)

4.3.3.2. Attributes

As stated, generic attributes included in the study are categorized in four aspects; (1) cabin comfort, (2) in-flight services, and price. These aspects are defined with ten attributes in the research study. The attribute levels included for ten attributes are determined using industry standards in the specified region in order to reflect the reality of the scenario to the decision maker. Based on the findings from the literature review, pilot study, informal discussions with experts, in the cabin comfort category, attributes related to seating and

storage characteristics are explored. Similarly, for in-flight services, technical services and meal services are included. Finally, the price is included to further explain the pricing strategy in the survey. In all cases, industry standards are described and integrated to the survey study for the definition of attribute levels. These industry standards are determined according to the actual policies, services and sizes of six different airlines operating on domestic Japanese routes and regional routes relative to the study. These airlines are a mixture of FSCs and LCCs including All Nippon Airways (ANA), Japan Airlines, Jetstar Japan, Peach, Spring Japan, and Vanilla Air.

Cabin comfort

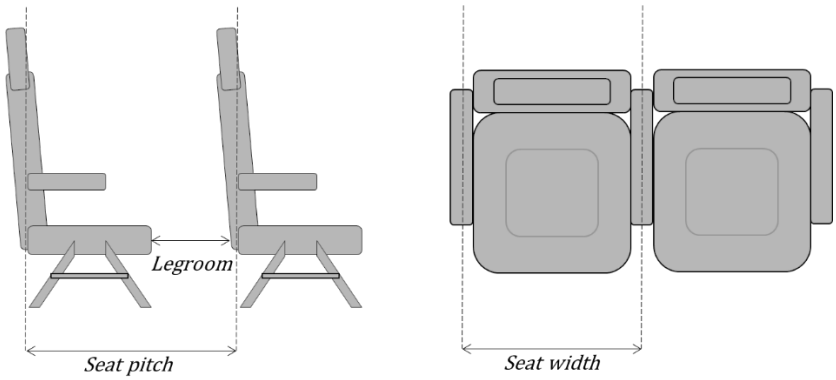
Cabin comfort includes any attribute that affects the comfort of the decision maker. Based on previous studies as presented in the previous chapter and the pilot study, described later in the text, and the qualitative study, cabin comfort attributes include seating characteristics and storage. Seating characteristics included in this research are adjustable headrests, seat size (e.g. seat pitch and seat width), and overhead storage size.

The presence of an adjustable headrest is the first attribute in the survey. The feature of having an adjustable headrest in the seat provides passengers with flexibility to utilize their headrest to improve comfort. It can be assumed that for passengers who wish to sleep and rest on the aircraft, this aspect may be especially important in terms of their comfort. An economy seat designed and manufactured by Recaro (2018) includes six-way adjustable headrests (**Figure 4.14**). These kinds of adjustable headrest integration in seat improves comfort as passengers can adjust the headrest based on their body sizes for improved neck support. An article in CNN mentions that adjustable headrest may be the solution to a better rest and sleep even more than the seat size (Durston, 2013).

Source: Recaro (2018)

Figure 4.14. *Adjustable headrest*

One other aspect included in the cabin comfort is the seat size. The seat size is measured by two dimensions; (1) seat pitch and (2) seat width. In this research, seat pitch is defined as the distance between two seats back to back and seat width is defined as the distance between the two armrests of a seat as shown in **Figure 4.15**. Based on the findings presented, seat size in terms of seat pitch and seat width are considered to be one of the factors influencing passenger comfort during flight.



Source: Author

Figure 4.15. *Seat pitch and seat width*

A reasonable seat pitch is necessary to have enough legroom to sit properly and move legs freely when necessary. Based on the information provided by SeatGuru (TripAdvisor, 2016), 7 different seat pitch size groups are identified from the smallest to the largest for selected FSCs economy class and LCCs operating with different types of aircraft in Japan and on regional routes. The maximum seat pitch is 86.4cm which are implemented mostly in the wide-body aircraft by FSCs. The minimum seat pitch observed is 73.3cm which applies to LCCs in narrow-body aircraft. The average seat size used in the sample is calculated to be 79.29cm. A clear distinction is present between FSCs and LCCs with the exception of Vanilla Air. Based on the analysis, three levels of seat pitch are considered based on industry standards; narrow (73.7cm), medium (78.7cm), and wide (83.8cm). The minimum and maximum boundaries values for the levels (level 1 and level 3) are determined based on six different airlines operating in Japan (**Table 4.11**).

Table 4.11. *Seat pitch data in centimetres from selected airlines operating in Japan*

Airline* (in cm)	1	2	3	4	5	6	7
ANA				78.7[1,2,3,4,5]	81.3[1,2,4]		86.4[4,5]
Japan Airlines			76.2[6]	78.7[2,3,4,5]	81.3[5]	83.8[4,6]	86.4[2,3,4]
Jetstar Japan	73.7[1]						
Peach	73.7[1]						
Spring Japan	73.7[2]						
Vanilla Air		74.9[1]			81.3[1]		

**Data retrieved from SeatGuru.com by TripAdvisor (2016)*

[1]*Operating Airbus A320 variants*

[2]*Operating Boeing 737 variants*

[3]*Operating Boeing 767 variants*

[4]*Operating Boeing 777 variants*

[5]*Operating Boeing 787 variants*

[6]*Operating regional jets (i.e. Bombardier CRJ-200 and Q series, Embraer E-170, Saab 340B)*

Similarly, the seat width is also considered in the study. According to the published information, seat width sizes of selected airlines operating in Japan and on regional routes are divided into 10 groups from the narrowest to the widest. The average seat width of the sample obtained is calculated to be 45.03cm. The maximum seat width is 48.3cm provided by JAL on wide-body aircraft whereas the minimum seat width is 40.6cm utilized by ANA on a Boeing 777 variant aircraft. Three levels are considered for seat width based on industry standards; narrow (40.6cm), medium (43.9 cm), and wide (48.3 cm). The minimum and maximum values for the seat width levels (level 1 and level 3) are determined based on six different airlines operating in Japan (**Table 4.12**). Overall, results from the attributes related to the seat would present a passenger expectation through preference on comfort in seat and environment.

Table 4.12. *Seat width data in centimetres from selected airlines operating in Japan*

Airline* (in cm)	1	2	3	4	5	6	7	8	9	10
ANA	40.6[4]	41.9[4]	43.2[1,2,3,4]	43.9[5]	44.5[3]	45.7[2]		47.2[3,5]		
JAL				43.9[2,3,4]	44.5[4,5,6]	45.7[5]	47.0[2,3,4,6]		48.0[5]	48.3[3,4]
Jetstar Japan						45.7[1]				
Peach			43.2[1]							
Spring Japan			43.2[2]							
Vanilla Air				43.9[1]						

**Data retrieved from SeatGuru.com by TripAdvisor (2016)*

[1]Operating Airbus A320 variants

[2]Operating Boeing 737 variants

[3]Operating Boeing 767 variants

[4]Operating Boeing 777 variants

[5]Operating Boeing 787 variants

[6]Operating regional jets (i.e. Bombardier CRJ-200 and Q series, Embraer E-170, Saab 340B)

The attribute relating to carry-on baggage size allowance is included to understand and capture the preference of passengers on their storage space within the cabin. While there is limited research on overhead storage space in the literature, present literature and the pilot study shows that overhead storage space is an attribute that is worth considering for passenger comfort in cabin. In addition, the findings from the research helps utilizing the overall cabin space based on the overhead storage space preferred. Overhead storage space is the storage space provided passengers over their seats for carry-on baggage. Due to the space constraints in the cabin, airlines have policies in place describing the allowed carry-on baggage size. While the actual capacity for overhead storage space varies based on the cabin configuration of different aircraft, airlines often use one size as the allowance for most of their flights. In this study, there are two levels included defining this attribute in terms of the dimensions for the carry-on baggage volume allowed per passenger based on the industry standards; small (55cm×40cm×25cm) and big (61cm×43cm×25cm). Data from the industry shows there are two standard dimensions in use for airlines operating in Japan and on regional routes (**Table 4.13**). The dimensions for the small option, 55cm×40cm×25cm, is determined based on different airlines operating in Japan as presented. On the other hand, 61cm×43cm×25cm is determined based on the dimensions

of the new Space Bins implemented on Alaska Airlines aircrafts. New overhead storage bins designed by Boeing called Space Bins are claimed to increase the capacity for overall number of carry-on baggage by up to 50% (Boeing, 2016). With the implementation of Space Bins, Alaska Airlines increased its carry-on baggage size allowance to 61×43×25cm (Alaska Airlines, 2016). Eventually, in terms of overhead storage space, decision makers are presented with two distinct sizes allowed for the carry-on baggage.

Table 4.13. *Different overhead storage capacity allowed per passenger*

Airlines	Dimensions (cm)
Jetstar Japan, Spring Japan, Vanilla Air	56×36×23
Japan Airlines, ANA, Peach	55×40×25
Space Bins (Alaska Airlines)	61×43×25

Data retrieved from respective airlines' websites (Alaska Airlines, 2016; ANA 2016; JAL, 2016; Jetstar Japan, 2016; Spring Japan, 2016; Peach, 2016; Vanilla Air, 2016)

In-flight services

As for the cabin comfort, the attributes for the in-flight services are determined based on the findings presented in the literature, pilot study, and the qualitative analysis. There is a total of four attributes identified for in-flight services which in turn are split into two distinct aspects; technical and meal service. Technical services include in-flight entertainment, internet connection, and power supply, while meal services include meal and drink services provided by the airline.

The first attribute in this category is the inflight entertainment (IFE) systems. IFE is becoming part of almost any flight now that is inevitable in different forms. Through the attribute, the sensitivity and the preferences of passengers towards IFE provided by the airline is examined. In theory, inflight entertainments include any form of activity provided by the airline to keep passengers occupied and entertained during the flight. Currently, IFE is most often in digital format. Different IFE services can include flight information (i.e. real time location map), games, either on demand or broadcasted audio (i.e. music, news, broadcasts) and video (i.e. documentaries, movies, television shows). These services can be provided through an integrated IFE system behind the seats or more recently through a cabin intranet or the internet to passengers' own mobile devices (i.e.

mobile phones, tablets, laptops), which is also called BYOD (bring your own device). In this research, the levels for this attribute are determined based on the industry standards. These standards are obtained from the analysis of six different airlines as for the previous attributes discussed (**Table 4.14**). IFE attribute included in the research has three levels; none, BYOD (bring your own device) where the entertainment content is provided through the Wi-Fi (with internet if applicable or with cabin intranet), and an interactive personal screen.

Table 4.14. *IFE services provided by selected airlines in Japan*

Airline*	Strategy	IFE system
ANA	FSC	Complementary interactive personal screen
Japan Airlines	FSC	Complementary interactive personal screen, BYOD (bring your own device)
Jetstar Japan	LCC	None
Peach	LCC	None
Spring Japan	LCC	None
Vanilla Air	LCC	None

**Data retrieved from respective airlines' websites (ANA 2016; JAL, 2016; Jetstar Japan, 2016; Spring Japan, 2016; Peach, 2016; Vanilla Air, 2016)*

One of the other important attributes in in-flight services is the internet connectivity (Wi-Fi). Providing the internet service in-flight has been an increasing trend within the airline industry. With this service, passengers are able to connect to the internet through their own devices. In this survey study, we consider three levels of Wi-Fi attribute; none, paid Wi-Fi, and free Wi-Fi. At the time when the data was obtained, none of the six airlines included for identifying the industry standards provided free Wi-Fi service to passengers (**Table 4.15**). However, in order to be able to estimate the economic value of paid Wi-Fi in terms of passengers' preferences, attribute level free Wi-Fi is included in the survey.

Table 4.15. *Wi-Fi services provided by selected airlines in Japan*

Airline*	Wi-Fi service
ANA	Paid Wi-Fi service
Japan Airlines	Paid Wi-Fi service
Jetstar Japan	No
Peach	No
Spring Japan	No
Vanilla Air	No

**Data retrieved from respective airlines' websites (ANA 2016; JAL, 2016; Jetstar Japan, 2016; Spring Japan, 2016; Peach, 2016; Vanilla Air, 2016)*

In addition to IFE and internet, power supply is another attribute included in the study as whether it is available or not in the seat. With an option of power supply, passengers can charge their mobile devices with battery or use other devices with no battery. The power supply included in this study refers to USB power outlets. With the power supply, passengers can be more flexible with their mobile devices and they do not have to worry about losing connectivity at their arrival due to low battery. The other aspect of in-cabin services is catering. The food and drinks attribute includes the meal service provided by the airline. In the study, there are three levels to food attribute which are limited meal menu for purchase where passengers have a limited selection of meals and drinks in-cabin to buy, full meal menu for purchase which passengers have a variety of selections in-cabin to buy, and a comprehensive meal served by the airline. Different meal options provided by different airlines in Japan are presented in **Table 4.16**.

Table 4.16. *Meal services provided by selected airlines in Japan*

Airline*	Meal service
ANA	Complementary meal service
Japan Airlines	Complementary meal service
Jetstar Japan	Limited inflight meal menu
	Meal purchase pre-flight only (international flights)
Peach	Full Meal Menu
Spring Japan	Full Meal Menu
Vanilla Air	Full Meal Menu

**Data retrieved from respective airlines' websites (ANA 2016; JAL, 2016; Jetstar Japan, 2016; Spring Japan, 2016; Peach, 2016; Vanilla Air, 2016)*

Price

Price is the cost of the flight not including any extra services provided by the airline in the cabin (i.e. ancillary services). It is necessary to include fare price in the stated preference survey study for the economic analysis (willingness to pay estimations). The fare price reflected in the survey must be realistic so that a relevant scenario is achieved. Based on the characteristic of the flight alternative, a price is set. The levels for the attribute are low, medium, and high. The exact amount of prices in each scenario and alternative are comparable to each other defining if they are low, medium or high level. Prices shown in the survey are estimated using the data retrieved from the published fares of associated airline's operating on determined routes for average economy basic option tickets (AirAsia X, 2016; ANA 2016; China Airlines, 2016; JAL, 2016; Jetstar Japan, 2016; Spring Japan, 2016; Peach, 2016; Vanilla Air, 2016). In the study, the average one-way ticket price for a flight from Tokyo to Sapporo in SH scenario is JP¥18,284.35 ($163.90[4]) and the average one-way ticket price included for a flight from Tokyo to Taipei in MH scenario is JP¥53,034.44 ($475.39[4]).

[4] Exchange rate (average of the last five years): $1 = JP¥111.56 (IMF, 2018b)

Each attribute group designed in this study reflects an aspect of the passenger preference output. Cabin comfort mainly investigates the comfort level of passengers in their seat and the storage allowance. In-flight services reflect the preference on the technical services and the meal service provided. Overall, defined levels for the attributes within the alternatives present a realistic flight options for passenger profile included in the study.

4.3.3.3. Number of choice sets and samples

In discrete choice models, it is important to include sufficient number of scenarios and samples for the analysis. While the number of scenarios (choice sets) identify the number of questions in the stated preference survey, the number of samples refers to the number of decision makers taking part in the survey. Through this section, first, the number of questions included in the research are presented. This is followed by the minimum number of sample necessary for the analysis is explained.

As stated, the total number of attributes included in the study is nine. Out of these nine attributes, six attributes have three attribute levels, and three attributes have two attribute levels. Considering an ideal design of experiments, the study would need 1,944 different stated preference questions (choice sets) for passengers to complete. Since this is not realistic, an efficient survey design is required with related sample size. Eventually, this number is decreased to six questions through an efficient survey design explained in the next section. Based on the analysis, three short-haul flight (TYO-SPK) scenarios and three medium-haul flight (TYO-TPE) scenarios are selected.

To determine the minimum number of samples required, Orme (2010) presents a standard sample size requirement used widely in the literature for stated preference surveys. N is the sample size, L^{max} is maximum number of attribute level among attributes, J is the number of alternatives, and S is the number of scenarios (**Eq**. 4.45). However, they also suggest having at least 200 respondents for studies involving analysis of differences between sample segments.

$$N \geq 500 \frac{L^{max}}{J \cdot S} \qquad \textit{Eq. 4.45}$$

Based on the standard sample size computation, the survey study requires at least 83 respondents to complete the six scenarios.

4.3.3.4. Survey Design

As discussed, there are six scenarios (choice sets) included. The scenarios are set in a context of fixed flight information, with the scenarios grouped into two based on the flight time. With the parameters included, an ideal full factorial study would have 1,944 questions. This is not realistic as it cannot be expected from decision makers to complete a survey including 1,944 stated preference questions. Therefore, an efficient design of the survey is necessary to decrease the number of questions included while ensuring the discrete choice model has sufficient input to estimate choice probabilities. This is crucial to sustain robust results.

Rose and Bliemer (2013) discuss a 'good' design for SP experiments to yield more robust outcome through orthogonal design or D-optimal design. In general, orthogonal design minimizes correlations between attribute levels in alternatives while D-optimal minimizes the (co)variances in the parameter estimates which proves to be statistically more efficient. However, D-optimal designs require prior data on attributes through assumptions or a pilot study (Hess and Rose, 2009). On the other hand, orthogonal designs are usually constrained even though they are considered to be a good method of reducing the number of choice situations in full factorial design. Firstly, the number of choice sets usually increases exponentially with an increasing number of attributes. Secondly, the number of choice sets cannot be freely chosen by the implementer. In addition, it may not be possible to use an orthogonal design if the number of attribute levels is different for most of the attributes. Orthogonal design may also include irrelevant choice sets for the final analysis. Finally, two-way interactions and higher-order interactions are usually not possible to estimate (Teye-Ali et al., 2013).

For the proposed survey study, a PDC algorithm will be used as proposed in Teye-Ali et al. (2013). In order to use the PDC algorithm, a level balance efficiency criterion is implemented. However, an efficient experiment design developed by Hole (2016) for STATA© with a modified Federov algorithm is also investigated. Teye-Ali et al. (2013) investigate new algorithms to balance the survey design choice sets. The study focuses on the survey design for multinomial logit (MNL) models, however it has been proven

that similar survey designs are also useful for nested logit (NL) or mixed logit models (Bliemer et al. 2009; Bliemer and Rose, 2010). There are three survey design methods investigated in Teye-Ali et al. (2013); modified Federov (1972) algorithm, PDC algorithm, and PDC with simulated annealing (PDC-SA). The results show that PDC and PDC-SA outperformed the modified Federov algorithm in terms of balance levels and D-efficiency. The balance levels for an ideal PDC algorithm implemented is 100% and the D-efficiency for a three alternative survey is over 95%.

The procedure adopted in this research includes two main steps. In the first step, a design is randomly selected from the full factorial candidate set of combinations and balance level is computed based on the balance efficiency criterion. The second step is the application of the algorithm to maximize the balance level based on the balance efficiency criterion. The balance efficient criterion (LB_{eff}) defines the balance level at the individual level which then reflects the overall balance efficiency of the design.

$$LB_{eff} = \frac{\sum_{j=1}^{J} A_j LB_j}{\sum_{j=1}^{J} A_j} \qquad \textbf{Eq. 4.46}$$

where

$$LB_j = 100\left(\frac{1}{A_j}\sum_{i=1}^{A_j}\eta_{ij}\right) \qquad \textbf{Eq. 4.47}$$

and where

$$\eta_{ij} = \min\left\{\frac{f_{lij}}{S/L_{ij}}, \qquad \forall l\right\} \qquad \textbf{Eq. 4.48}$$

where f_{lij} is the frequency of occurrences of level l of attribute i in alternative j, L_{ij} is the number of levels of attributes i in alternative j, S is the number of scenarios (choice sets), and A_j is the number of attributes available for alternative j.

Based on the initial balance level found for randomly selected design, an improvement algorithm is put in place to maximize the balance level by replacing specific attribute levels in the design. The procedure for the PDC algorithm has the following order;

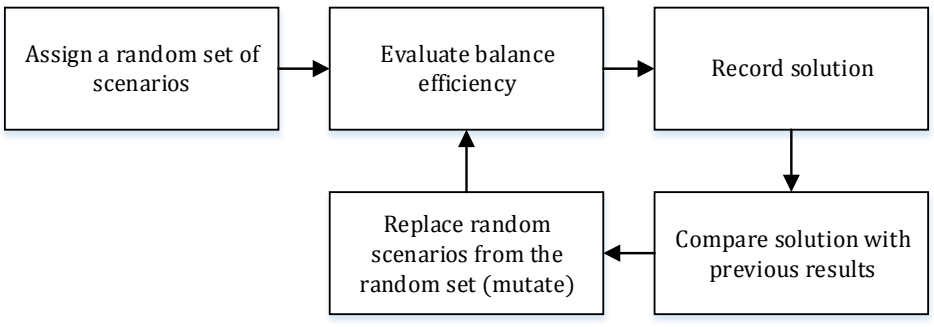
1. For each attribute in each alternative compute the maximum number of times each level for the attribute can occur (**Eq**. 4.49).

$$L_{max} = {}^{S}/_{L} \qquad \textit{Eq. 4.49}$$

where L is the number of levels of the attribute, and S is the number of choice sets

   a. Count the frequency of each attribute level in the alternative
   b. Find the minimum (f_{min}) and maximum (f_{max}) values in the frequency
   c. If f_{max}<L_{max} goto step 2, else compute $f_{max} - L_{max}$
   d. Replace f_{max}-L_{max} with the f_{min}
   e. Repeat steps a to e until all levels are less or equal to Lmax
2. Repeat step 1 for all attributes for the alternative
3. Repeat steps 1 and 2 for all alternatives

In addition to the conventional algorithm proposed, an evolutionary algorithm is also considered for an efficient design in maximizing the balance level efficiency. Within the given candidate set, constraints are identified. Assume K is the number of scenarios in the full factorial candidate set, then candidate scenario k=1, 2, 3, …, K is randomly selected and assigned to one of the six scenarios in the design and replaced (mutated) with other random scenarios in the candidate set at each iteration. The solutions are compared and assessed at the end of each iteration within the set population size of solutions (**Figure 4.17**).

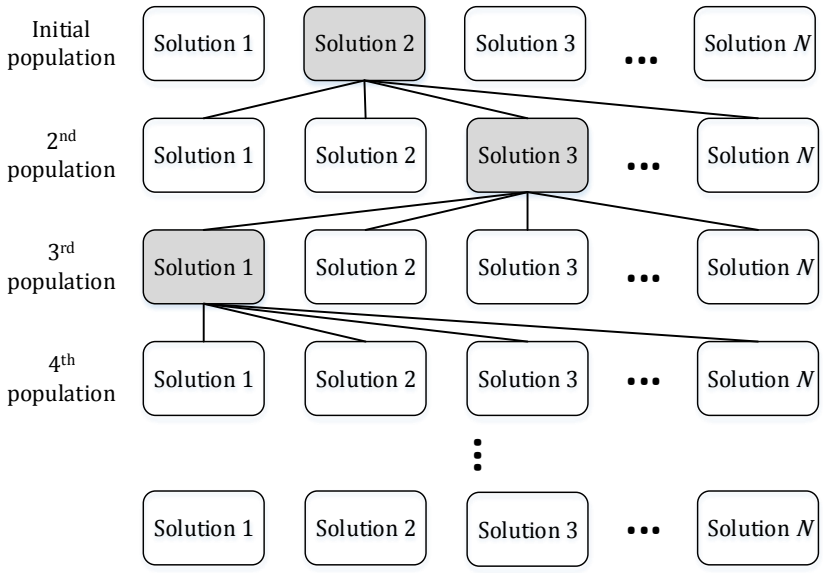


Source: Author

Figure 4.16. *Flowchart of evolutionary algorithm*

At each iteration, a population is defined for the solutions. The best solution is identified and mutated in search for better solution in the next iteration (**Figure 4.17**). This procedure is repeated until the best solution is found within the defined parameters by the

user. The parameters defined in this algorithm as follows, if no better solution is found for 90 seconds, then the algorithm is stopped with the best possible solution.



Source: Author

***Figure 4.17**. Diagram of evolutionary algorithm with highlighted solutions being the best solution in the population*

4.3.3.5. Criteria for the survey study

In order to reflect the true nature of preferences through the survey study, specific criteria is developed to identify applicable respondents in addition to the basic requirements of a survey. Two types of criteria is implemented to sustain a non-bias sample to provide a robust analysis.

First type of criteria includes respondent-specific criteria. Initial criteria for respondents is that they must have been on at least one flight in the past year so that they can relate to the survey questions provided. The rest of the criteria in respondent-specific constraints are to minimize bias in terms of respondents' characteristics and background, respondents with a certain occupation are determined not to be included in the survey study. In this case, respondents from a marketing or research fields are denied. In addition, respondents who work in an air transport related industry are also neglected.

Second type of criteria is defined as sample criteria. Based on the background of the respondents, it is desired to have a homogenous sample distribution in terms of age and

gender to minimize bias and to allow relatively easier analysis. This criteria can be extended to other demographic attributes if possible through the survey progress.

The criteria allows for a non-bias and sustained data for analysis in choice modelling. In addition, it allows for a case-specific analysis of preferences based on different attributes of respondents.

4.4. Quantitative pilot study

As mentioned earlier, a pilot study is included in the study to understand the applicability of different factors in cabin features and services. Fagoaga et al. (2017) reveals willingness to pay for various ancillary services in the aircraft of passengers from Europe. Authors investigate the ancillary revenues provided by airlines in Europe with data published by airlines. It is stated in the pilot study that ancillary revenue is an important source for airlines' profitability. CAPA (2016) found that the share of ancillary revenue on overall revenue increased from 4.0% in 2010, by 6.6% in 2014, to 8.3% in 2015. It is mentioned that this source of revenue is quite recent and would yield more profit than cargo services as of 2016. Later, they adopt a discrete choice model methodology with a stated preference survey to estimate choice probabilities and willingness to pay of respondents on defined attributes. For the discrete choice analysis, a multinomial logit model is developed.

As in several studies, general flight attributes are used in the pilot study. There are fifteen different attributes are investigated including the airline brand as an attribute. The rest of the fifteen attributes include fare price, travel time, number of stops, airport type, aircraft type, cabin baggage, hold baggage, seat allocation, seat pitch, seat width, on-board catering, in-flight entertainment, Wi-Fi, and power supply. Three alternatives are presented with labelled values in two different scenario groups; short-haul flights and long-haul flights.

The preliminary results showed the majority of the respondents are male (with 68%). Also 68% of the respondents are between 20 and 29 years old, and 13% of the respondents are between 39-40 years old. This is likely due to the type of platform used (social media) and it is acknowledged that this can lead to some bias in the interpretation. Concerning body characteristics, it is found that the mean of the sample height is 1.75m and the average weight is 70kg. These two characteristics are normally distributed within the

sample. The sample includes respondents from 40 different countries; France (47%), the United Kingdom (25%), Japan (5%), Germany (2%), and Spain (2%).

Overall, 810 observations per scenario are recorded. Two models are retained for the short-haul scenario and the long-haul scenario. The final results for the willingness to pay estimates are provided in **Table 4.17**. The willingness to pay is represented per unit increase in the value of the attribute. Final results are found similar to previous studies that implemented discrete choice modelling with stated preference data in their willingness to pay studies as presented in the previous chapter.

Table 4.17. *Willingness to pay estimations in the pilot study*

Short-haul scenario				
Attribute	**Willingness to pay for improvement**	**Willingness to accept to avoid change**	**Lower limit**	**Upper limit**
Main Airport	£19.11	-	£12.92	£25.30
Secondary Airport	-	£19.11	£12.92	£25.30
No hold baggage	-	£6.82	£4.89	£8.74
Hold baggage	£6.82	-	£4.89	£8.74
Long-haul scenario				
Attribute	**Willingness to pay for improvement**	**Willingness to accept to avoid change**	**Lower limit**	**Upper limit**
Travel time (hour)	-	£14.81	£5.53	£24.09
Number of stops	-	£123.99	£102.59	£145.38
No hold baggage	-	£60.49	£53.96	£67.04
Hold baggage	£60.49	-	£53.96	£67.04
No meal	-	£13.07	£8.55	£17.69
Good quality meal	£13.07	-	£8.55	£17.69
IFE (none)	-	£71.90	£39.24	£104.56
IFE (personal)	£71.90	-	£39.24	£104.56
IFE (VOD library)	£4.97	-	£3.25	£6.69

Data retrieved from Fagoaga et al. (2017)

The pilot study has several limitations in terms of design and stated preference data collection. As presented, several attributes are missing in the analysis due to lack of data supporting the results. The number of attributes included in the study are relatively high and in many cases, the multinomial logit model was not able to estimate the choice probabilities. On the other hand, the indications from the study are clear in terms of the application and the approach towards revealing passenger preferences on cabin features and attributes. Some of the significant factors from the pilot study include baggage meal service, IFE systems, and luggage. These aspects of cabin features and services are also shown to be important for passenger from different backgrounds in other literature as discussed previously.

4.5. Summary

In this chapter, research design, methodologies and tools used in this research are explored. To establish a strong background for the research in terms of the research design, several aspects in the process are described. In addition, specific methodologies and tools adopted to develop an understanding to model and estimate passenger preferences in Japan for short and medium-haul flights are presented in two topics based on the methodological choice for data collection and analysis as qualitative and quantitative research.

In the first section, the research design, the research philosophy is established. As the philosophy of this research, positivism is defined and described along with other philosophies for different research. With positivism, it is explained that this research has a clear idea on the factual nature of the knowledge and that with following progress a strong prediction can be achieved through the study. The following progress then includes the research approach which is defined to be a mixture of both deductive and inductive approaches in terms revealing information and integrating two approaches to supplement in each other to prove credible results. Based on the discussed approach, the research strategy is explained. In this research, the main strategy adopted to collect data is to design and conduct a relevant survey. As explained later, in specific, a stated preference survey is developed in this context. In addition to the survey, a taxonomic analysis strategy is involved to explore Japanese passengers in a cabin context. For the strategies defined, both a qualitative and a quantitative research study are implemented. This choice is

defined as a mixed methodology and more specifically, mixed-method research for this study. In this case, a qualitative and a quantitative study are used simultaneously for instrument development purpose as described in detail. Further into the research design, the time horizon for this research is described to be a cross-sectional where the information is collected at certain point in time rather than over time. Finally, with the techniques and procedures, the specific tools and methodology to answer each of the research questions initially stated in this research.

In the next section, the qualitative study is introduced. Qualitative research synthesis method is explored and applied in the context of this research. With this qualitative research synthesis, findings on culture-specific characteristics in terms of Japanese nationals and their behaviours as passengers in a cabin context are explored and analysed to develop a passenger profile. This profile ultimately is adopted in the development and the design of the discrete choice model with relevant survey scenarios with key attributes. For the analysis, a taxonomic analysis is used to analyse findings in the literature.

In the third section, the main strategy and the approach for this research is explained as the quantitative study. An in depth understanding to choice theories is presented. These choice theories established the backbone of the discrete choice model developed in the research to estimate the choice probabilities of Japanese passengers. It is shown that rational behaviour is in the core of discrete choice models while the applications is driven by the economic consumer choice theory. In this context, the estimation process is explained in detail. It is acknowledged that the estimations are only predictions as a result of the rational understanding of choice theories and mathematical explanation of choice probabilities in terms of discrete choice theory and random utility. In order to develop the discrete choice model, stated preference data is preferred based on the advantages it presents for the research.

In conclusion, this chapter provides a well-structured understanding of how the research is undertaken from a general point of view in research design into the very specifics of the methodology used. With this established knowledge, in the next chapter, the analysis of the study is presented along with the details for the survey conducted.

CHAPTER 5 - USER TRENDS AND CHARACTERISTICS

This chapter presents the analysis carried out to reveal characteristics of Japanese passengers in terms of their inflight experiences through qualitative research. The purpose of this research is to identify key characteristics of Japanese passengers through the national culture as defined previously. In order to fulfil the relative research question and objectives, a qualitative research synthesis method is applied.

In this context, a metasummary of the literature is presented in Sections 5.1 and 5.2. The first section of this chapter explains the target findings identified which are separated from the relevant literature. In Section 5.2, the target findings are edited and grouped to provide the metasummary of the findings in the literature. In Section 5.3, as a result, a conceptual design is developed based on the findings through a taxonomic analysis.

Overall, the study is an instrument that helps developing and improving as well as confirming the survey design and results. It is useful in the sense that the results from the choice model in the next chapter are confirmed.

5.1. Target Findings

As mentioned earlier, it is important to understand passenger preferences and trends through a cultural and social-framework. With that in mind, the study examines Japanese passenger preferences with the findings presented in the literature. In order to complete the analysis successfully, target findings, as defined in Section 4.2, needs to be identified and defined clearly (Sandelowski and Barroso, 2007).

For the context of this research, target findings are defined as any findings that represents the natural behaviour and preferences of Japanese people which can be reflected in terms of passenger behaviour and preferences. For this purpose, the target findings involve respective data for adults in Japan without any further categorisation of individual groups such as those based on income levels, education levels, or residency. This is important in order to establish and define more precisely in cultural terms who is a Japanese passenger.

While there are various studies of Japanese culture within the context of organisational aspects for business relations, there is limited literature which reveals insight into the

characteristics of Japanese people more generally and more specifically with respect to the aircraft cabin context. Based on the literature research, two studies are identified that are particularly relevant to the purpose of this study. As described earlier, the qualitative study Mäkinen et al. (2017) identify user trends and culture norms with regard to passengers in China, Republic of Korea, and Japan. User preferences, trends and culture are revealed through various sources identified within both the academic literature and commercial publications. In addition, Gilbert and Wong (2003) examine cross-cultural differences in terms of nationality among Japanese, Korean, Chinese, and American airline passengers through a questionnaire directed at Korean Air cabin crew with experience working on related routes. From both studies, the defined target findings are identified and separated from other findings in the respective literature. In addition to the selected studies, supplementary knowledge on demographic and economic aspects of the geography are identified as conditions related to the subject. Through the findings, differences among different nationalities is presented. Brief summaries of the target findings in the two studies selected are presented below.

Initial findings in Mäkinen et al. (2017) include traditional characteristics and other culture specific elements. While the study investigates these factors for Japan, China, and Republic of Korea, findings relative to the Japanese people are extracted. The initial findings conclude that Japanese people are generally characterised as polite, punctual, kind, hardworking, and shy in the study. They value hygiene, collectivism, discipline and etiquette. However, Japan is not a homogenous country where all characteristics apply to all. One of the most obvious differences are age and gender, for example while privacy is valued by most and private space is important, younger generations value individualism much more compared to the older generation. On the contrary, the study also reveals that collectivism is highly valued in terms of respecting others and prioritising the social harmony and unity over individual ambition. Yet, there exists a hierarchy in most segments of Japanese society. The interviews with industry members expands further the body of knowledge gathered by the study. The two biggest airlines in Japan and flight attendants from airlines operating to/from Japan are included in the interviews. Different topics from the interviews are included such as; “first assumptions”, “behaviour”, “common problems”, “needs”, “own solutions and practices”, and “group travel”, revealing information relating to the behaviours of Japanese passengers in aircraft cabin.

"First assumptions" revealed by the cabin crew on Japanese passengers are that they are polite, quiet, modest, discrete and patient in line with the previous findings. According to the study in terms of "behaviour", especially younger Japanese passengers are busy with their mobile devices and that space is important for Japanese passengers in terms of stretching and privacy. "Common problems" observed by the cabin crew are stated as reclining the seat, communication due to language, and storage. The "needs" of Japanese passengers according to the cabin crew are hygiene, food selection, and language. In addition, they state Japanese passengers have high standards and expectations during flight. For "own solutions", the cabin crew has frequently observed Japanese passengers with eye masks, face masks, plastic bags to place on the floor, some toiletry kits, and a small towel. As the final topic, "group travel" of Japanese passengers are investigated which revealed that older Japanese passengers are more likely to travel in groups. Overall, the study reflects a comprehensive review of Japanese people as wells as their behaviour as passengers.

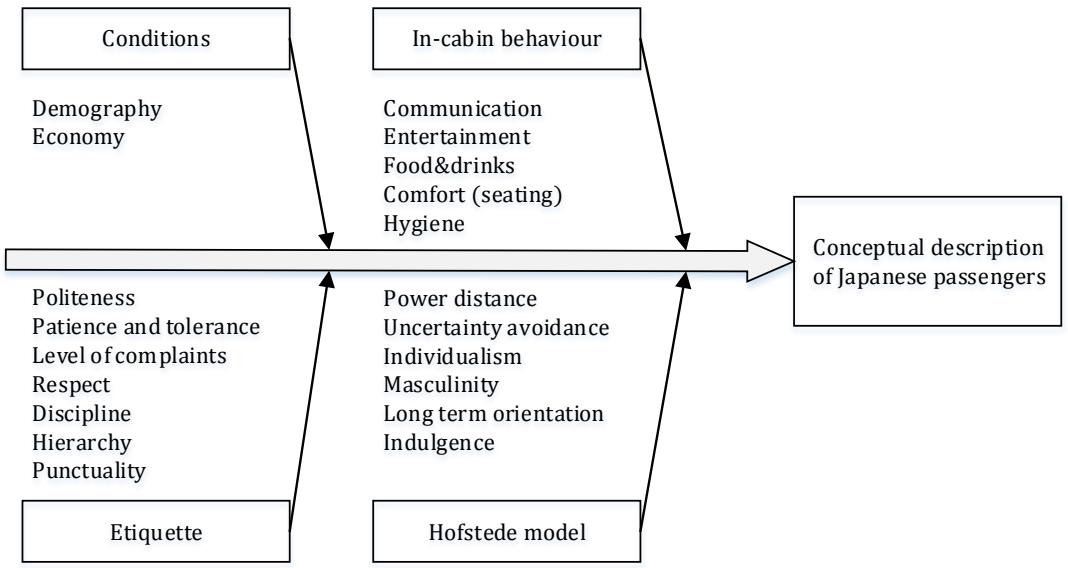
In a more refined study, Gilbert and Wong (2003), undertook a cross-cultural comparison investigating the passenger behaviour. While the target findings are filtered to include only Japanese passengers, the results from this research are generalised and presented with respect to Korean, Chinese and American passengers. In this context, the study reveals Japanese passengers as respective towards cabin crew and other fellow passengers. It is stated that Japanese passengers tend to be disciplined and quiet as they tend not to complain even though they are dissatisfied. In addition, they are less likely to ask for service, for example they are less likely to ask for more water or food. Based on the analysis, findings include the high expectations of Japanese passengers in terms of inflight services, meal and drink quality, comfortable and clean cabin interior and seats, and kind and helpful cabin crew. For inflight services, Japanese passengers find the consistency of ground services and operational performance valuable in addition to hygienic cabin space with comfortable seats. Up-to-date IFEs are also important in terms of adequate programmes in place. In addition, cabin crew interaction is found to have an important role in Japanese passengers' perception of important service dimensions. In this case, they expect cabin crew to understand specific needs and adequately address any requests or issues with individual attention. To extract the target findings, any findings related to Japanese passengers, in comparison to other nationalities, are filtered.

In addition, for the final conceptual description, the Hofstede model applied to Japanese people is considered as the baseline. The specifics of the findings from the Hofstede model for Japanese people are presented in Chapter 2. Based on these findings, calibration of the target findings that fits in the overall national culture is explored.

Based on the identified target findings, further analysis is undertaken to clearly present the compilation of findings. In the next section, the target findings are edited and grouped in the context of this research.

5.2. Japanese passengers in themes

The identification and separation of the target findings enables further clarification of the findings from the selected studies. Upon editing the findings to improve accessibility while sustaining the original intentions and objectives, the findings are grouped in four main categories; (1) conditions, (2) in-cabin behaviour, (3) etiquette, and (4) the Hofstede model (**Figure 5.1**). Conditions represents the fixed environment of Japan in terms of demography and economy that affect the daily lives of people. In-cabin behaviour lists the expectations, preferences and overall approach during inflight experience. Etiquette is considered to reflect the attitude of Japanese passengers within social context. The Hofstede model presents national culture based on generic observations and comparisons with other cultures.



Source: Author

Figure 5.1. *Conceptual mapping of the target findings*

Conditions

The conditions are fixed for the analysis as they are presented in Chapter 2 for Japan and presented in **Table 5.1**. In terms of demographics, one of the most pertinent trends is the phenomenon of population ageing which is especially prominent in Japan where 40% of the population are aged 50 and above. This trend reflects into the future population trends where it is expected that the total population will decline with consequent effects adverse on economic growth and pressures on public expenditure. In addition, the population density is highest in the Tokyo area (Group 1) followed by Group 2 and 3. In terms of economic performance, Japan ranks third in the world in terms of total GDP. Overall, the country is listed within the high income group with stable economic growth.

Table 5.1. *Findings on conditions category*

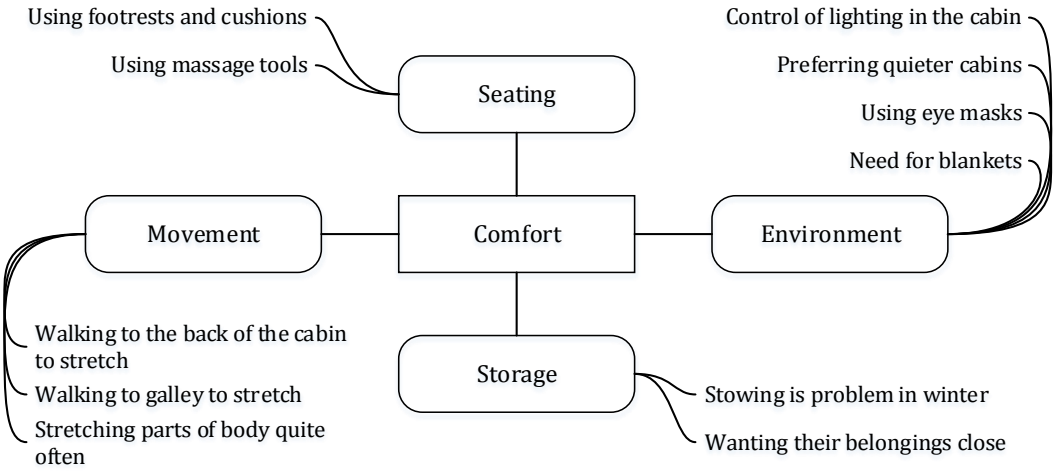
Condition	Findings
Aging population (C1)	Aging population means more older passengers in the future
Urbanisation (C2)	Densely populated areas in or around big cities
High income (C3)	Relatively high standards of living and affordability

In-cabin behaviour

The second group, in-cabin behaviour, includes four categories identified through the analysis based on the theme. Based on the findings aggregated from the literature, these categories include; (1) comfort, (2) entertainment, (3) hygiene, and (4) communication. This category is labelled as "B" for the taxonomic analysis for defining the conceptual description. The detailed table for in-cabin behaviour is provided in Appendix D.

Comfort category (B1) includes anything related to the comfort of the passenger within the cabin. Through the analysis, findings are subcategorised within the respective category (**Figure 5.2**). Within the analysis, target findings are identified within each subcategory for the same theme of the topic. In this context, seating (B1-1) includes any related finding that is applicable when related to seating. Environment (B1-2) consists of findings related to noise, lighting, temperature, and overall atmosphere in the cabin. B1-

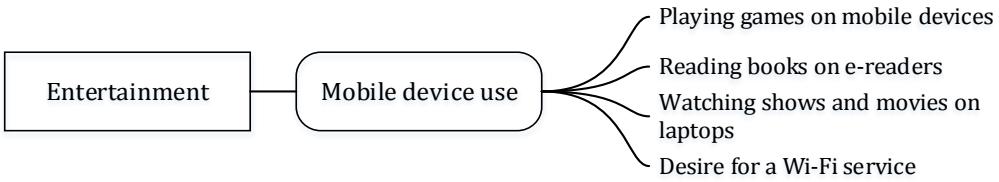
3 presents findings related to storage of any personal items within the cabin. Movement (B1-4) includes findings related to any activity observed within the cabin environment.



Source: Author

Figure 5.2. *Grouping of findings in comfort*

Within the entertainment category (B2), one subcategory is identified; mobile device use (**Figure 5.3**). Based on the findings analysed, it is revealed that mobile devices are widely used by passengers to perform several activities including watching shows or movies, playing games, and reading. In addition, the findings show that there is demand for Wi-Fi services to be provided which is accessed through personal devices.



Source: Author

Figure 5.3. *Grouping of findings in entertainment*

The next thematically identified category in this category is hygiene (B3). Through the literature, hygiene is found to be very important for Japanese passengers. In the analysis, hygiene is subcategorised in two topics; general hygiene (B3-1) and toilets (B3-2) (**Figure 5.4**). Findings related to general hygiene includes findings related to any observed activities or actions performed by passengers in the cabin while toilet presents the findings relating to hygiene in on-board lavatories.

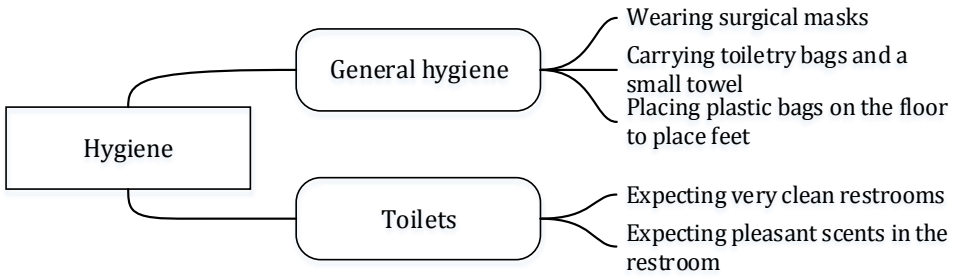


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Figure 5.4. *Grouping of findings in hygiene*

The fourth category includes communication (B4). Within this category, different subcategories are identified including; complaints (B4-1), instructions and information (B4-2), respect (B4-3), requests (B4-4), social aspect (B4-5) (**Figure 5.5**). Findings from the literature suggest communication is an important topic for Japanese passengers.

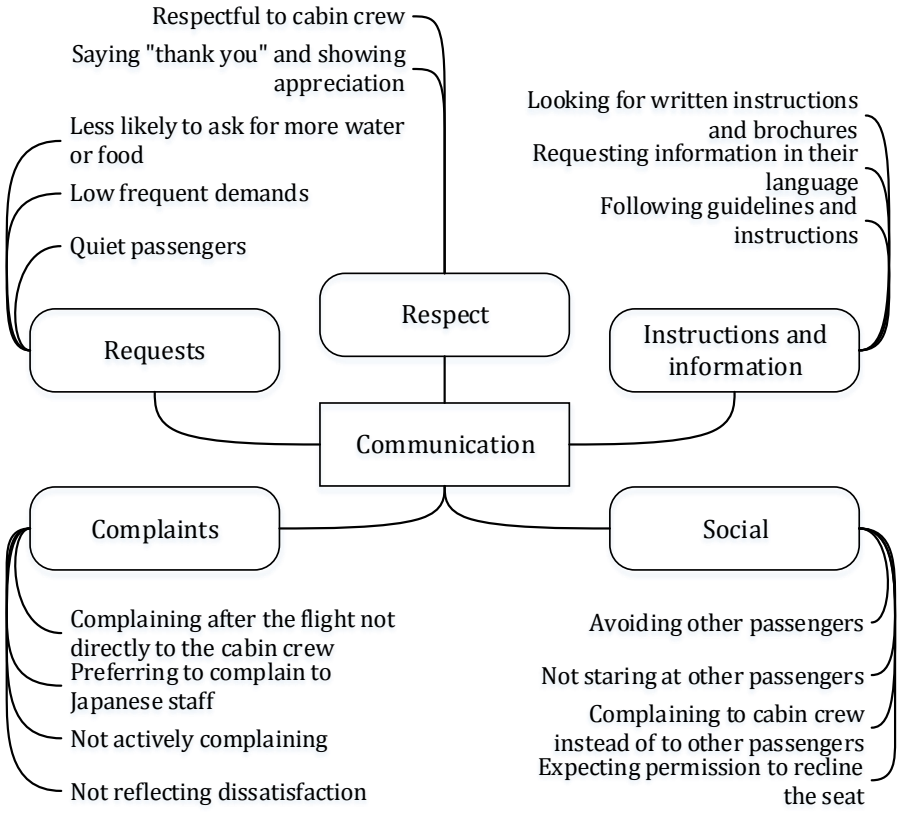

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Figure 5.5. *Grouping of findings in communication*

Finally, the food is identified through findings as one of the categories (B5). While there is limited input for this category, one subcategory is obtained through the analysis; variety. Based on the findings, a preference towards having a variety of options to choose from for in-flight meal is recorded.

Etiquette

In the analysis, etiquette is included to reflect the approach of Japanese people in social situations. The topics included in the category are labelled as "E" consecutively. Based on the definitions through the findings in the literature, overall characteristics of Japanese people are included in five topics. These characteristics include politeness, patience and tolerance, complaints, respect, and discipline. Within the selected studies, findings defining each character are presented in **Table 5.2**.

Table 5.2. *Identified etiquette of Japanese passengers*

Etiquette	Findings	Source
Politeness (E1)	Japanese people are polite. They tend to avoid disturbing behaviour and staring at other passengers. They show appreciation for services.	Mäkinen et al. (2017) and Gilbert and Wong (2003)
Patience and tolerance (E2)	Japanese people are very patient. They tend to be modest and discrete. They tend not to ask for more water or food.	Mäkinen et al. (2017) and Gilbert and Wong (2003)
Complaints (E3)	Japanese people complain in a very mild manner. Often they are quiet and choose not to complain even though they are dissatisfied. They are less likely to write protest letter when compared to other nationalities.	Mäkinen et al. (2017) and Gilbert and Wong (2003)
Respect (E4)	Similar to politeness, Japanese people are very respectful. They expect permission to recline the seats.	Mäkinen et al. (2017) and Gilbert and Wong (2003)
Discipline (E5)	Japanese people are disciplined. They follow rules, instructions, and guidance when provided.	Mäkinen et al. (2017) and Gilbert and Wong (2003)

National culture

National culture is categorised based on the six dimension presented in Hofstede model as discussed. Based on the target findings included, as presented in Section 2.4, further analysis presents grouping of the findings related to the research. According to the scores assigned to Japan relative to other nations in Hofstede et al. (2010), key findings are identified for each dimension based on the assigned score (**Table 5.3**). The dimensions in this category are labelled as "H".

Table 5.3. *Findings based on the Hofstede model in six dimensions*

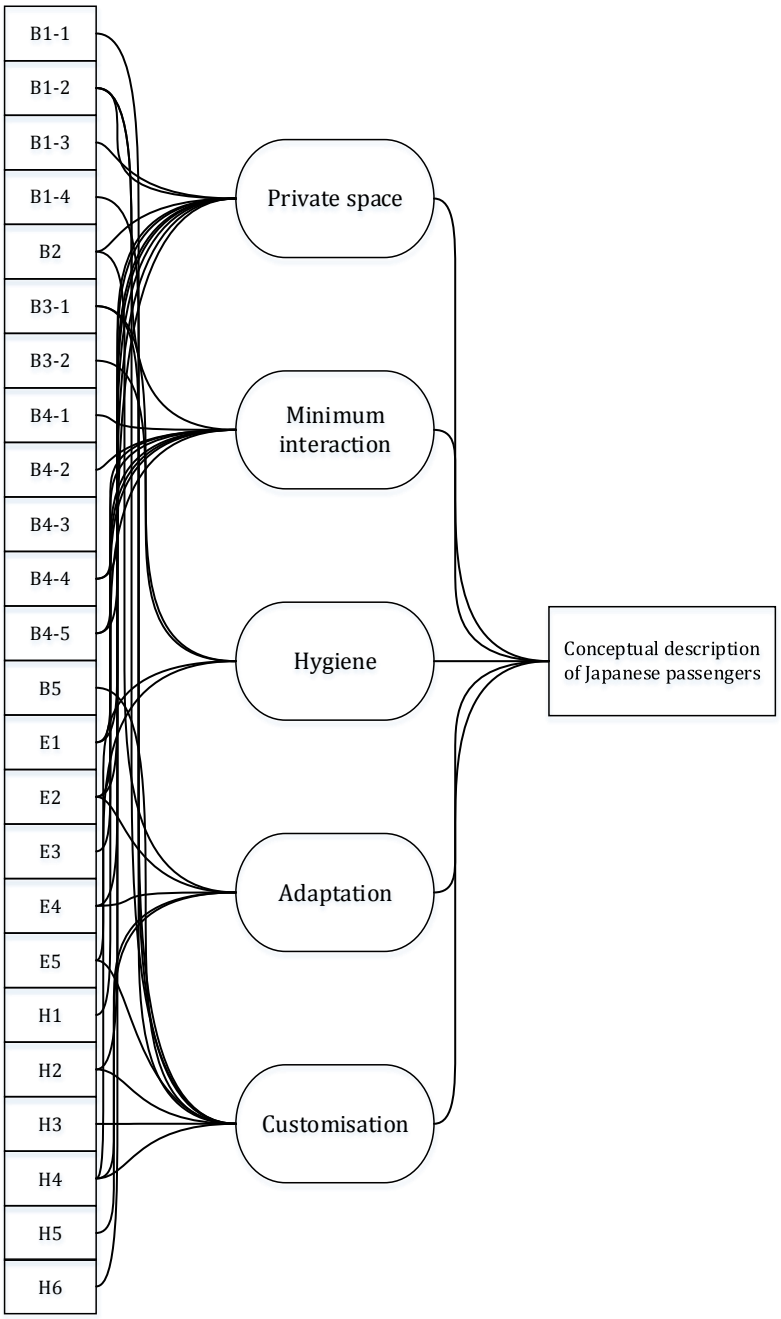
Dimension	Score	Key findings
Power distance (H1)	54	There is hierarchical system, yet concept of equality is strong. The power should be used through sensible obligations.
Individualism (H2)	46	There is strong sense of extended family reflecting individualism, however, loyalty is a very important topic. In general, unified harmony is above the individual opinions with a fear of shame.
Masculinity (H3)	95	Japanese are perfectionist. They desire to achieve the best they can do with a competitive sense of feeling. There is still a distinct line between the roles of genders and how much they can progress in their careers.
Uncertainty avoidance (H4)	92	In Japan, every social interaction, activity, or action is predicted. At many events, every aspect from what to wear to how to behave are defined for attendees. In other words, they don't want to face unexpected situations.
Long term orientation (H5)	88	Japanese people are long term oriented in the sense that they serve for a greater purpose in the course of history. Their actions are reflected through the future.
Indulgence (H6)	42	With respect to individualism, Japanese society is relatively restrained that people do not reflect themselves easily. While certain aspects of Japanese society is indulgent such as relatively higher importance of leisure, some are restrained such as moral discipline code.

5.3. Conceptual description

Overall, based on the understanding of Japanese culture and society through findings presented and summarised from the literature, the characteristics and expectations of Japanese passengers within the cabin context are compiled through a taxonomic analysis of five different elements; (1) private space, (2) minimum interaction, (3) hygiene, (4) adaptation, (5) customisation (**Table 5.4**). These elements define and reflect the trends and the characteristics of Japanese passengers in a way that the compiled findings can be materialised in terms of cabin features and services.

Table 5.4. *Identified elements in the conceptual description and related contributing factors*

Elements	Contributing factors
Private space	B1-2, B1-3, B2, B4-4, B4-5, E1, E2, E4, H2, H6
Minimum interaction	B1-2, B4-1, B4-2, B4-4, B4-5, E1, E2, E3, H1
Hygiene	B3-1, B3-2, E5, H4
Adaptation	B2, E2, E4, H4, H5
Customisation	B1-1, B1-2, B1-4, B2, B3-1, B5, E5, H2, H3, H4



Source: Author

Figure 5.6. *Visual representation of contributing factors and elements*

The first element is the relaxed and comfortable private space. It is important to maintain a feel-good atmosphere where any disruption is minimised. While it is difficult to provide a private space in densely configured cabin, especially in short and medium-haul flights, the sense of private space can be created through new technologies and specific design parameters. Several aspects of environment, storage, mobile use device, requests, social interactions in-cabin behaviour suggests the importance of private space for passengers

in addition to the etiquette they follow and the national culture characteristics. It is perceived that private space is not only for personal preference but also not to disturb others. The findings contributing to the element suggests provision of a private space can improve the comfort of passengers.

The second element is minimum interaction with others and staff. While passengers want their own space, they want to utilise this space without disturbing others. Examples of disturbing behaviours in this context include having to hand out trash over the passenger sitting next to them, or having to turn on the reading light while others are sleeping, or more a common problem which is pointed out through the findings is the adjustment of the seat for own comfort while affecting the space of others. In addition, it is revealed that Japanese passengers are quiet. This is supported through several findings in the analysis from the way they complain to the frequency of requesting more drinks or more food. In this sense, in-direct communication methods can benefit the passengers so they can reflect their opinions or direct their requests more comfortably through the implementation of a digital platform either through existing IFE systems or through passengers' mobile devices. This would also benefit the service providers by possibly increasing ancillary revenue and also understand the passengers and improve services respectively.

The third element is hygiene. Feelings of cleanliness is important for Japanese passengers in expanded cases of lavatory services, tray use, amenity kits or ancillary products (magazine, blankets, pillows, etc.). Especially the lavatory facilities needs to have high standards of hygiene with pleasant scent and presentation. In addition, the inclusion of wet towels (oshibori) through cabin services can be considered as a complimentary service as it has been on rail services in Japan or as an ancillary product with a small charge. It has also been noted that passenger carry with them a toiletry bags and small towels which can be offered by the service provider in addition to surgical masks. As Japanese people are perceived as disciplined people and they tend to avoid uncertainties, hygiene plays an important role as to high standard expectance of the services.

The fourth element is the ability of Japanese passengers to adapt latest changes that may be implemented in cabin. For example, with changing technologies, Japanese passengers are able to utilise their mobile devices within the cabin to perform various activities such

as watching shows or movies, playing games, listening to music, or reading books or other materials. In addition to this, etiquette and the national culture suggests that Japanese people are patient and tolerant and they are long-term oriented. Long term orientation means that people are more likely to adapt to changes.

The fifth element identified is customisation. It is found that being able to customise the flight experience is important. From seating to environment, Japanese passengers prefer to have control as pointed out through the findings in use of footrests, cushions, and lighting. As it is revealed that Japanese people are disciplined and have high uncertainty avoidance, this suggests they would prefer various aspect in the cabin within their own standards or expectance as passengers. Then being able to change or customise their seating environment can be beneficial to improve their comfort.

5.4. Summary

Through the qualitative analysis, five major user trend and characteristics of Japanese passengers are identified within the cabin environment. These five elements include; private space, minimal interaction, hygiene, adaptation, and customisations. These comprehensive elements define the lead user understanding in Japan.

Within the defined methodology, target findings are defined and extracted from the literature. Based on the grouped findings according to themes of findings several factors contributing to the understanding of Japanese passengers in cabin context are revealed. These factors are then reviewed to create the definitive elements of Japanese passengers in a cabin context.

These findings are important as the baseline to the lead user definition is established. The definition is included as part of the knowledge input to the design of the choice model through developing the stated preference survey. In addition, the findings from the choice model are confirmed with the findings from the qualitative analysis presented in this chapter. Further synthesis of both findings is carried out to improve overall key findings and pinpoint more specific results.

Overall, the results are beneficial to move forward in the study with supplementary knowledge established in understanding of lead user trends and characteristics. In order to reflect the conceptual description of Japanese passengers in cabin context, the

integration of the findings from the qualitative study are synthesised in the last stage of the research.

CHAPTER 6 - CHOICE MODEL FOR JAPANESE PASSENGERS

Having established the supplementary information, in this chapter, the models and results from the quantitative study are presented.

Section 6.1 presents the stated preference survey design based on the relative methodology presented in Chapter 3. Several attributes that are defined within the industry standards for the Japanese air transport market are included in the survey to present realistic scenarios. Through the development and design of the survey, in the following section, the demographic and flight history output from the survey study conducted in Japan are explained. Through the output, a preliminary descriptive statistical analysis of respondent characteristics are analysed and criteria defined for the respondents are tested with the output in Section 6.2.

In Section 6.3, the results from the stated preference survey are reported with the relative choice models. Different choice models are explained and presented. Through the choice models and the analysis, in Section 6.4, estimations for willingness to pay values are calculated for short and medium-haul flight scenarios. The findings are further analysed to present an estimate of willingness to pay based on the flight time variable.

Through the analysis, a preliminary description of the demographics and flight histories of Japanese passengers are reflected in addition to predicted choice probabilities. Through the predictions, estimates for willingness to pay values are revealed for attributes included in the study. With the economic valuation of the attributes for passengers, baseline for understanding and estimating Japanese passengers is established.

6.1. Design of the stated preference survey

As defined in Chapter 4, a specific procedure and algorithm is developed for this research. While an ideal full factorial analysis would require 1,944 choice sets for respondents, the amount was reduced to six within the time and budget constraints as explained. Based on guidance from the literature, a survey is designed to reduce the number of questions without compromising the ability to produce robust results from the analysis. **Table 6.1** presents the relative attributes, their levels and codes used in the analysis. From the

definition, a candidate set is generated and random occurrences are selected to design the initial survey structure (**Table 6.2**).

Table 6.1. *Included attributes, levels, and codes*

Attribute	Code		Level
Flight time	*T*	x_1	-1 1
Adjustable headrests	*AH*	x_2	-1 1
Seat pitch	*SP*	x_3	-1 0 1
Seat width	*SW*	x_4	-1 0 1
Carry-on baggage size allowance	*CO*	x_5	-1 1
Inflight entertainment (IFE)	*I*	x_6	-1 0 1
Wireless internet (Wi-Fi)	*W*	x_7	-1 0 1
Power supply	*PS*	x_8	-1 1
Food	*M*	x_9	-1 0 1
Fare	*C*	x_{10}	-1 0 1

Table 6.2. *Randomly selected scenarios in the survey design*

Scenario	Alternative	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9
1	*1*	-1	1	0	1	1	0	1	-1	1
	2	-1	-1	1	1	-1	1	-1	1	-1
	3	-1	-1	0	0	1	-1	-1	-1	-1
2	*1*	-1	-1	-1	-1	1	-1	-1	1	1
	2	-1	1	1	-1	1	-1	-1	1	-1
	3	-1	1	0	1	-1	-1	1	1	-1
3	*1*	-1	-1	1	1	1	1	0	1	0
	2	-1	-1	1	-1	1	-1	0	-1	-1
	3	-1	-1	-1	-1	1	0	0	-1	-1
4	*1*	1	1	1	1	1	1	1	1	1
	2	1	-1	1	-1	-1	-1	0	-1	0
	3	1	1	-1	-1	-1	1	-1	1	1
5	*1*	1	1	0	1	-1	-1	-1	1	0
	2	1	1	0	1	-1	-1	1	1	-1
	3	1	-1	-1	0	-1	-1	-1	1	0
6	*1*	1	-1	1	1	-1	-1	1	1	-1
	2	1	-1	0	-1	1	1	-1	1	1
	3	1	1	1	-1	-1	1	-1	1	-1

The algorithm defined earlier in the methodology is then applied and an efficient design for the survey study is developed. The initial balance level, LB_{eff}, for randomly selected design yields 71% as LB_j values are presented in **Table 6.3**. While time is included as another attribute defining the scenarios, they are fixed in order to have a homogenous set of scenarios for short and medium-haul flight scenarios. As seen, the contributing balance efficiency for the time attribute is always one (100%). Balance levels for each alternative (LB_j) are calculated as 0.69 for alternative 1 and 2, and 0.75 for alternative 3. The objective is to maximise these values so that the overall balance efficiency (LB_{eff}) is 1 or 100%. Upon retrieving the initial balance level, an improvement algorithm is used to replace the specific attribute levels in the design.

Table 6.3. *Balance level values for three alternatives in randomly selected scenarios*

Alternative (j)	Levels	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	LB_j
1	-1	3	3	3	1	1	2	3	2	1	1	
	0	0	0	0	2	0	0	1	1	0	2	
	1	3	3	3	3	5	4	2	3	5	3	
	η_{j1}	1	1	0.75	0.75	0.5	0.5	0.75	1	0.25	0.75	0.688
2	-1	3	3	4	0	4	3	4	3	2	4	
	0	0	0	0	2	0	0	0	2	0	1	
	1	3	3	2	4	2	3	2	1	4	1	
	η_{j2}	1	1	0.5	0.5	0.75	0.75	0.5	1	0.5	0.5	0.688
3	-1	3	3	3	3	3	4	3	4	2	4	
	0	0	0	0	2	2	0	1	1	0	1	
	1	3	3	3	1	1	2	2	1	4	1	
	η_{j3}	1	1	0.75	0.75	1	0.5	0.75	0.75	0.5	0.5	0.75

Eventually, the final survey design yields 97% balance level. While it was possible to achieve a higher balance level (99.99%), due to effects of external constraints on the survey regarding to the execution of the survey and the time constraints imposed from the project (FUCAM), the survey design was modified to achieve at least a 97% balance level. Internal constraints also affected the outcome for the balance level efficiency. These constraints include the valuation of the price which is based on the eight attributes defining the alternative. Heuristic rules are developed for the determination of the price level for each scenario. These rules effectively reflect the overall standard of the alternative. Based on the definition, assume

$$H = \sum_{s=1}^{6} \sum_{j=1}^{3} \sum_{i=2}^{9} x_{sji} \qquad \textbf{\textit{Eq. 6.1}}$$

where s is the scenario (s=1, 2, 3, 4, 5, 6), j is the alternative (j=1, 2, 3), and i is the attribute (i=2, 3, …, 9) excluding the tenth attribute price and the first attribute flight duration (defining short and medium-haul flights), then,

$$x_{10} = \begin{cases} -1 & \text{if } H \leq -3 \\ 0 & \text{if } H \geq -3 \text{ and } H \leq 3 \\ 1 & \text{if } H \geq 3 \end{cases} \qquad \textbf{\textit{Eq. 6.2}}$$

In addition to the algorithm proposed and utilised in the design, during the process, an evolutionary algorithm is also tested to maximise the balance efficiency level. As discussed in Section 4.3, the algorithm is developed to combine different scenarios from

the candidate set of full factorial scenarios with the same objective of maximising the balance level efficiency. The parameter values are determined in the algorithm for the variable mutation rate and population size and the algorithm is run on Microsoft Excel. Based on the defined parameters, the best solution is found to be 97.9% for the level balance efficiency without any price attribute constraints. Although the results from the algorithm are not included in the final survey design, genetic algorithms as part evolutionary algorithms are shown to be an option in an efficient survey design.

Overall, the survey is designed with a balance efficiency level of 97% with constraints in place. With the designed stated preference survey distributed along with the demographic and flight information survey, the next section presents the preliminary results. The final text of the survey designed is presented in Appendix E.

6.2. Preliminary survey results

The survey was conducted on 4 November 2016 in cooperation with Jamco[5] including 150 eligible Japanese respondents after the preselection process. The survey yielded 900 statistical observations for the stated preference analysis. As mentioned previously, two main criteria are used for preselection of the respondents are (1) the participant shall not be from marketing and research fields and shall not have an occupation in air transport industry and (2) participant must have been on at least one flight in the past year. The results from respondents who did not meet the requirements are eliminated and an additional survey is provided to enhance the number of responses. The survey was distributed in Japan and the nationality of all the respondents included were Japanese.

6.2.1. Demographics

Preliminary analysis show that the survey results prove homogenous distribution based on age (among three groups; 18-34, 35-54, and 55-70) and gender (ratio of 1:1) as shown in **Figure 6.1**.

[5] Jamco is a leading company in Japan and in the world for aircraft interior manufacturing, aircraft seat manufacturing, aircraft components manufacturing, and aircraft maintenance (Jamco, 2018).

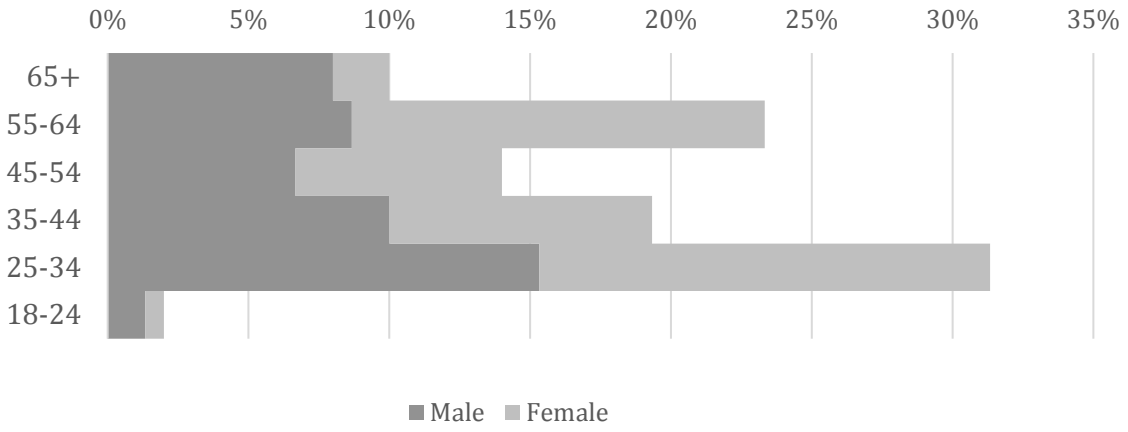


Figure 6.1. *Age and gender distribution of the respondents*

Further analysis into the respondents reveals that the majority of the respondents are employed in a full-time job (55%) with a majority of males (38%) (**Figure 6.2**). The rest of the respondents are included in a part-time job (15%), temporarily unemployed (9%), retired (9%), or others (12%) category which corresponds to homemakers and/or permanently unemployed.

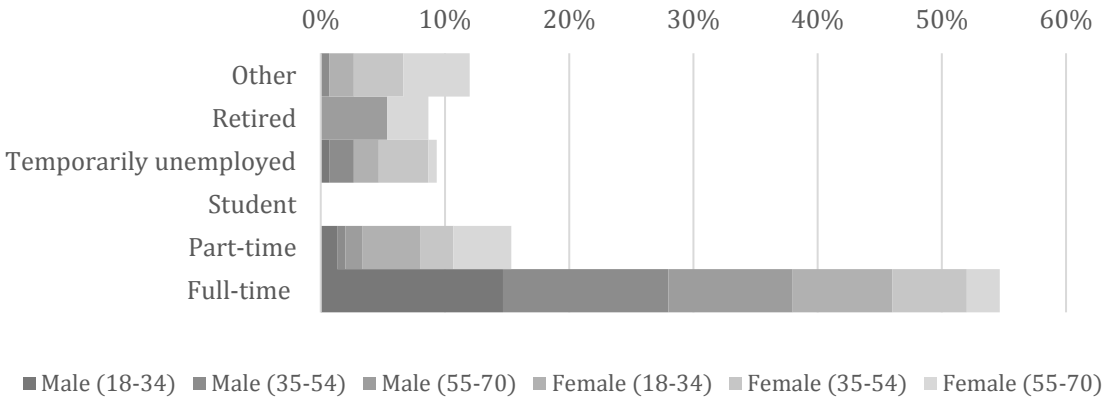


Figure 6.2. *Occupation of the respondents*

As for the income level, the majority (59%) of respondents earns an income level of more than JP¥5 million ($44,800[6]) per year. While almost nine percent of the respondents preferred not to disclose their income level, six percent of the respondents have an income level less than JP¥2 million ($18,000[6]) and 27% of the respondents have an income level between JP¥2 million and JP¥5 million.

[6] Exchange rate (average of the last five years): $1 = JP¥111.56 (IMF, 2018b)

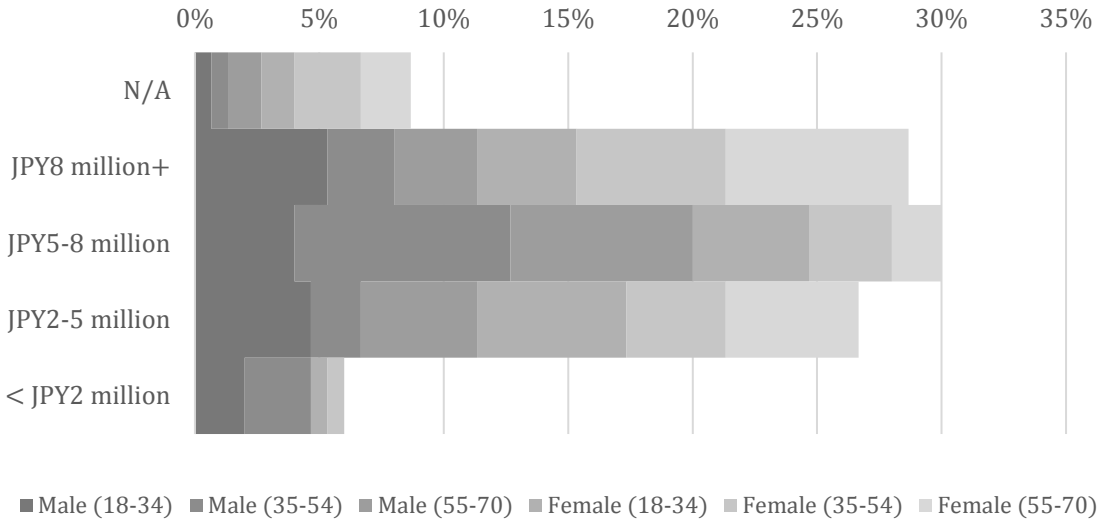


Figure 6.3. *Income level of the respondents*

Fifty-eight percent of the respondents are educated to a level of Bachelor's degree and 9.3% to a Master's level. Thirty-one percent of the respondents are graduates of upper secondary school and/or associate degree (**Figure 6.4**). There were no Ph.D. graduates among the respondents.

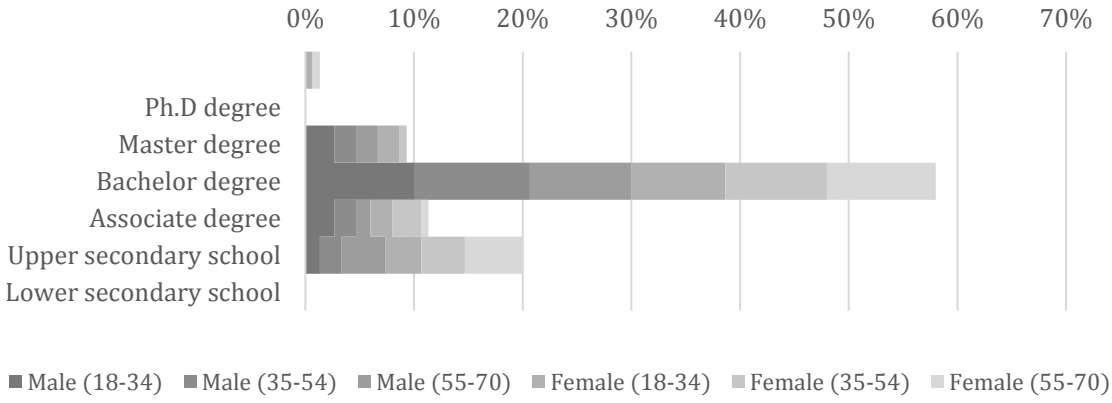


Figure 6.4. *Education level of the respondents*

In terms of physical attributes, the height of the majority of the respondents are between 150 cm and 175 cm (85%) while three percent are shorter than 150 cm and 12% is taller than 175 cm (**Figure 6.5**). A majority of the respondents weigh less than 60 kg while 35% of the respondents weigh between 60 kg and 75 kg and 11% of the respondents weigh more than 75 kg (**Figure 6.6**).

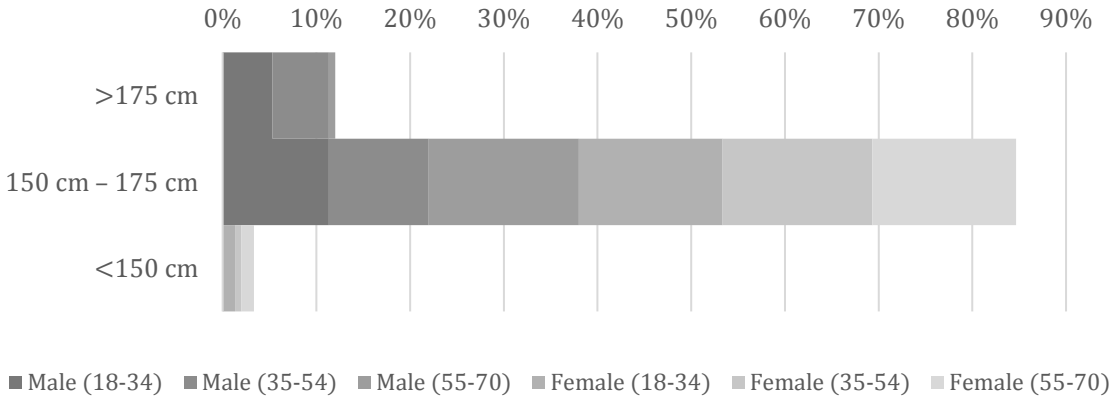


***Figure 6.5**. Height of the respondents*

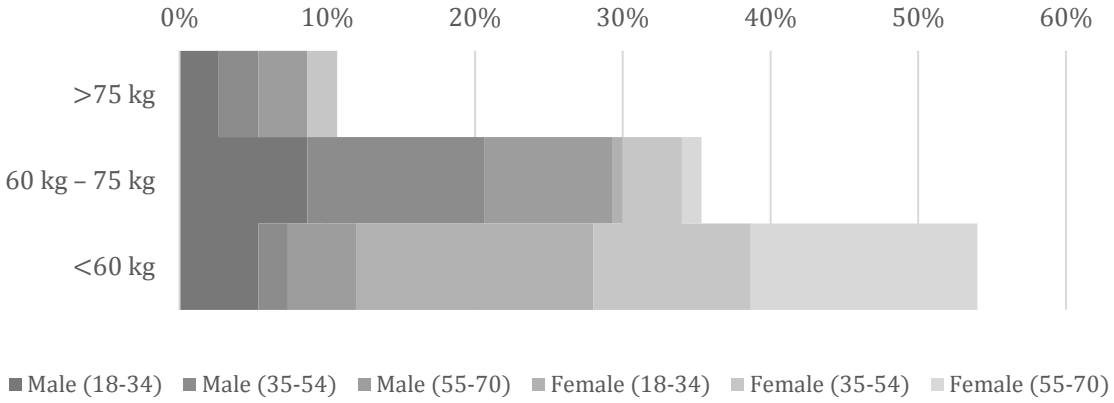


***Figure 6.6.** Weight of the respondents*

6.2.2. Flight history and background

In addition to demographic data, information about travel behaviour and connectivity is included in the survey study. Based on the provided survey, respondents were asked to share information regarding their travel behaviour, particularly in air travel. Based on the results, 43% of respondents travelled by air two more times a year while 57% of the respondents travelled once a year. Ten percent of the respondents travel six or more times a year. Eighty-four percent of the respondents stated that they usually fly short to medium-haul routes (68% short-haul and 16% medium-haul). The majority of the routes include domestic destinations with 65.3% followed by 20% international regional destinations, and 14.7% includes international destinations out of Asia (**Figure 6.7**).

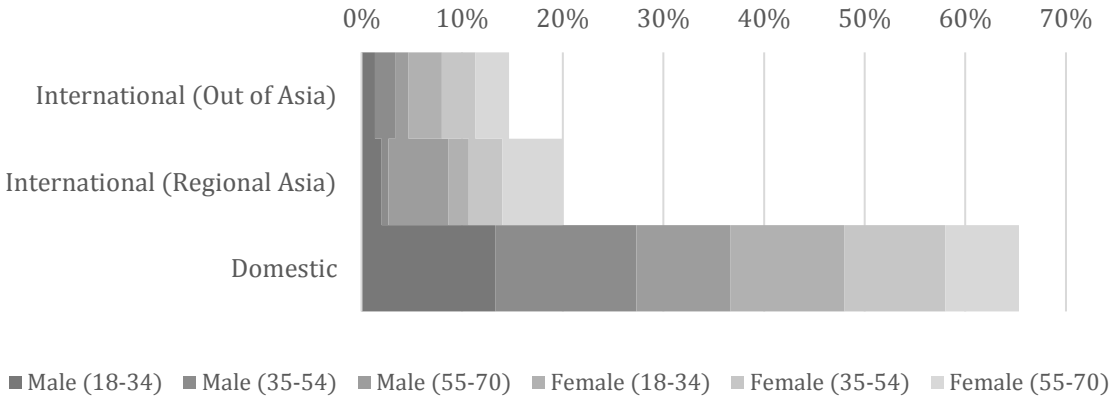


Figure 6.7. *Destinations of respondents*

The majority of respondents often fly in economy class provided by a FSC while 13% of the respondents often fly with a basic economy class provided by a LCC. Only a small percentage of the respondents included in the study often flies in premium economy class and/or business class while none of the respondents fly in first class (**Figure 6.8**).

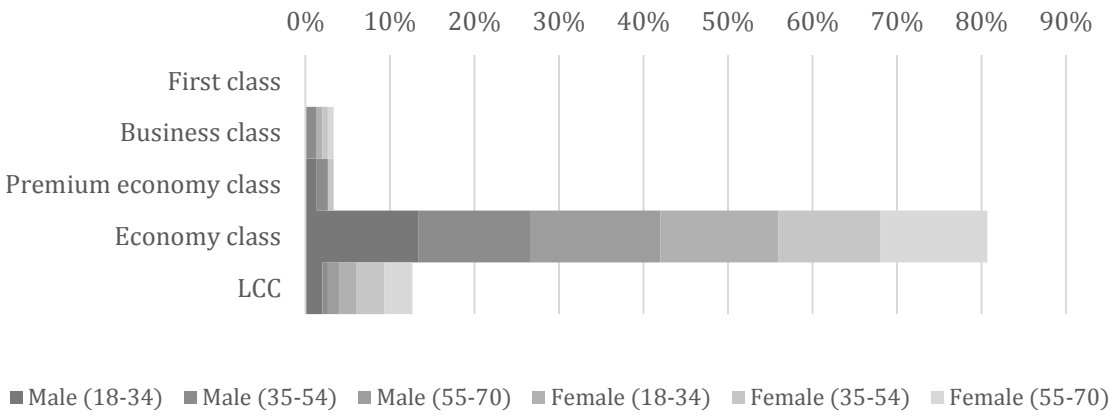


Figure 6.8. *Cabin class flown by the respondents*

When the reason for travel was asked, 77% of the respondents stated they travel by air usually for leisure, 13% of the respondents travel for relative visits, and 9% travels for business reasons (**Figure 6.9**). All of the business travels are found to be male among the respondents.

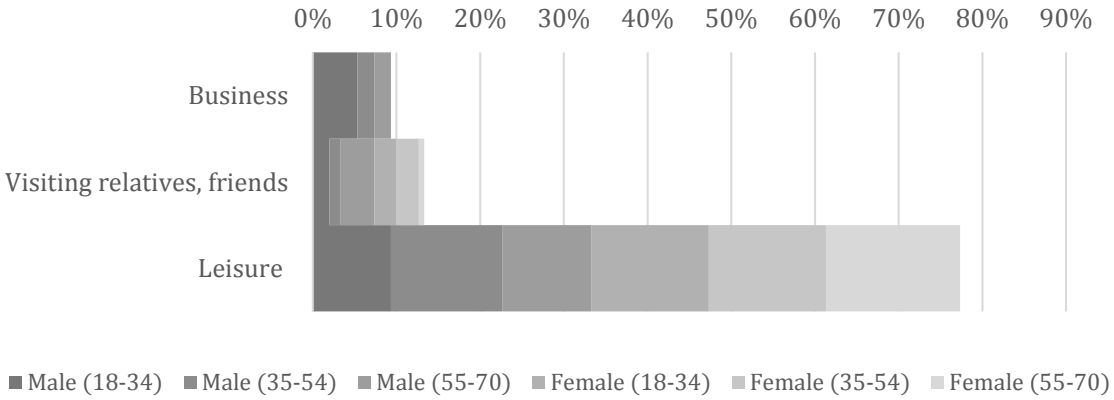


Figure 6.9. *Reason for travel of the respondents*

When respondents were asked about seat comfort, only 3.3% stated that seats are comfortable while 13.3% stated total discomfort with seats (**Figure 6.10**). Forty-one percent stated seats were not uncomfortable and 42.7% stated seats were somewhat comfortable. In terms of discomfort during sleeping in the seat, one third of the respondents indicated the seating position or uncomfortable seats and lack of head support as a reason for discomfort. For dining comfort in cabin, thirty-two percent of the respondents stated that tray tables are small and narrow in addition to five percent stating the seats as the source of discomfort.

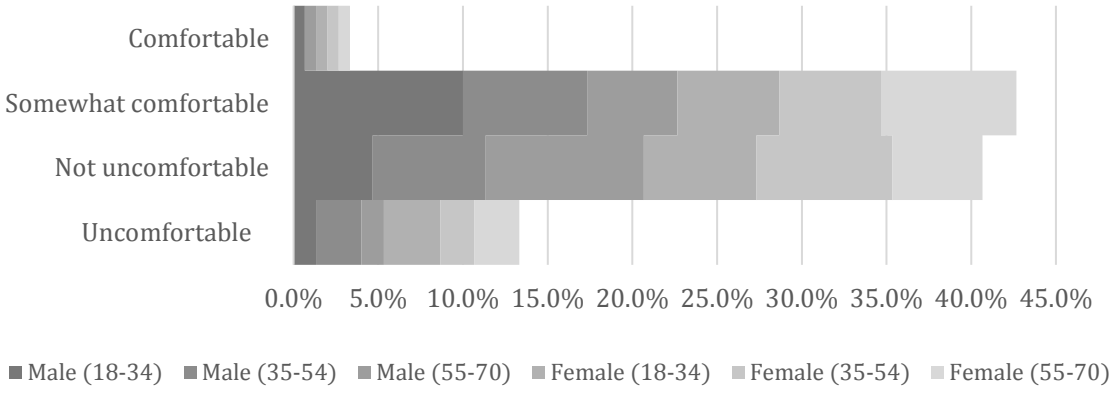


Figure 6.10. *Seat comfort levels stated by respondents*

In terms of activities in flight, thirty-five percent of the passengers stated they prefer to sleep during the flight while 18.7% prefers to watch a video or movie, and 32.7% of the respondents prefers to read or listen to music or podcasts.

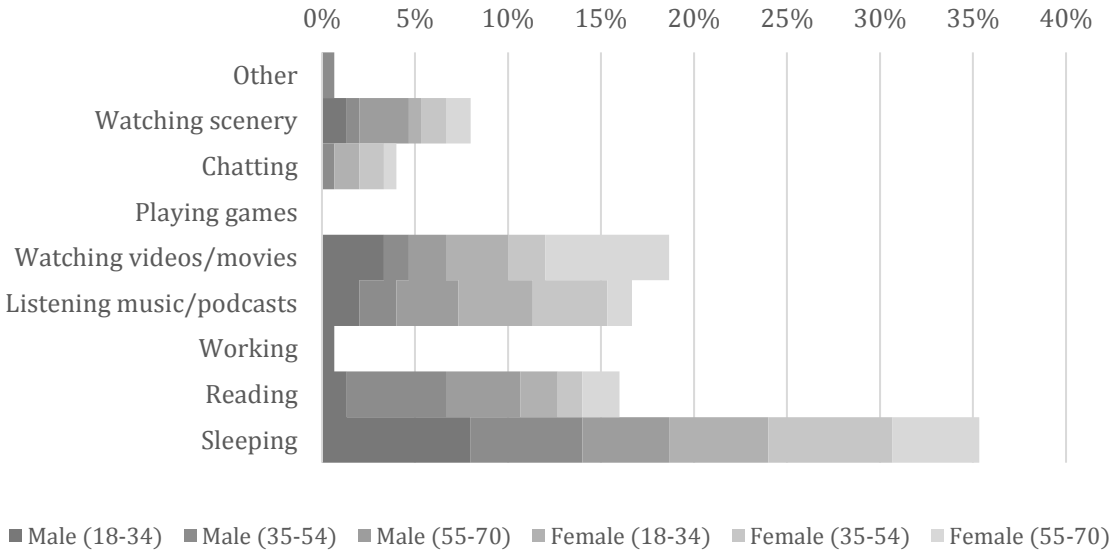


Figure 6.11. *Activities during flight by respondents*

Respondents also highly valued internet connectivity with nearly 90% of respondents spending two hours or more every day on the internet (**Figure 6.12**). In terms developing technologies, more than one third of respondents are very interested in experiencing new technologies in the cabin with a total of 80% showing an interest in a new technology.

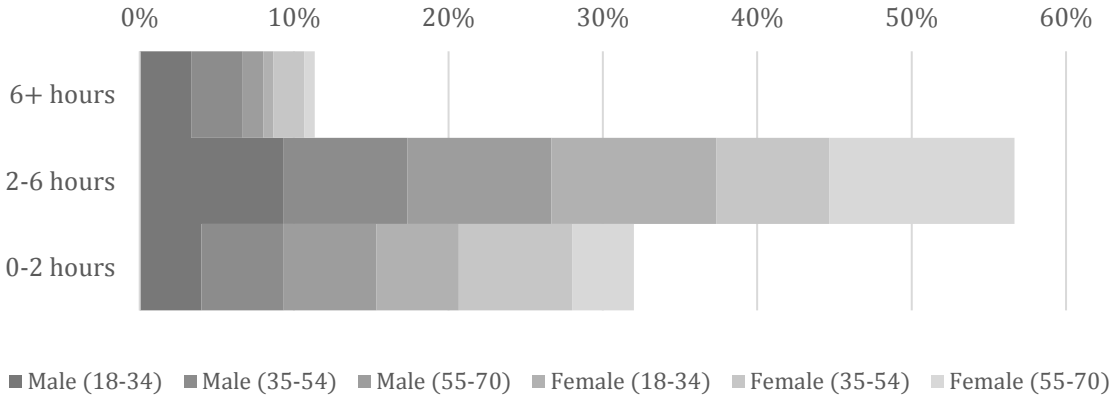
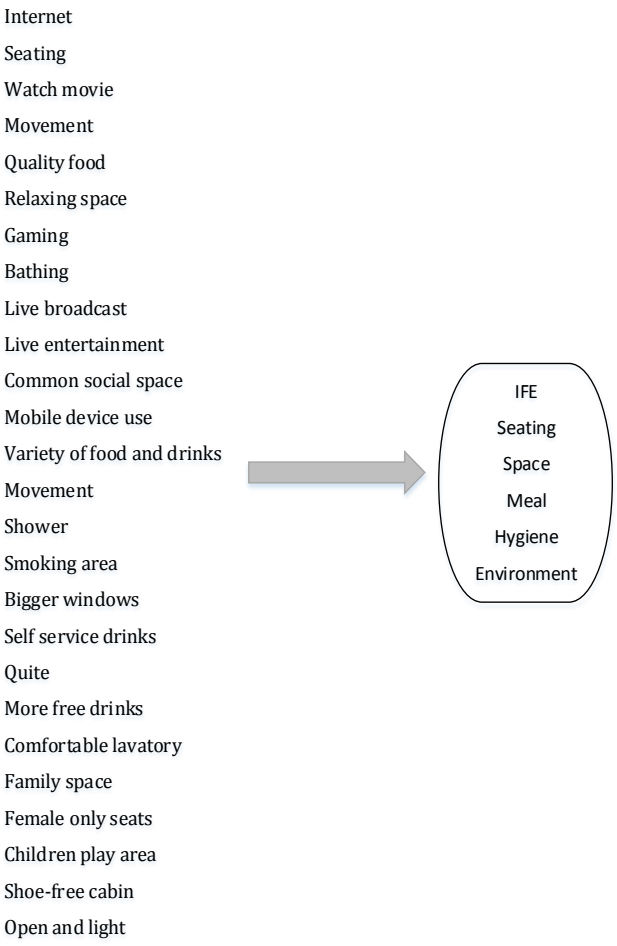


Figure 6.12. *Use of internet per day by respondents*

6.2.3. Respondent expectations

In addition to the quantifiable data, respondents were presented with an open ended question which aimed to reveal the changes and additions the respondents would make if they had the chance in cabin design. The question includes open-ended answers which then are analysed with a thematic analysis.

Six different themes are identified through the analysis which are similar to the previous themes included in Chapter 5. Out of 150 respondents, 114 respondents answered the question. Twenty-six different specific codes are revealed defining the six themes (**Figure 6.13**).



Source: Author

Figure 6.13. *Codes and themes identified in passenger expectation*

The results of the analysis based on six different respondent groups according to gender and age are presented in **Figure 6.14**. Based on the identification of codes and themes, 38% of respondents indicated an expectation in movement and space. Within the theme, the most prominent aspect was the ability move freely around the cabin (i.e. walking down the aisle, wider aisles, and stretching,). This theme clearly shows the importance of space and the ability to move within the cabin. Thirteen percent of respondents indicated expectations on seating. Among the answers, the most repeated expectation was the ability to recline the seat flat in addition to comfortable seating with custom applications

and a wider space between seats. Ten percent of respondents indicated expectations with regards to IFE with internet, streaming of videos, movies or live shows, and the need for an overall mobile device friendly environment. Seven percent indicated preferences regarding meals with a particular interest for a greater variety of drinks and food offered, and the option of self-service. Five percent of the respondents were interested in hygiene related aspects with preferences to have the option to shower/bath, use more comfortable lavatories, and shoe-free environment in the cabin. Only three percent of respondents indicated an expectation relating to environment with the desire to have bigger windows, quieter cabins, and open and bright atmosphere.

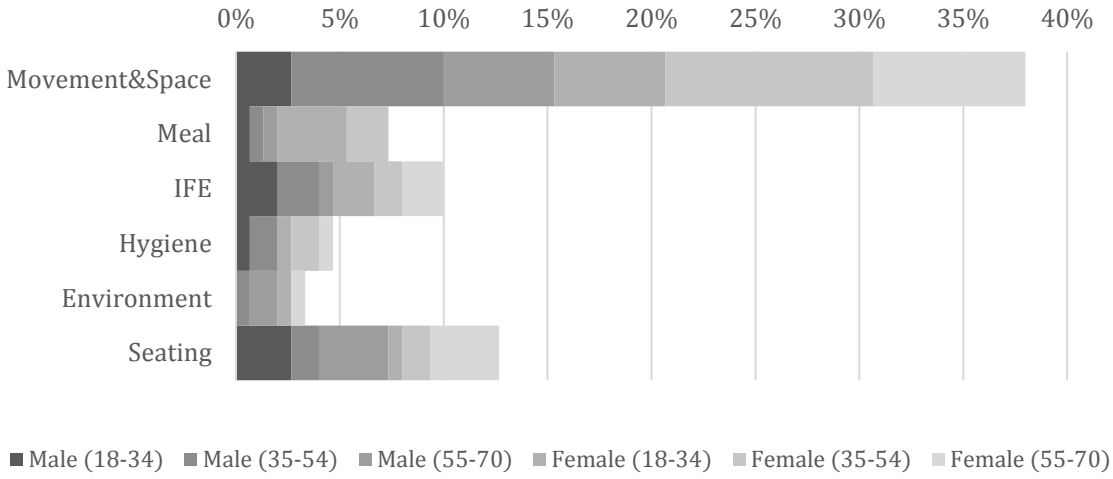


Figure 6.14. *Passenger expectations by age and gender*

Overall, the analysis shows the expectations of different group of respondents if they had the chance to alter any of the cabin aspects. Through the results, it can be revealed that the most frequent themes indicated by the respondents are the areas that need attention assuming the themes that are mentioned with lower frequencies meet the expectations of the respondents. In any case, the results closely correlate with the findings included in the previous chapter, which confirms the respondents from the survey study are similar to the user definition from the user trend and characteristics identified.

6.3. Choice models and probabilities

Different models are developed starting with the base model (price sensitivity). For alternatives, different price ranges are included as cheap, moderate, and expensive options. Initial models are developed using the MNL model to reveal preliminary choice

probabilities based on different attributes. The main analysis is then conducted with the mixed logit model in two scenarios; short-haul (SH) and medium-haul (MH) flights.

Descriptive analysis of the data reveals that 64% of respondents chose the cheapest option in short-haul (SH) routes (i.e. domestic) and 76% of respondents chose the cheapest option in medium-haul (MH) flights (i.e. regional). The frequency of choices for combined scenarios is presented in **Table 6.4**. Based on the attributes of respondents including both SH and MH scenarios, through the observation of frequencies, the middle age group (35-54) seem more likely to purchase more expensive tickets with 42.4% of choice for expensive option were chosen by them compared to the young age group (18-34) with 25.3% and the old age group (55-70) with 32.2%. In terms of gender, there is no substantial difference between the choices made among three options with the biggest margin being 5% in the expensive option with more male respondents. In 4, while vertical observations can be made clearly for age and gender due to the homogenous nature of the data, for income level and education level, the frequencies are reflected horizontally.

Table 6.4. *Frequency of choices based on respondent attributes*

	Cheap		**Moderate**		**Expensive**		**Total**
	No.	Freq.	No.	Freq.	No	Freq.	No.
Age							
18-34	223	35.4%	52	30.4%	25	25.3%	300
35-54	189	30.0%	69	40.4%	42	42.4%	300
55-70	218	34.6%	50	29.2%	32	32.3%	300
Total	630	100.0%	171	100.0%	99	100.0%	900
Gender							
Female	315	50.0%	88	51.5%	47	47.5%	450
Male	315	50.0%	83	48.5%	52	52.5%	450
Total	630	100.0%	171	100.0%	99	100.0%	900
Income							
Low	42	6.7%	12	7.0%	10	10.1%	64
MidLow	161	25.6%	51	29.8%	28	28.3%	240
MidHigh	233	37.0%	59	34.5%	28	28.3%	320
High	158	25.1%	36	21.1%	26	26.3%	220
N/A	36	5.7%	13	7.6%	7	7.1%	56
Total	630	100.0%	171	100.0%	99	100.0%	900
Education							
UpperSecond	127	20.2%	35	20.5%	18	18.2%	180
AssociateDg	61	9.7%	27	15.8%	14	14.1%	102
BachelorDg	373	59.2%	93	54.4%	56	56.6%	522
MastersDg	63	10.0%	12	7.0%	9	9.1%	84
Other	6	1.0%	4	2.3%	2	2.0%	12
Total	630	100.0%	171	100.0%	99	100.0%	900

Instead of observing the frequency of choices based on respondent characteristic, in 5, choice frequency from each level of attributes are presented. For all of the options in both attributes, variation based on the standard deviation are small with 0.071 in cheap, 0.053 in moderate, and 0.24 in expensive option.

Table 6.5. *Horizontal choice frequencies of respondents based on income levels and education levels*

	Cheap		**Moderate**		**Expensive**		**Total**	**%**
	No.	Freq.	No.	Freq.	No	Freq.	No.	
Income								
Low	42	65.6%	12	18.8%	10	15.6%	64	100.0%
MidLow	161	67.1%	51	21.3%	28	11.7%	240	100.0%
MidHigh	233	72.8%	59	18.4%	28	8.8%	320	100.0%
High	158	71.8%	36	16.4%	26	11.8%	220	100.0%
N/A	36	64.3%	13	23.2%	7	12.5%	56	100.0%
Total	630	70.0%	171	19.0%	99	11.0%	900	100.0%
Education								
UpperSecond	127	70.6%	35	19.4%	18	10.0%	180	100.0%
AssociateDg	61	59.8%	27	26.5%	14	13.7%	102	100.0%
BachelorDg	373	71.5%	93	17.8%	56	10.7%	522	100.0%
MastersDg	63	75.0%	12	14.3%	9	10.7%	84	100.0%
Other	6	50.0%	4	33.3%	2	16.7%	12	100.0%
Total	630	70.0%	171	19.0%	99	11.0%	900	100.0%

For the regression analysis of the data, initial models are developed with multinomial logit model. With MNL, regressions allow the modelling of choices through passengers' characteristics and preliminary choice probabilities of different attribute levels. **Table 6.6** presents the results from the multinomial logit models developed for the short-haul scenario. The results present the mean coefficient values and relative standard deviations for the chosen alternatives (valued '1') compared to the base outcome which are the not chosen alternatives (valued '0'). As expected, the fare price attribute is negative for all models included. From the individually observed results in different models, seat pitch, seat width, carry-on bag size, IFE, internet, power supply and meal services are found to be statistically significant. The seat pitch has relatively higher value (0.0680*) when choosing the alternative compared to seat width which is found to have a negative sign (-0.1272**). In terms of IFE, both personal (interactive) screens and wireless content are found to have negative values which indicates the lack of desire for these services on short-haul scenario. On the contrary, free internet when compared to no internet and the presence power supply are found to be statistically significant with positive values of 0.9112* and 1.0354* respectively. In meal services, the results show relatively positive

values for complementary meal service (1.0237*) and negative values for full meal menu (-1.4508*) when compared to a limited option meal menu. Due to the high variation, several intersections of different attributes were neglected.

Similarly, the results for medium-haul scenario are presented in **Table 6.7**. In all cases, the fare price coefficient is found to be negative in all models. When compared to short-haul scenario, not as many attributes are found statistically significant. In medium-haul scenario, seat pitch, adjustable headrest, IFE, internet, power supply and meal services are found statistically significant. The seat pitch is found to have a positive sign (0.2243*) with a greater value than in the short-haul scenario. The adjustable headrest has a negative value (-1.3857*) which would decrease the choice probability of a respective alternative. In medium-haul scenario, IFE is found to be relatively important for respondents with a wireless content (BYOD) having a positive coefficient value with 0.8307*. The internet service is also found to be important for respondents provided with a cost or free with values of 1.1384* and 1.2022* respectively. While the estimates show a basic understanding of the choice probabilities for different attributes, the variety among the results is limiting the observation of several intersections of different attributes.

Table 6.6. *Estimated multinomial logit regression results for short-haul scenario*

Choice		Attributes		M1	M2	M3	M4	M5
0					*base outcome*			
1		Price	Mean	-0.0001**	-0.0002*	-0.0002*	-0.0002*	-0.0004*
			SD	0.0000	0.0000	0.0000	0.0000	0.0000
		Seat pitch	Mean	0.0680*	-	-	-	-
			SD	0.0188	-	-	-	-
		Seat width	Mean	-0.1272**	-	-	-	-
			SD	0.0424	-	-	-	-
	Carry-on bag size	Small	Mean	*base level*	-	-	-	-
			SD		-	-	-	-
		Big	Mean	-1.7049*	-	-	-	-
			SD	0.1931	-	-	-	-
	Adjustable headrest	None	Mean	-	-	-	-	-
			SD	-	-	-	-	-
		Present	Mean	-	-	-	-	-
			SD	-	-	-	-	-
	IFE	None	Mean	-	*base level*	-	-	-
			SD	-		-	-	-
		Wireless content	Mean	-	-1.0835*	-	-	-
			SD	-	0.1493	-	-	-
		Personal screen	Mean	-	-0.6378*	-	-	-
			SD	-	0.2002	-	-	-
	Internet	None	Mean	-	-	*base level*	-	-
			SD	-	-		-	-
		Paid	Mean	-	-	-	-	-
			SD	-	-	-	-	-
		Free	Mean	-	-	0.9112*	-	-
			SD	-	-	0.2749	-	-
	Power supply	None	Mean	-	-	-	*base level*	-
			SD	-	-	-		-
		Present	Mean	-	-	-	1.0354*	-
			SD	-	-	-	0.1508	-
	Meal	Limited	Mean	-	-	-	-	*base level*
			SD	-	-	-	-	
		Full menu	Mean	-	-	-	-	-1.4508*
			SD	-	-	-	-	0.1981
		Complementary	Mean	-	-	-	-	1.0237*
			SD	-	-	-	-	0.1953
		Log-likelihood		-701.551	-792.312	-776.690	-765.961	-713.750
		No of Obs.		450	450	450	450	450

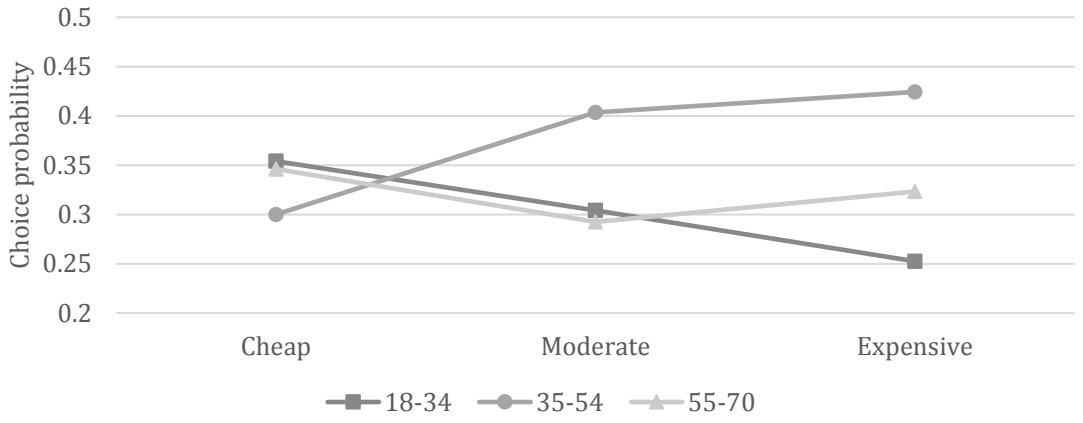
** Statistical significance level at p≤0.001*
*** Statistical significance level at p≤0.01*
**** Statistical significance level at p≤0.05*

Table 6.7. *Estimated multinomial logit regression results for medium-haul scenario*

Choice		Attributes		M1	M2	M3	M4	M5
0				*base outcome*				
1		Price	Mean	-0.0001*	-0.0001*	-0.0001*	-0.0001*	-0.0001*
			SD	0.0000	0.0000	0.0000	0.0000	0.0000
		Seat pitch	Mean	0.2243*	-	-	-	-
			SD	0.0378	-	-	-	-
		Seat width	Mean	-	-	-	-	-
			SD	-	-	-	-	-
	Carry-on bag size	Small	Mean	-	-	-	-	-
			SD	-	-	-	-	-
		Big	Mean	-	-	-	-	-
			SD	-	-	-	-	-
	Adjustable headrest	None	Mean	*base level*	-	-	-	-
			SD		-	-	-	-
		Present	Mean	-1.3857*	-	-	-	-
			SD	0.2589	-	-	-	-
	IFE	None	Mean	-	*base level*	-	-	-
			SD	-		-	-	-
		Wireless content	Mean	-	0.8307*	-	-	-
			SD	-	0.1869	-	-	-
		Personal screen	Mean	-	-	-	-	-
			SD	-	-	-	-	-
	Internet	None	Mean	-	-	*base level*	-	-
			SD	-	-		-	-
		Paid	Mean	-	-	1.1384*	-	-
			SD	-	-	0.2337	-	-
		Free	Mean	-	-	1.2022*	-	-
			SD	-	-	0.1865	-	-
	Power supply	None	Mean	-	-	-	*base level*	-
			SD	-	-	-		-
		Present	Mean	-	-	-	-0.8952*	-
			SD	-	-	-	0.1935	-
	Meal	Limited	Mean	-	-	-	-	*base level*
			SD	-	-	-	-	
		Full menu	Mean	-	-	-	-	-0.8821*
			SD	-	-	-	-	0.2347
		Complementary	Mean	-	-	-	-	-
			SD	-	-	-	-	-
		Log-likelihood		-565.335	-583.724	-571.725	-584.296	-580.855
		No of Obs.		450	450	450	450	450

** Statistical significance level at p≤0.001*
*** Statistical significance level at p≤0.01*
**** Statistical significance level at p≤0.05*

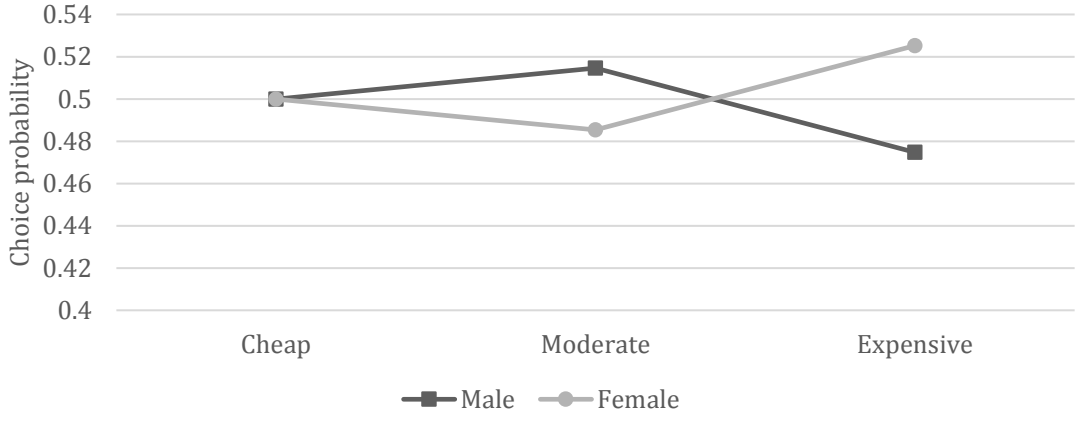
When respondent attributes are integrated to the models, there is no significant difference found between the young, middle and the older age groups (**Figure 6.15**). However, the indication is present for middle-age group to choose the more expensive alternatives.



Source: Author

Figure 6.15. *Choice probabilities of age groups*

For preference differences between genders, the data analysis proves that there is no significant difference. Another case-specific attribute included to analyze the preference of respondents is the income level. While there are indications that as the income level increases, tendency to purchase more expensive ticket increases, it is not statistically significant.



Source: Author

Figure 6.16. *Choice probabilities of different genders*

Overall, the initial models estimated provide logical but not accurate results due to high variance over several regressions. The results reveal the preliminary analysis of attribute levels and relative choice probabilities. For the main analysis, mixed logit models are included. Several regression models are developed for the analysis in short-haul and

medium-haul scenarios combined with a mixed logit model. Compared to the preliminary analysis, even though MNL successfully provides initial analysis with regression models on case specific variables, mixed logit models prove more effective with robust and accurate results including different interaction and correlation of attributes. This is thought to be due to the nature of ML models where the random coefficients are fitted into a distribution and then simulated to estimate values for analysis which may reduce the variance over models compared to MNL models (Espino et al., 2008). While conditional logit models were also explored with the results proving similarly reliable including case specific variables, the main analysis is conducted using a total of 36 different mixed logit models in two scenarios based on the categorisation of attributes. Final results are provided with alternative specific characteristics computed using software STATA© (Hole, 2013).

In the following sections, estimated ML models are presented for SH and MH scenarios. In both scenarios, models are grouped based on categories. Three different model groups are defined including seat related attributes (seat pitch, seat width, carry-on bag size, and adjusted headrest), technology attributes (IFE, internet connection, and power supply), and meal service attribute. Through the results, the estimations with a significance value of 95% or higher ($p \leq 0.05$) are included in the analysis with a total of 17 models presented out of several regressions.

The mixed logit model developed for the both scenarios is

$$P_n(i) = \int \frac{e^{V_{in}}}{\sum_{j \in C_n} e^{V_{jn}}} f(\beta|\theta) d\beta \qquad \textbf{Eq. } 6.3$$

where,

$$V_{in} = \theta_P x_{in} + \theta_{SP} x_{in} + \theta_{SW} x_{in} + \theta_{CO} x_{in} + \theta_{AH} x_{in} + +\theta_{I2} x_{in} + \theta_{I3} x_{in} + \theta_{W2} x_{in} + \theta_{W3} x_{in} + \theta_{PS} x_{in} + \theta_{I2} x_{in} + +\theta_{M2} x_{in} + \theta_{M3} x_{in} + \varepsilon_{in} \qquad \textbf{Eq. } 6.4$$

with

θ_P is the fare price coefficient
θ_{SP} is the seat pitch coefficient

θ_{SW} is the seat width coefficient

θ_{CO} is the carry-on bag size coefficient

θ_{AH} is the adjustable headrest coefficient

$\theta_{I1}, \theta_{I2}, \theta_{I3}$ are the three levels of IFE coefficient

$\theta_{W1}, \theta_{W2}, \theta_{W3}$ are the three levels of internet coefficient

θ_{PS} is the power supply coefficient

$\theta_{M1}, \theta_{M2}, \theta_{M3}$ are the three levels of meal service coefficient

6.3.1. Short-haul scenario

Different regression models are developed and estimated for the short-haul scenario. These models include the base model with price attribute which is found to be statistically significant. The results show that the utility value increases due to a slight decrease in the price. On top of the base model, 16 different ML models are developed and then 9 models are specified in the final analysis (as shown in **Table 6.8** with statistically significant factors). As stated, three different model groups are defined including seat related attributes, technology, and meal service.

With nine models specified, adjusted headrests failed to prove as a statistically significant factor. This result indicates that adjusted headrests does not have any influence in the utility of respondents during decision making for the SH scenario. Through the analysis, seat pitch is found significantly important for passengers. Larger seat pitch increases the utility of an alternative for respondents as the values for seat pitch (θ_{SP}) suggests (i.e. 0.076^{***} in M4). On the contrary, seat width is found to be varying among different models. While seat width (θ_{SW}) is found statistically significant only in M2 with a positive value of 0.204^{*}, in other models it fails to be significant. Overall, based on the findings, seat width is not a significantly important factor while there are indications towards the effect on the utilization. For the storage aspect, the size of the carry-on bags allowed for the flight estimated to be not an important factor. Based on the analysis, normal carry-on size has more choice probability for SH scenario. The negative value of carry-on bag size (θ_{CO}) in M3 (-0.901^{***}), M4 (-1.041^{***}) and M5 (-1.104^{**}) implies that utility decreases as the carry-on bag size increases along with the price while normal size increases the overall utility.

The second group of models includes the technology aspect. Within the group, IFE, internet connection, and power supply attributes are considered. The analysis results indicate that all the attributes included are statistically significant. In SH flights, estimates imply that IFE is not demanded. Respondents are more likely to choose a flight without an IFE than a flight option having any type of IFE considering the price. The results from M5, M6, and M7 indicate that the coefficients of IFE options (θ_{I2} and θ_{I3}) are lower than 'no IFE' (θ_{I1}) option. Out of three levels provided in IFE, having 'no IFE' is significantly more attractive than 'generic IFE' and 'IFE content on personal device' provided by the airline. Between the 'generic IFE' and 'IFE content on personal device', while the effect of 'IFE content on personal device' on the utilization is negative (-0.972* in M5 and -1.1604*** in M7), option for a 'generic IFE' with personal screen is positive (1.203* in M6). While IFE is not important, considering the use of personal devices, respondents prefers flights where a power supply provided. In the study, the 'power supply' attribute is presented as a binomial value and the results imply an increase in the utility when a power supply is present for the alternative. While it is an interesting finding, it can be supported with the lack of desire for an IFE in the cabin as passengers may prefer using their own devices (i.e. mobile phones, tablets, laptops).

As for the internet connection, it is indicated that there is no statistically significant difference between 'no internet connection' and 'free internet' as they both have similar positive effect in M6 (respectively 1.136* and 1.168*) on the decision maker. In other words, for respondents, an alternative with 'free internet' connection and an alternative with 'no internet' connection has very similar values for the utilization assuming other attributes are fixed.

On the other hand, 'paid internet' has negative value on the decision maker as indicated by the coefficient value of 'paid internet' connection (θ_{W2}) in M5 (-0.839*) and M7 (-1.275*). This implies that an alternative with a 'paid internet' option is less valuable for respondents compared to other internet options assuming other attributes are fixed. With this information, as the parameter estimation outputs of 'free internet' connection and 'power supply' indicate positive effect on the utilization along with the lack of interest in IFE as stated earlier, the results imply that respondents prefer using their own personal devices. In the third group, meal service is analyzed. All variables (θ_{M1}, θ_{M2}, and θ_{M3}) are found statistically significant in all the models included. Among the attribute levels,

decision makers have more choice probability for a ‘complementary meal’ option or a ‘limited menu’ for purchase than a ‘full menu’ options for purchase. The coefficient of ‘full menu’ option (θ_{M2}) is -0.704** which suggest that compared to other attributes utility is decreased when ‘full menu’ is an option.

Table 6.8. *Estimated mixed logit regression results for short-haul scenario*

Attribute			M1	M2	M3	M4	M5	M6	M7	M8	M9
Price (θ_p)		Mean	-0.0002*	-0.0004*	-0.0002*	-0.0002***	-0.0002*	-0.0002*	-0.0002*	-0.0001*	-0.0002*
		SD	-	-	-	-	-	-	-	-	-
Seat Pitch (θ_{SP})		Mean	0.0702*	0.1435*	0.0781***	0.0756***	0.0654*	0.1148*	-	-	-
		SD	0.0006	0.0015	0.0017	0.0044	0.0137	0.0024	-	-	-
Seat Width (θ_{SW})		Mean	-	0.2040*	-	-	-	-	-	-	-
		SD	-	0.3089	-	-	-	-	-	-	-
Carry-on Bag Size (θ_{CO})		Mean	-	-	-0.9008***	-1.0412***	-1.1042**	-	-	-0.6525**	-
		SD	-	-	1.0444	1.2085	0.7986	-	-	0.5628	-
Adjusted Headrest (θ_{AH})		Mean	-	-	-	-	-	-	-	-	-
		SD	-	-	-	-	-	-	-	-	-
IFE	No IFE (θ_{I1})	Mean	-	-	-	-	1.3730*	1.2806*	1.3373*	-	-
		SD	-	-	-	-	1.6224	1.7542	1.5420	-	-
	Wireless Content (θ_{I2})	Mean	-	-	-	-	-0.9722*	-	-1.1639***	-	-
		SD	-	-	-	-	0.2172	-	0.1204	-	-
	Personal Screen IFE (θ_{I3})	Mean	-	-	-	-	-	1.2034*	-	-	-
		SD	-	-	-	-	-	0.3154	-	-	-
Internet Connection	No Internet (θ_{W1})	Mean	-	-	-	-	1.1326***	1.1357*	-	-	-
		SD	-	-	-	-	0.2451	0.2728	-	-	-
	Paid Internet (θ_{W2})	Mean	-	-	-	-	-0.8387*	-	-1.2748*	-	-
		SD	-	-	-	-	0.0177	-	0.0001	-	-
	Free Internet (θ_{W3})	Mean	-	-	-	-	-	1.1679*	0.6628**	-	-
		SD	-	-	-	-	-	0.1117	0.1102	-	-
Power Supply (θ_{PS})		Mean	-	-	-	-	-	0.8614*	1.2114*	-	-
		SD	-	-	-	-	-	0.0205	0.0041	-	-
Meal Service	Limited Menu (θ_{M1})	Mean	-	-	-	-	-	-	-	-	0.9568*
		SD	-	-	-	-	-	-	-	-	0.0633
	Full Menu (θ_{M2})	Mean	-	-	-	-	-	-	-	-0.7036**	-
		SD	-	-	-	-	-	-	-	0.1194	-
	Complementary Meal (θ_{M3})	Mean	-	-	-	-	-	-	-	0.7716*	1.6410*
		SD	-	-	-	-	-	-	-	0.0161	0.0187
Log-likelihood			-406.262	-384.072	-380.035	-375.378	-384.334	-389.707	-383.876	-405.510	-399.120
No of Obs.			450	450	450	450	450	450	450	450	450

** Statistical significance level at p≤0.001*
*** Statistical significance level at p≤0.01*
**** Statistical significance level at p≤0.05*

Further analysis includes the compiled choice probabilities based on various levels of different attributes. Two attributes, IFE and internet, are selected based on the findings. In the short-haul scenario, the choice probability for an alternative with 'no IFE' is estimated to be 0.41 while the choice probability for an alternative with a 'personal screen' is estimated as 0.36. While there is no significant difference between the two levels as the respective confidence intervals at 95% are intersecting, 'wireless content' provided in BYOD concept has significantly lower choice probability of 0.26.

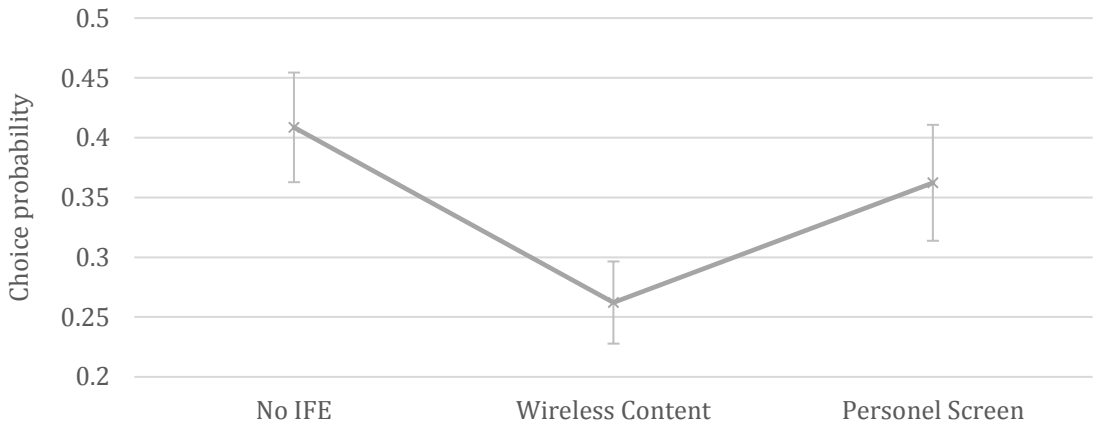
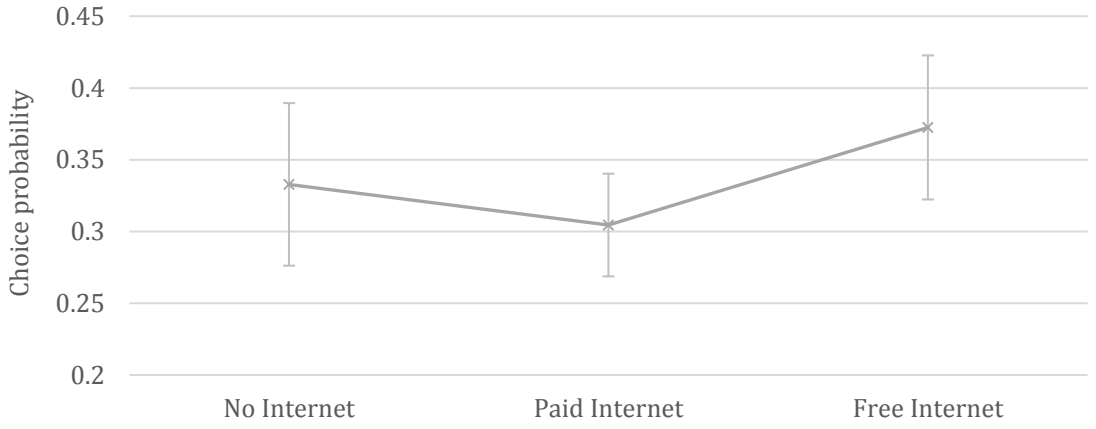


Figure 6.17. *Compiled choice probabilities of different levels in IFE for the short-haul flight*

In terms of the internet service provided in the cabin, for short-haul scenario there is no significant difference between three levels of the attribute. However, the results indicate that 'free internet' has relatively higher choice probability with an average of 0.37 while the choice probability for 'no internet' and 'paid internet' are estimated as 0.33 and 0.31 respectively.



Source: Author

Figure 6.18. *Compiled choice probabilities of different levels of internet for the short-haul flight*

6.3.2. Medium-haul scenario

As in short-haul scenario, various regression models are implemented in the analysis. The base model is developed with the attribute price which was found to be statistically significant. Similar to the SH scenario, the price attribute is negative as expected where the utility of an alternative decreases as price goes up. Out of 19 ML models developed 8 models are specified in the final analysis (as shown in **Table 6.9** with statistically significant values).

In the first group of models, seat pitch, seat width, adjusted headrests, and carry-on bag size are analyzed. Through the analysis, seat pitch is found to be an important factor over several models. Similarly to the SH scenario, as the seat pitch increases, the overall utility increases for the relative alternative with values estimated in M1, M2, M4, M5, and M7. Seat width is statistically significant only in M3 where the sign of the coefficient for the attribute (θ_{SW}) is estimated to be negative (-0.229^{***}) which suggests a lack of importance of seat width in MH scenario. Overall, the impact of seat width is excluded. In the same model, M3, the adjusted headrest (θ_{AH}) option also have negative impact (-1.100^{***}) which can be interpreted as not an important factor. For carry-on bag size, models M4, M5, and M8 suggest that greater size option does not reflect as a benefit in the overall utility as the values are -0.815^{***}, -0.652^{***}, and -0.898^{***} respectively. Similar to SH scenario, the standard size accepted by the airlines for the carry-on bag seems sufficient for decision makers.

In the second group, technology, IFE, internet, and power supply are included. Based on the analysis, contrary to SH scenario, IFE is found to be an important factor in the utility of an alternative as having 'no IFE' (θ_{I1}) has negative impact on the utilization with a coefficient of -0.258***. Within the attribute levels, 'IFE content on personal device' provided by the airline (θ_{I2}) is estimated to have positive effect (0.350*** in M4) compared to having 'no IFE'. Among the two IFE options, the results indicate that 'IFE content on personal devices' (θ_{I2}) has more positive impact with 0.415*** in M5 than 'generic (personal screen) IFE' (θ_{I3}) with 0.061*** in M5 on the utilization. Internet is another attribute found significant in the study. Compared to having 'no internet' connection (θ_{W1}) provided, 'free internet' option (θ_{W3}) with a coefficient of 0.733*** (M5) and 'paid internet' (θ_{W2}) with a coefficient of 0.285*** (M4) both increase the overall utility of an alternative for respondents. Providing 'no internet' in any case decreases the utility of an alternative with estimated values from M4 (-0.694***) and M5 (-0.545***). Respondents are less likely to choose an alternative with 'no internet' connection. For 'power supply', contrary to SH scenario, having a 'power supply' does not positively impact the decision maker with estimated negative values in M6 and M8.

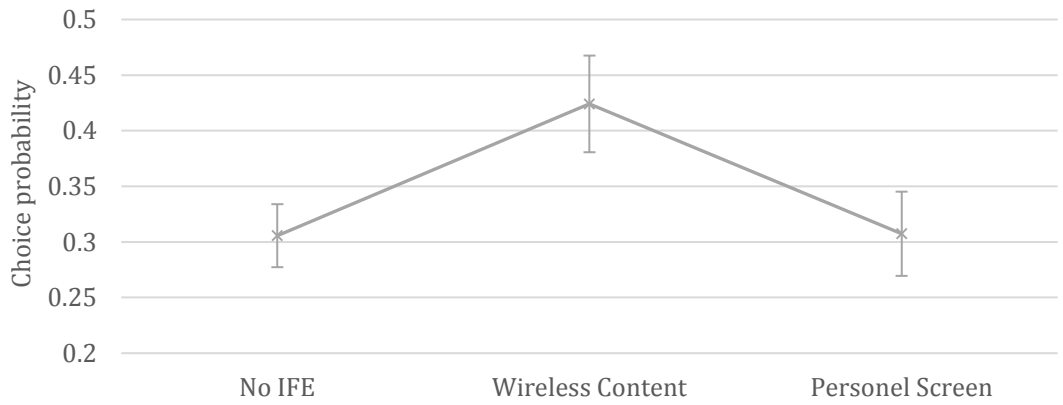
In the third group, the meal option is analyzed. Through the analysis, the results imply that 'limited menu' (θ_{M1}) option has the highest positive impact with coefficient values of 0.896*** in M7 compared to 'full menu' (θ_{M2}) similar to the SH scenario. Between 'limited menu' (θ_{M1}) and 'complementary meal' (θ_{M3}), while 'limited menu' has positive impact with 0.967*** in M8, 'complementary meal' has a coefficient value of 0.654***.

Table 6.9. *Estimated mixed logit regression results for medium-haul scenario*

Attribute			M1	M2	M3	M4	M5	M6	M7	M8
Price (θ_P)		Mean	-0.0001*	-0.0001*	-0.0001*	-0.0001*	-0.0001*	-0.0001*	-0.0001*	-0.0001*
		SD	-	-	-	-	-	-	-	-
Seat Pitch (θ_{SP})		Mean	0.0747**	0.0761**	-	0.0777**	0.0650***	-	0.0890*	-
		SD	0.0004	0.0014	-	0.0057	0.0035	-	0.0064	-
Seat Width (θ_{SW})		Mean	-	-	-0.2288***	-	-	-	-	-
		SD	-	-	0.0796	-	-	-	-	-
Carry-on Bag Size (θ_{CO})		Mean	-	-	-	-0.8146***	-0.6520***	-	-	-0.8985***
		SD	-	-	-	2.3077	2.1831	-	-	2.1367
Adjusted Headrest (θ_{AH})		Mean	-	-	-1.1004***	-	-	-	-	-
		SD	-	-	1.7751	-	-	-	-	-
IFE	No IFE (θ_{I1})	Mean	-	-	-	-0.2583***	-	-	-	-
		SD	-	-	-	0.0104	-	-	-	-
	Wireless Content (θ_{I2})	Mean	-	-	-	0.3499***	0.4153***	-	-	-
		SD	-	-	-	0.0093	0.0192	-	-	-
	Personal Screen IFE (θ_{I3})	Mean	-	-	-	-	0.0611***	-	-	-
		SD	-	-	-	-	1.0484	-	-	-
Internet Connection	No Internet (θ_{W1})	Mean	-	-	-	-0.6936***	-0.5448***	-	-	-
		SD	-	-	-	0.5150	0.4030	-	-	-
	Paid Internet (θ_{W2})	Mean	-	-	-	0.2853***	-	-	-	-
		SD	-	-	-	0.0221	-	-	-	-
	Free Internet (θ_{W3})	Mean	-	-	-	-	0.7335***	-	-	-
		SD	-	-	-	-	0.2539	-	-	-
Power Supply (θ_{PS})		Mean	-	-	-	-	-	-0.5284***	-	-0.6201**
		SD	-	-	-	-	-	0.0085	-	0.0262
Meal Service	Limited Menu (θ_{M1})	Mean	-	-	-	-	-	-	0.8960***	0.9670***
		SD	-	-	-	-	-	-	2.3234	2.3120
	Full Menu (θ_{M2})	Mean	-	-	-	-	-	-	-0.7588***	-
		SD	-	-	-	-	-	-	0.1190	-
	Complementary Meal (θ_{M3})	Mean	-	-	-	-	-	-	-	0.6541***
		SD	-	-	-	-	-	-	-	0.3142
	Log-likelihood		-309.988	-309.865	-278.765	-309.456	-306.830	-304.165	-281.840	-285.434
	No of Obs.		450	450	450	450	450	450	450	450

** Statistical significance level at p≤0.001*
*** Statistical significance level at p≤0.01*
**** Statistical significance level at p≤0.05*

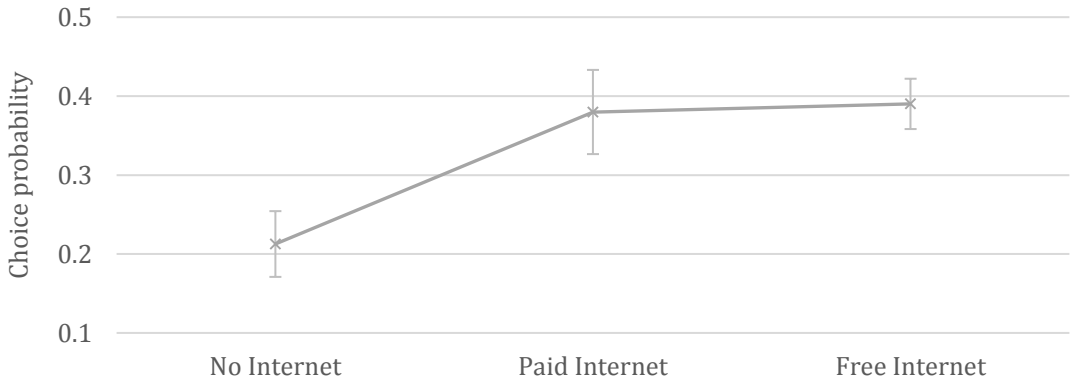
Within the various levels of different attributes, compiled choice probability reflects the differences. In this case, IFE and internet attributes are analyzed presenting the differences in choice probabilities for different levels. In IFE, contrary to the results in short-haul results, the highest choice probability is given with 'wireless content' included in BYOD concept with 0.42 with a significant difference compared to 'no IFE' and 'personal screen' levels. There is no significant difference found between 'no IFE' and 'personal screen' options with choice probability values of 0.31.



Source: Author

Figure 6.19. *Compiled choice probabilities of different levels of IFE for the medium-haul flight*

For internet service attribute, the results for choice probabilities reflect the relatively higher desire for an internet service in medium-haul scenario compared to short-haul scenario. With no significant difference present between 'paid internet' and 'free internet', the choice probabilities estimated are 0.38 and 0.39 respectively. The choice probability of an alternative given 'no internet' service present is estimated to be 0.21 with a significant difference to 'paid internet' and 'free internet' levels.



Source: Author

Figure 6.20. *Compiled choice probabilities of different levels of internet for the medium-haul flight*

6.4. Willingness to pay

The economic valuation is derived from the willingness to pay estimations of the different models. A confidence interval of 95% is implemented for the estimation. The distinction between the WTP estimations for SH scenario and MH scenario is clearly present based on results. In SH scenario, valuable attributes for decision makers among estimated values is found to be free internet, power, complementary meal, seat pitch and seat width. For MH scenario, the estimates indicate greater value for seat pitch, IFE, internet, and meal service. While certain values estimated in the WTP seems high, it is explained due to the higher cost of air travel in Asia and the exchange rate used for the time period. Along with WTP, willingness to accept (WTA) is also included. WTA represents the compromised economic value passengers are willing to accept. The estimated results are presented in **Table 6.10**.

In the analysis, seat pitch has a value of $2.82 for SH scenario and $12.76 for MH scenario for a unit increase. In addition to seat pitch, some estimate results for seat width for the SH scenario are obtained as $4.82 per unit increase. For carry-on bag size in SH scenario, passengers are willing to accept a flight with normal size allowance for $21.37 which indicates that passengers prefer the normal size allowance rather than having to pay more price for having a bigger size allowance for the carry-on bag size. The WTA for normal carry-on bag size increases to $55.12 in MH scenario. For IFE, as found, passengers prefer no IFE in SH scenario. WTA estimate obtained in SH scenario for personal screen suggests that passengers prefer paying $4.45 less in price and have no personal screen

IFE. On the contrary, in MH scenario passengers are willing to pay respectively $56.16 and $9.82 for wireless IFE content on personal devices and personal screen IFE. The internet is found to be valuable for passenger in both SH and MH scenarios. The value of free internet is $23.77 in SH scenario and $40.55 in MH scenario. In addition, in MH scenario, passengers also willing to pay $4.91 more in the price for the option of paid internet. As for the power, while it is found to be the most valuable attribute for passengers in SH scenario, it has no value in the MH scenario. Meal service is found to be valuable in both scenarios. Passengers are willing to pay $26.92 for a complementary meal in SH and $52.25 in MH scenario. In addition, passengers are willing to accept a limited menu option for purchase and pay $17.80 less compared to a full menu option for purchase in SH scenario. However, this value decreases to $11.75 in MH scenario.

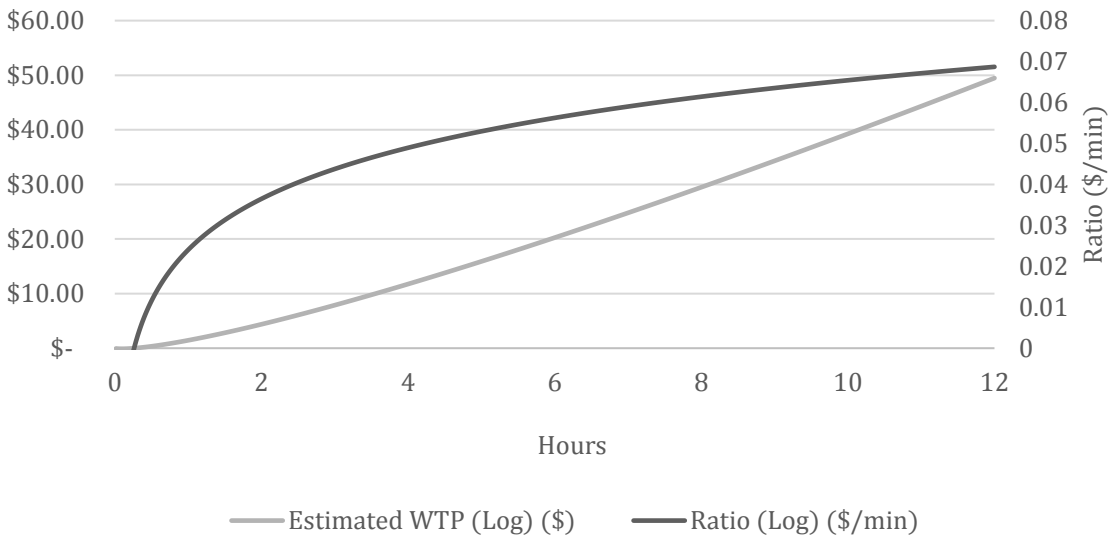
Table 6.10. *Estimated WTP values for short-haul and medium-haul scenarios*

	Attribute	WTP	WTA	Lower Limit	Upper Limit	WTP	WTA	Lower Limit	Upper Limit
Short-haul	Adj. Headrest	¥ -	¥ -	¥ -	¥ -	$ -	$ -	$ -	$ -
	Seat pitch	¥ 314.18	¥ -	¥ 214.12	¥ 414.25	$ 2.82	$ -	$ 1.92	$ 3.71
	Seat width	¥ 537.87	¥ -	¥ 298.15	¥ 777.59	$ 4.82	$ -	$ 2.67	$ 6.97
	Carry-on bag	¥ -	¥ 2,384.10	-¥ 3,537.77	¥ 8,305.90	$ -	$ 21.37	$ -31.71	$ 74.45
	IFE - Wireless Content	¥ -	¥ -	¥ -	¥ -	$ -	$ -	$ -	$ -
	IFE - Personal Screen	¥ -	¥ 496.88	-¥ 1,751.71	¥ 2,745.47	$ -	$ 4.45	$ -15.70	$ 24.61
	Internet - Paid	¥ -	¥ -	¥ -	¥ -	$ -	$ -	$ -	$ -
	Internet - Free	¥ 2,652.20	¥ -	-¥ 12,079.89	¥ 17,384.30	$ 23.77	$ -	$-108.28	$ 155.82
	Power	¥ 5,380.39		¥ 1,929.72	¥ 8,831.07	$ 48.23	$ -	$ 17.30	$ 79.16
	Meal - Full Menu	¥ -	¥ 1,986.25	-¥ 1,038.33	¥ 5,010.83	$ -	$ 17.80	$ -9.31	$ 44.91
	Meal - Complementary	¥ 3,002.78	¥ -	¥ 2,825.94	¥ 3,179.63	$ 26.92	$ -	$ 25.33	$ 28.50
Medium-haul	Adj. Headrest	¥ -	¥ -	¥ -	¥ -	$ -	$ -	$ -	$ -
	Seat pitch	¥ 1,423.36	¥ -	¥ 342.48	¥ 2,504.23	$ 12.76	$ -	$ 3.07	$ 22.45
	Seat width	¥ -	¥ -	¥ -	¥ -	$ -	$ -	$ -	$ -
	Carry-on bag	¥ -	¥ 6,149.66	¥ 2,372.64	¥ 9,926.68	$ -	$ 55.12	$ 21.27	$ 88.98
	IFE - Wireless Content	¥ 6,265.25	¥ -	¥ 55.04	¥ 12,475.47	$ 56.16	$ -	$ 0.49	$ 111.82
	IFE - Personal Screen	¥ 1,095.01	¥ -	-¥ 7,317.83	¥ 9,507.86	$ 9.82	$ -	$ -65.59	$ 85.22
	Internet - Paid	¥ 548.10	¥ -	-¥ 6,991.40	¥ 8,087.61	$ 4.91	$ -	$ -62.67	$ 72.49
	Internet - Free	¥ 4,523.55	¥ -	-¥ 7,888.70	¥ 16,935.80	$ 40.55	$ -	$ -70.71	$ 151.80
	Power	¥ -	¥ -	¥ -	¥ -	$ -	$ -	$ -	$ -
	Meal - Full Menu	¥ -	¥ 1,310.65	-¥ 15,044.65	¥ 12,423.36	$ -	$ 11.75	$-134.85	$ 111.36
	Meal - Complementary	¥ 5,829.20	¥ -	-¥ 973.04	¥ 12,631.45	$ 52.25	$ -	$ -8.72	$ 113.22

Note: Exchange rate (average of the last five years) of $1=JP¥111.56 is used (IMF, 2018)

In addition to the estimated WTP values, based on the assumption that price in WTP is a function of time, WTP for different duration of flights can be forecasted. By assuming that the values for the ratio ($/min) from two time points (1.5 hours and 4.25 hours) follow a logarithmic distribution, WTP values for different durations can be computed. Based on the findings, the estimates for seat pitch, free internet and complementary meal service are included for the approximation.

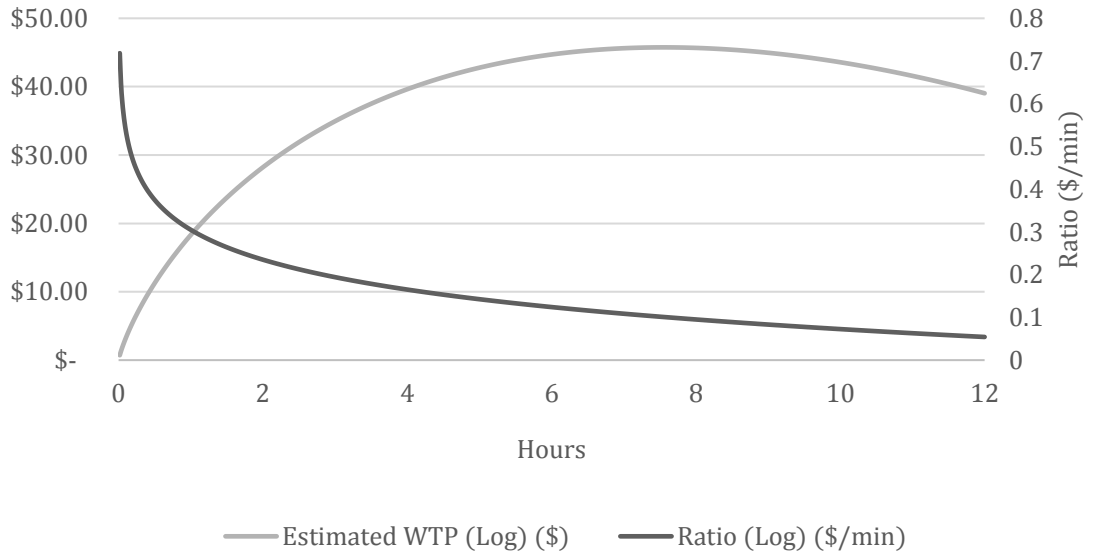
In **Figure 6.21**, the forecasted results for the WTP value of seat pitch are presented. The results show that as the duration of the flight increases, the value of the seat pitch increases. Passengers would be willing to pay more for more seat pitch for longer flights. The ratio has a slow growth trend which decreases over time. Passengers are willing to pay for each additional unit of increase in seat pitch an estimate amount of $4.38 for a two hour flight, $20.25 for a six hour flight, and $49.47 for a 12 hour flight.



Source: Author

Figure 6.21. *Forecasted distribution for ratio (USD/min) and estimated WTP for seat pitch in USD ($)*

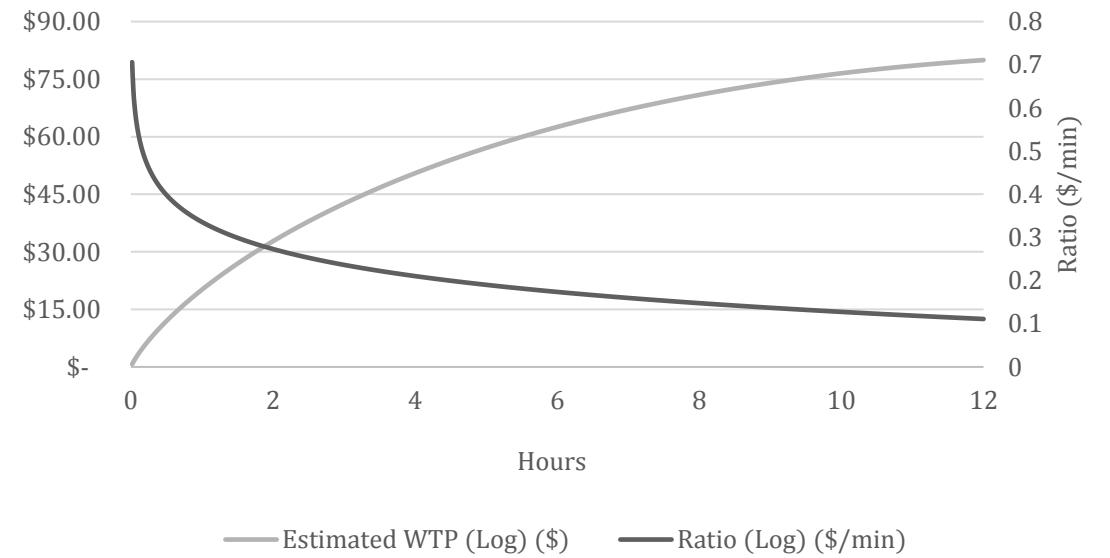
Figure 6.22 presents the forecasted WTP values for a free internet service for flights with increasing flight time. Contrary to seat pitch, the ratio for internet attribute has a negative trend. As seen in the graph, the estimated WTP slowly increases over time until it starts decreasing. For a representative example, WTP for an internet service is estimated to be $39.63 for a four hour flight which is very similar to a 12 hour flight with estimated WTP of $32.04 while estimated WTP for a 7.5 hour flight is $45.75.



Source: Author

Figure 6.22. *Forecasted distribution for ratio (USD/min) and estimated WTP for internet in USD ($)*

Similar to internet attribute, **Figure 6.23** presents the values for 'complementary meal' attribute where the ratio has also a negative trend over time. While the WTP for a 'complementary meal' increases over time the rate the values change decreases. In this case, the WTP estimation for a 'complementary meal' in a two-hour flight is $32.77, in a six hour flight $62.54, and in a 12 hour flight $79.96.



Source: Author

Figure 6.23. *Forecasted distribution for ratio (USD/min) and estimated WTP for complementary meal in USD ($)*

While the ratio for seat pitch increases with increased duration of the flight, the ratios for free internet and meal service decreases with the increased duration of time. This can be explained as the price for the flight increases with increased travel time, passengers are less likely to spend more money for attributes. In case of an 8 hour flight, seat pitch value increases to $29.48, free internet value increases to $45.67, and complementary meal value increases to $70.90.

6.5. Summary

While the qualitative analysis provides lead user characteristics and trends for Japanese passengers, the quantitative study presented in this chapter presents specific figures based on the stated preference data. With the identification of respondents through demographic and flight information data, the results are widened.

In this chapter, the first section describes the specific design developed for the stated preference survey. As an efficient design is required to carry out the analysis, various options to design the survey are examined. Eventually, a survey design with a 97% level balance efficiency is developed with the algorithm described. In addition to the algorithm proposed by the literature, an evolutionary algorithm developed to maximise the efficiency was tested. The results from the evolutionary algorithm developed are found to be very similar to the algorithm proposed by the literature. For the final survey design, the algorithm proposed by the literature was used.

The initial results and descriptive statistics from the survey which were conducted in October 2016 are presented in the next section with demographic, flight history and background data. It is important to note that a homogenous distribution among age and gender were achieved through a sample of 150 respondents which reflects 900 observations for the choice model analysis. The key findings based on demographics of respondents include results from employment, income levels, education level, and physical attributes. Almost three quarters of the sample are employed full-time (55%) or part-time (15%) with almost 60% of the sample earning $44,800[7] or more per year. The results are similar to the average values published by the Ministry of Health, Labour and Welfare (MHLW, 2016) with an average household income of $48,153[7] in 2016. Most of

[7] Exchange rate (average of the last five years): $1 = JP¥111.56 (IMF, 2018b)

the sample (58%) has an education level of a Bachelor's degree. In terms of physical attributes, the height of the majority of the sample (85%) is between 150 cm and 175 cm while the weight of almost 90% of the sample is 75 kg or less.

In terms of flight history, majority of the sample (65%) is found to travel domestically. The main reason for travel among the sample is leisure (77%) with 81% of the sample usually traveling in economy class. The result presents a sample that usually travels on short-haul routes (68% traveling 3 hours or less) with more respondents flying in economy class of FSC rather than LCCs. For in-cabin comfort, 34% of the sample stated at least one reason for discomfort specifically for seating when sleeping which is an important aspect since 35% of respondents said they prefer to sleep during the flight. Another comfort related attribute revealed was the tray table which 32% of the respondents stated tray tables as a source of discomfort. In addition to the closed-ended questions with multiple choices, one question was included to reveal respondents' perspectives on cabin design. Through the thematic analysis, movement and space within the cabin is found to be the major aspect respondents mentioned with 38%. Other themes in the analysis included seating (13%), IFE (10%), meal (7%), hygiene (5%), and environment (3%).

Upon presenting the descriptive statistics of respondents in the survey, choice models are developed preliminarily with multinomial logit model and mainly with mixed logit model. Through the preliminary findings, the price sensitivity of respondents are revealed with 64% of respondents preferring the cheap flight options on short-haul scenario and 76% of the respondents preferring the cheap flight options on medium-haul scenario. For expensive alternative, while middle age group (35-54) are found to have more choice probability in terms of age attribute, there is no substantial difference is observed among gender. Based on the results from MNL regressions, seat pitch, internet, and meal service are found to be significant attributes for respondents in both SH and MH scenarios. Differences between SH and MH scenarios are reflected for IFE and power supply attributes. While the respondents show no desire for IFE on SH scenario, for MH scenario the coefficients of both levels of IFE ('wireless content' and 'personal screen') present statistically significant positive influence on the choice probability when compared to 'no IFE' level. On the other hand, the value of coefficient for 'power supply' decreases on the longer MH scenario compared to SH scenario. Following the preliminary analysis,

the main results are estimated with mixed logit for both SH and MH scenarios. While the findings are found to be similar to the preliminary analysis conducted with MNL, due to reduced variation, the results are more accurate with several interactions and correlations included. Seat pitch is found statistically significant and with a positive influence on choice probability in six different models for SH scenario and in five different models for MH scenario. Similarly, the meal service is significant and have a positive influence on the choice probability for both SH and MH scenarios. On the other hand, the carry-on bag size is found to have a negative effect on the choice probability with findings presented in four models in SH scenario and three models in MH scenario. The difference between SH and MH scenarios found in the preliminary analysis are confirmed in the main analysis with mixed logit model. The results indicate the desire for power supply and lack of desire for IFE on SH scenario, while it is contrary on MH scenarios.

In the last section, the results from the choice models are reflected in economic valuation of attributes with willingness to pay estimations. The results present the trends observed in the choice models where the respondents are willing to pay for additional unit or higher level of seat pitch ($2.82 in SH and $12.76 in MH), internet ($23.77 for 'free internet' in SH and $40.55 for 'free internet' in MH), and meal ($26.92 for complementary meal in SH and $52.25 for complementary meal in MH) in both scenarios. Similarly, the difference presented between SH and MH scenario within the choice models are present in WTP estimations. While there is no WTP for IFE services estimated in SH scenario, the value of 'wireless content' increases to $56.16 in MH scenario. On the contrary, while the value for a power supply is $48.23 in SH scenario, no WTP is estimated in MH scenario. Based on the estimated results, WTP values of seat pitch, internet and meal services are forecasted to reflect the change in WTP per flight hours. For attributes internet and meal service, the values for WTP show an initial growth as flight duration increases with decreasing rate for longer flights. For seat pitch, the value of WTP is constantly increasing with a slowing but positive rate per increase in flight duration.

Overall, the quantitative analysis reveals the preferences of Japanese passengers in a selected sample through the stated preference data. The respondents are identified through data collected in the survey which show similarities to findings for the Japanese passenger characteristics and trends found in the previous chapter. The numerical results are analysed and provided for the overall discussion of the research in addition to the

answering relative research questions. With revealed choice probabilities, the economic valuation for different attributes in a cabin context are estimated and forecasted for different flight durations based on the findings from short-haul and medium-haul flights.

CHAPTER 7 - CONCLUSION

Through the research, the aim and objectives of this research are satisfied through the literature review, methodologies, and analyses answering relative research questions. In this chapter, the conclusive remarks for the research are included with an overall summary.

In Section 7.1, the outcome of the research is presented through a discussion. All of the results and findings from the research are discussed and integrated. Based on the research questions presented in Chapter 1, the relative answers based on the findings are included. In Section 7.2, recommendations and suggestions derived from the findings and discussions are presented.

Section 7.3 reveals the significance of this research in terms of contribution to the knowledge. The research aim and objective are shown with the findings reflected as contribution to the existing body of knowledge. Finally, in Section 7.4, limitations and constraints faced in this study are explained with further research opportunities related to this study.

7.1. Discussion

Understanding passenger preferences and providing a suitable service is crucial for airlines. In culture-specific settings, passengers have different preferences based on their national culture, which is defined as one of the contributing factors affecting decision-making process. The aim of this research is to investigate the preferences of Japanese passengers based on the cabin interior and services for short to medium-haul flights in order to identify key factors which contribute to the decision-making process. Through the study, the research questions identified to satisfy the aim of the research are answered within different chapters. **Figure 7.1**, below, presents the relationship between the research structure and the relevant research questions answered.

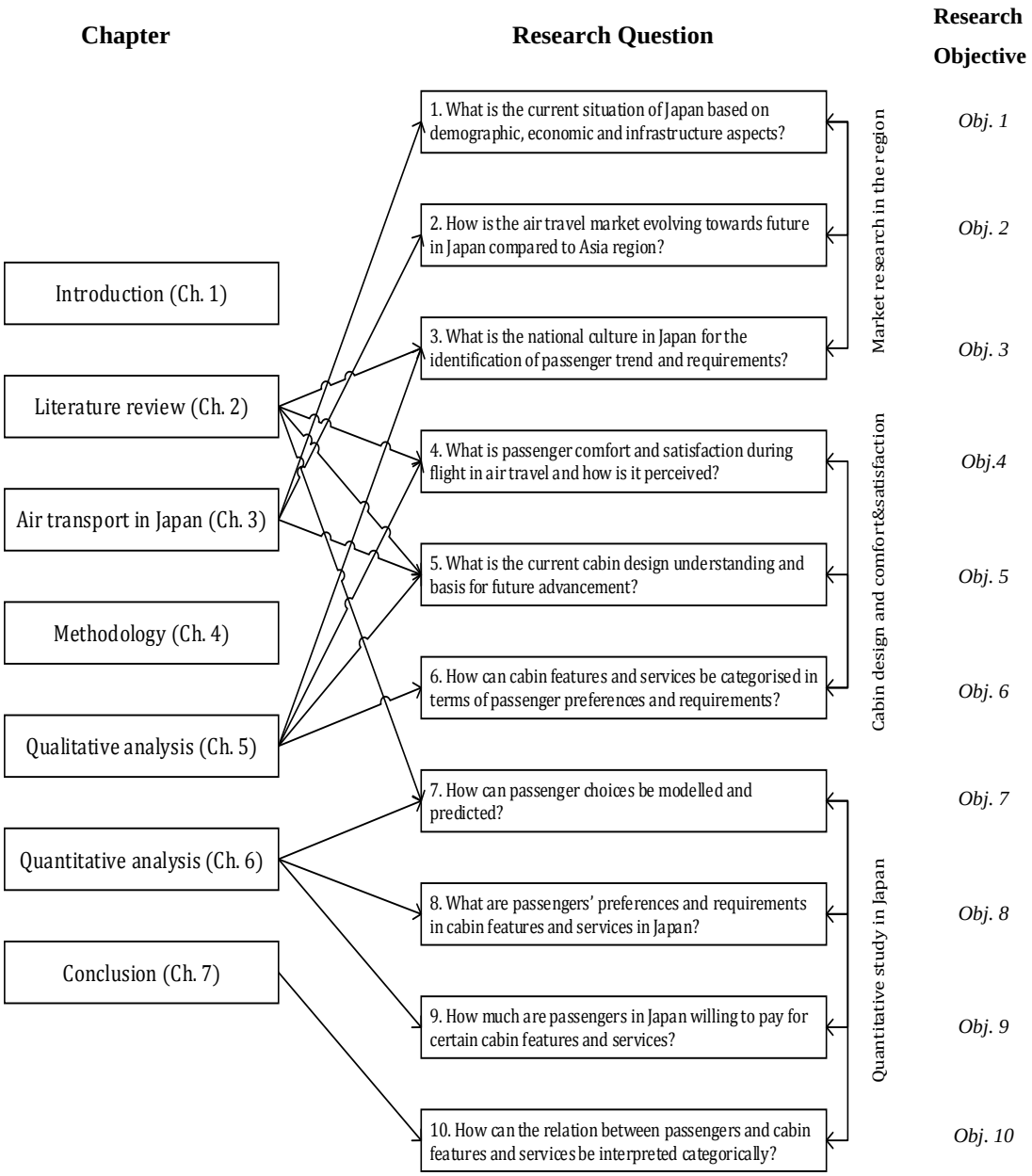


Figure 7.1. *The research structure and the relative research questions*

In order to discuss the findings of the research, each objective listed in Section 1.3 is addressed and answered in the following three subsections.

7.1.1. Overview of Japan, air transport market and Japanese passengers

When considering Japanese passengers, the understanding of Japan based on demographic, economic and transportation infrastructure aspects is established through a literature review and analysis of data provided by governments and other official organisations in relation to Objective 1. Based on the findings, it is shown that Japan has an aging population. The aging population means that the growth rate of the population

is zero or even negative including the decreasing working population. This observation reflects a future potential gap in the labour force for several businesses which can be filled through immigration. A potential increase in immigration through policy changes would increase the number of travellers both for work and for visiting family and friends of immigrants. As the economy is quite stable and living standards are high, Japan may prove to be a very attractive destination for people from countries within the region such as Southeast and Northeast Asia which in turn can contribute to the regional traffic to/from Japan. Inevitably, this presents an opportunity for air travel expanding the potential regional market. Considering this growth, it is found that the fact that most airports are owned and managed by the national or local governments proves a challenge for the commercial growth. However, the overall outlook, in terms of number of airports and accessibility throughout the country, proves beneficial and promising for future growth.

In addition to Objective 1 focusing on demography, economy, and infrastructure of Japan, Objective 2 presents the current and the future prospects for air transport market in Japan. As an island nation, air travel proves to be the most efficient mode of transport for intraregional destinations. Expansion of air travel market in short to medium-haul destinations would generate more point to point routes with more LCCs introduced with increased passenger traffic. The growing ASK numbers of LCCs when compared to stable ASK numbers of FSCs in Japan can be shown to reflect this situation. As point to point routes increase, the value of Tokyo as an international hub is expected to grow connecting the long-haul international market. Currently, increasing number of connecting flights in international hubs in South Korea and specifically in China pose a risk to the international connecting flights in Japan. In terms of the current domestic air transport market in Japan, routes are limited for airlines to expand due to geographical constraints and the high competition posed by the Shinkansen. It can be concluded that the future of air transport market in Japan lies in the regional routes and sustaining Tokyo as one of the major international hubs in the region over the Pacific routes. However, two major constraints are identified in achieving this scenario. The first constraint is the lack of competition among airlines in Japan, as the whole air transport market is dominated by only two FSC which are supported by government. In addition, government ownership and management of airports in Japan may also be considered a potential constraint. As discussed, all of the

airports in Japan are owned by the government and almost all of them are operated by the national or local governments. This may pose a risk for a lack of commercial motivation to improve or develop new networks and services in airports. While the constraints prove challenges, the air transport market in Japan and in the region is expected to grow.

In terms of Objective 3, the term national culture is defined to reveal the generic characteristics of Japanese people. Based on the literature review, Hofstede's model is widely accepted when assessing the different dimensions of a national culture. In order to reveal the differences among different nations, four countries are selected around the globe. The review indicates the different traits of Japan in terms of national culture. Considering the potential impact of national culture with different dimensions on perceived quality, the unique stance of Japan compared to other nations is presented.

Through the analysis, the decreasing number of seats based on the weighted average derived from ASK can suggest the utilisation of relatively smaller aircraft with higher frequencies at least for two major FSCs included in the study. While the variation in the size of the aircraft is mainly for FSCs, LCCs carriers are found to utilise mostly narrow-body aircraft. In any case, for the regional traffic (short to medium-haul routes) with the assumed increase in point-to-point routes, narrow-body aircraft are more likely to be operated by airlines based on the current fleet structures.

7.1.2. Cabin design and comfort & satisfaction

In order to reflect the preferences and experiences of passengers in terms of cabin context, the overall understanding or comfort and satisfaction is established through the research. Addressing Objective 4, the passenger comfort and satisfaction are found to be variables and difficult terms to distinguish and define in specific cases. The conceptual understanding, however, is achieved through the identification of internal and external factors affecting the inflight experience with level and quality of service. Comfort is a contributing factor to the overall passenger satisfaction among other factors. On the other hand, the perception of comfort can be altered with the level of overall satisfaction. The overall passenger satisfaction is a comprehensive result of different stages of air travel. As one of the contributing stages, inflight experience which includes inflight comfort is an important stage affecting overall passenger satisfaction. Considering the change in the business environment, focusing on passenger expectations to improve overall satisfaction

becomes a dynamic problem. To further complicate the situation, there is variety in the definition of satisfaction and comfort among different people. In order to address these problems, identification of different characteristics of passengers affecting comfort and satisfaction is necessary. Through the review, these factors are identified as demography, socio-economic status, physical attributes (i.e. height and weight), previous experiences, and national culture. While a passenger-oriented cabin can prove beneficial for both airlines and passenger, it is worth mentioning the importance of the balance between the price and the level and quality of the service provided which also relates to the difference between LCC and FSC services.

Previously, the changing business environment is mentioned reflecting the dynamic nature of the industry. As part of this changing environment, one considerable factor is the technology relevant to the cabin context. In this context, Objective 5 explores the future cabin technologies in various concepts. It is apparent that more technologies become available for implementation in cabin context benefiting both passengers and airlines. In terms of wellbeing, technologies involving passenger monitoring, improved lavatory services, and further wellbeing and hygiene products are highlighted. In addition, a conscious cabin concept managing the cabin environment through ventilation, illumination, and noise can prove effective for both passengers and the crew member decreasing the workload. Similarly, improvements in meal preparation and distribution can decrease the workload of crew members. Further technology that are foreseen include comprehensive connectivity through high-speed internet connection. Overall, even though some technologies are still in development stage, the amount of technologies discussed that can be integrated within the cabin context show that current cabins seems outdated in terms of potential improvements.

Building on the established output so far and with the potential of future growth of air transport market in Japan and the region, identification of a lead-passenger characteristics and trend in a cabin context is important to address the relevant issues relating to Objective 6. In order to reveal the lead user understanding, national culture of Japan is analysed along with findings presented from the literature for Japanese passengers with a qualitative study. The outcome of the analysis presents a conceptual description. Based on the conceptual description, Japanese passengers, in terms of cabin context, are defined through five elements. These elements include requirements, preferences, and

characteristics in private space, minimal interaction, hygiene, adaptation, and customisation. The output of this analysis reflects the potential key factors defining Japanese passengers. Through the elements, the average Japanese passenger is expected to respect private space and prefers minimal interaction with other passengers and the cabin crew while emphasising a great value in the overall hygiene. In addition, a Japanese passenger can easily adapt to different situations and settings within the cabin with a desire to be able to customise their travel experience. Based on the qualitative study, a baseline for preferences and requirement of Japanese passengers is established. In addition, these results can suggest further implications to the expectations and character of Japanese passenger for inflight experience.

7.1.3. Quantitative study in Japan

With the established understanding from the qualitative study, a quantitative study is developed to predict preferences as stated in Objective 7. When assessing a passenger-based decision making process, it is crucial to represent the true nature of the passengers. In order to achieve this, there are different methodologies involving various survey studies. Through the review, discrete choice models (DCMs) are found to be the most widely used model when estimating preferences and choice probabilities. Along with DCM, the most suitable form of data is determined to be stated preference data where a hypothetical scenarios can be included with specific information collected in relevant time period. While revealed preference (RP) consists of looking at passengers past behaviour in real situations, stated preference (SP) presents a choice scenario to passengers to simulate their choice as the literature suggests. To design an efficient survey, in addition to the selected algorithm for improvement, an evolutionary algorithm is proposed to improve balance level efficiency based on the PDC algorithm which proved promising results. For the analysis, multinomial (MNL) and mixed logit (ML) models are considered according the strengths and weaknesses.

Based on the findings for a suitable methodology to undertake this research, a DCM is utilised. Relating to Objective 8 and 9, the choice probabilities of Japanese passengers are predicted revealing different preferences and requirements along with willingness to pay estimates. The data required to estimate passenger preferences is obtained from passengers in the form of a survey as stated preference data. In addition, data collected related to demographic, economic, and previous flight experience present valuable

results. The overall results can be discussed based on the decision makers' characteristics and the characteristics of the alternatives as provided in the SP study. Age is found to be an important characteristic in the decision-making process. Based on the results, middle aged passengers (34-55) are more likely to spend more money for their flight. While there is no difference found between genders, the income levels of decision makers can positively influence how much they are willing to spend on their flight.

As for the characteristics of the alternatives, in both scenarios attributes related to seat size are found to be an important factor. Specifically, the seat pitch is an important factor with willingness to pay values of $2.82 for the SH flight and $12.76 for the MH flights. Based on the estimation and the reflection of WTP over different flight times, the value of the attribute is shown to increase for longer flights (i.e. $4.38 for a two-hour flight and $49.47 for a 12-hour flight). The estimated results for WTP also prove similar yet distinct values to the results in the literature. Overall, the effect of providing the adjusted headrest option is accepted as null for all flights considered in the study. For carry-on bag size, while the option for a larger allowance can prove beneficial for passengers and airlines, the study shows that the normal size allowance is good enough for passengers for both SH and MH flights with no desire to pay to carry a relatively larger carry-on bag. In a technological aspect, for flights in Japan, internet connection is an important factor for passengers. Ideally, passengers prefer and are willing to pay for a free internet connection with cost included in the ticket price. In SH flights, in comparison, no internet connection is preferred compared to having an option to pay for it. However, in longer flights, paid internet connection can be an option to be provided based on the findings of passenger preferences. Similar to the seat pitch, while the estimation proves a decreasing growth rate, the value of internet increases as the flight time increases. The decreasing growth rate for willingness to pay for internet may be a result of higher fares included for longer flights. In terms of in-cabin entertainment, in shorter flights IFE does not seem to be an important factor. Correlating these results with the preference for a power supply in SH flights, it can be interpreted as passengers prefer or find it sufficient using their own device without the need for any content provided by the airline. On the other hand, the importance of IFE is present for MH flights while the desire for a power supply decreases. In longer flights, passengers prefer to use their own device but are willing to pay for some content provided by the airline through the intranet in a BYOD setting. That said,

passengers still seem to be interested in a generic form of IFE (i.e. personal screens) in MH flights, however, they are willing to pay less for that option compared to using their own devices with provided IFE content. There is also a distinction between short and medium-haul flights in terms of meal service. Even though in both scenarios a complementary meal service is preferable, the results show that meal becomes an important attribute in longer flights for passengers. Based on the estimations, the value for a complementary meal service ranges between $32.77 in a two-hour flight and $79.96 in a 12-hour flight.

Based on the defined elements of the conceptual description of Japanese passengers, the findings from the quantitative study reveal choice probabilities and willingness to pay for different aspects of cabin are synthesised as defined in Objective 10. Three elements from the conceptual description are highlighted; adaptation, private space, and minimum interaction. The first highlighted element in this research is found to be the adaptation. Specifically, in terms of technological aspect, the results from DCM reveal the importance of connectivity and IFE in cabin which can be confirmed by the conceptual description developed for Japanese passengers. The difference in the preference to use airline IFE versus own device is revealed based on the length of travel. This finding can further be applied with other aspects of technology adaptation. As a considerable number of the respondents (80%) stated an interest in experiencing new technologies, adaptation to ongoing and future technology is an important factor in cabin context. Other highlighted elements from the conceptual description are private space and minimal interaction. While the DCM does not particularly present relative findings, respondent expectation based on open ended questions reveal the importance of space and movement within the cabin.

Based on the discussion of findings from the research, relative recommendations are presented in the section.

7.2.Recommendations

Through the research findings, namely, the definition of Japanese passengers in cabin context and choice probability models with estimated WTP values, a number of recommendations can be made regarding the optimal level of service standards, ancillary revenue systems, and the cabin interior and configurations in a culture-specific setting.

First of all, the analysis of the air transport market and the stable economy of Japan indicates a steady growth of air transport in the region. Based on the analysis, not surprisingly, narrow-body aircraft are foreseen to continue to dominate the air traffic market. Based on this indication, future cabin designs can be centred around narrow-body aircraft. Considering short to medium-haul flights, narrow-body aircraft can also be more beneficial for airlines in terms of operational efficiency except for high density routes.

Several aspects of service and attributes provided in the cabin could also be adjusted in light of the research findings. Irrelevance of certain attributes such as IFE on SH routes or the importance of certain attributes can help manage the service provided by the airline. In this case, removal of IFE systems on SH flights can help airlines save fuel costs with decreased weight and maintenance while ensuring passenger expectations and preferences. Similar examples can be given with the meal service. While a generic idea on meal service is included in the study, the importance of meal service for Japanese passengers are shown. As shown by the results, a full menu (i.e. variety of options to purchase which is provided by some LCCs in Japan) may not be an optimal strategy compared to having a fixed course of meal and/or a menu with limited options based on the passenger preferences. The optimisation of these levels can help reduce waste and cost while maintaining passenger satisfaction levels.

Another finding in the study shows the importance of internet connection. Overall, providing a free internet service seems to be an advantage in improving passenger comfort and satisfaction. While in SH flight it is not found as a crucial aspect, on medium-haul routes providing preferably a free internet connection with the cost included in the ticket price can prove useful for both passengers and airlines. As connectivity becomes a commodity, airlines will most likely provide an internet service for passengers free or paid. In this context, as the results suggests, it is an important area to focus on and find the most profitable way to provide this service.

In terms of seating space, both qualitative and quantitative study suggest improvements are needed. A cost benefit analysis can be conducted with the estimated WTP for extra space for comfort to adjust the dimensions of seats while ensuring the profitability as capacity would change with increased dimensions of seats.

The findings from this research implies the relevance of passenger-based decision making when making changes in the design of aircraft cabin. Based on the findings and further research, the optimum operating and service environment of cabin can be improved. While maximising the efficiency of the space presented in the cabin, issues pointed out by passengers can be addressed in an effective manner. Development in the technology and the introduction of these technologies in a cabin environment create different options to address passenger expectations while cutting costs for the airlines. For example, as discussed, connectivity in terms of internet connection presents a challenge for the airlines as the implementation is costly, however, the value derived from this research indicates the level of importance for passengers. Then an investment in this technology for a main stream method for providing internet in the cabin during flight would be beneficial in the long term for airlines. Another example, the use of inflight entertainment provided by airlines during flight is found to have relatively low value on short-haul flights. While more and more airlines start providing content through smartphone applications, further interest in this topic can improve the quantity and quality of the content provided. For meal service, based on the scope of this research, it is revealed the desire of passengers to have different options and flexibility show the need for a new method. As an aircraft cabin has limited space to hold only certain number of variety for the capacity, the number of different alternatives included in the menu is restricted. New technologies, such as food printing as discussed, in creating variety of meal options on board can provide the flexibility the passengers' desire.

In the context of revealing passenger preferences, it is important to understand and implement correct strategies and technologies to satisfy passengers while minimizing cost for airlines. Through the study, generic aspects of cabin attributes and services are analysed with key recommendations and suggestion discussed.

7.3.Significance and contribution to knowledge

This research is intended to provide an understanding of passenger-oriented cabin design for short to medium-haul flights. In order to improve results, in terms of perception of inflight experience, a culture-specific setting is defined. While inflight experience is an important contributing factor to overall passenger satisfaction, in particular, aircraft cabin design has not experienced a dramatic improvement or change. Therefore, it is important

to explore a passenger-centred approach to make an effective change. The more specific a lead-user (passenger) is defined, the better results can be obtained.

For the culture-specific focus, the base for the lead-user understanding for a Japanese passenger is achieved with the defined conceptual description. The collective approach in addressing research objectives with the use of quantitative and qualitative study confirms results mutually. The integration of the description (conceptual description) for a lead-user based on the qualitative study into the discrete choice model through the survey design and the confirmation of results proves beneficial for a more robust approach in assessing and estimating choice probabilities of a culture-specific audience.

In terms of the main methodology in the analysis, discrete choice model is utilised. Through the survey design, in addition to the algorithm proposed in the literature, an evolutionary algorithm is developed to maximise the level balance of the stated preference survey. While the design based on the evolutionary algorithm is not utilised for the final survey, the level balance results proves promising results for utilising the methodology for a future study. In the survey, one domestic (SH) flight to Sapporo, Japan and one regional/international (MH) flight to Taipei, Taiwan from Tokyo, Japan is included. Respondents were asked to choose between three different unlabelled airlines for the respective route with different attribute levels. In addition, demographic data of respondents and the data regarding to their previous experiences in air travel were collected. For the analysis of the data collected, both MNL and ML models are implemented to reveal culture-specific passenger preferences. For the final analysis, results from ML models are used. The utilisation of ML proves valuable results which shows the adoption of this methodology is useful in a similar future study. Based on the results, the characteristics and preferences of Japanese passengers with their WTP for various attributes are estimated. In addition to the static WTPs per scenario (SH and MH), the change in WTP over different flight scenarios (i.e. different flight times) are estimated to reflect the effect of selected attributes in a dynamic setting. These estimations can be used in future studies to reflect the change in values of factors over different flight times.

The concept of passenger satisfaction is very important, but is poorly understood due to high variation among users. Overall, while there is extensive literature on discrete choice models (DCMs) studies in airline preference with included cabin features as shown

throughout the study, this research builds on the existing literature by providing an understanding of the use of DCM in aircraft cabin design for a specific culture centred around the passenger satisfaction.

As to the main focus of this research, there has been no study found in relation to the preference of Japanese passengers on inflight services and attributes in cabin design context for short to medium haul flights. While the qualitative study identifies conceptual description of Japanese passengers in terms of cabin context, numerical results from the quantitative study reveals the estimated preferences and WTP for cabin features and services. As the needs and preferences varies among different cultures, the analytical outcomes from this research contribute to the design of the overall cabin interior and configuration as well as the optimal ancillary revenue system of airlines. With the findings from both the qualitative study, revealing conceptual description of the culture-specific lead user, and the quantitative study, revealing passenger preferences through choice probabilities and estimated WTPs, overall findings suggest the introduction of a culture-specific outlook in DCMs is applicable and can prove valuable results when making passenger-centred decisions.

7.4. Limitations and future research

The findings from the research show the benefit and application of the adopted methodology in a cabin context for a culture-specific lead user definition. As expected in most cases, this research has faced certain limitations and constraints. Two major challenges played a part in the progress of this research. The first limitation related to the project constraints which this research contributed. The second challenge relates to the literature utilised for the qualitative study.

Part of this research was conducted as a contribution to the FUCAM project which imposed several time and budget constraints. In terms of time constraints, limited time was assigned for the development of the survey study. As a result, unconventionally, the survey was designed and distributed at the early stages of this research to meet the deadlines of the project. With the addition of budget limitations, the number of scenarios (choice sets) within the stated preference survey study was limited. While the results from the analysis suggests that including more scenarios per respondent could prove more robust and significant values, the results provide sufficient estimates for understanding of

passengers in Japan and confirm the integration of a culture-specific setting into the methodology is applicable. Through the analysis, despite the limitation, the value of seat pitch, internet connection, IFE, and inflight meal options are found to be significant for passengers in Japan. In addition, the difference in the preferences of passengers for short and medium-haul flights are revealed.

The second limitation was the limited number of literature as a source for the target findings on Japanese passengers in a cabin-setting for the qualitative study. As part of the research, characteristics and trends of Japanese passengers in cabin context were analysed using qualitative research synthesis methodology. This methodology requires multiple (at least two) literature to allow for an analysis, while including additional sources provide a more substantial analysis. In this case, through the literature search, two suitable sources of literature were identified which constrained the findings of the analysis to two sources of data. Yet, the analysis was able to define and describe sufficiently the user trends and characteristics in Japan for cabin related features and attributes from the target findings obtained from the literature. Overall, the output of the study, the conceptual description, presents useful knowledge as an input to the findings.

Considering the limitations and opportunities arose during the research progress, for future research, the additional data on passenger demographics can be utilized to reveal different passenger behaviour for different attributes. Based on the current results, services and attributes provided in-flight can be customized based on the duration of the flight. Using the lead from the research, more focused studies on different attributes can help optimize the service provided for passenger comfort while reducing costs for airlines in culture specific cases. In addition, further research with more samples would supplement the findings to suggest more robust results.

While some airlines are making improvements to their cabin designs and inflight services and products, aircraft cabins have not seen a substantial change over many years. Especially, the economy class cabin design has not experienced a dramatic update in terms of innovation. The focus for implementing innovation and changes in air travel has mainly been on the technical aspects of the aircraft or the operational efficiency while the cabin design and innovations are mostly forsaken. With more research identifying key factors of an aircraft cabin from passengers' perspectives, the key elements of cabin

design, services and products that need improvement can be highlighted providing a framework for future development. Further integration of this research can involve digging deeper to passenger-specific cabin services and products rather than the more general level of culture-specific for future concepts. In this case, implementation of different passenger characteristics to each attribute would also provide suggestions for passenger-specific customization of products and services in cabin.

Inflight experience is an important part of the whole passenger experience in air travel, which needs constant improvement. As the needs, tastes, and demands of passengers change with regards to the changes especially in technology but also in society and living standards, future research in a similar context could prove useful in investigating requirements and preferences in cabin context for the dynamic consumer behaviour. To be able to demonstrate the improvements efficiently, passenger-oriented cabin design in specific settings has a crucial role in the decision-making process.

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APPENDIX

Appendix A. IHS economic and country risk

Six-factor country risk ratings methodology

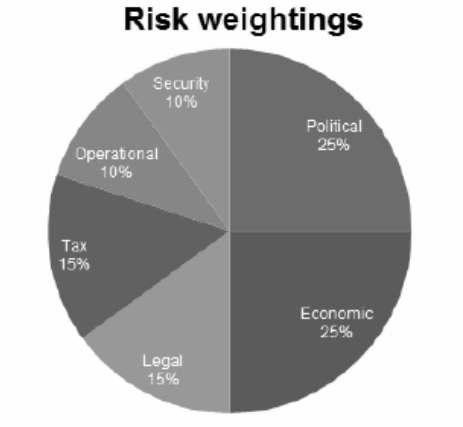

***Figure A-1**. Risk weightings on different aspects*

IHS has developed a unique country risk-rating system for its clients to assess the investment environment in 205 different countries in the world (IHS, 2014). The risk-rating system includes political, economic, legal, tax, operational, and security aspects rated in each country. This provides a comprehensive scale for stability and quality of conditions for investors.

The risk rating is given between 1 and 5 for each factor identified (political, economic, legal, tax, operational, and security); 1.0 indicating lowest risk and 5.0 highest risk. The minimum increment increase and decrease is 0.25 (Table A-1). Upon assessing risk rating for each factor, the overall risk factor is calculated according to the weight of each factor. As seen in Figure A-1, political and economic factors have 25% weight, legal and tax have 15% weight, and operational and security have 10% weight in the overall score.

***Table A-0.1.** Overall risk ratings and respective risk description*

Overall Risk Rating	Risk Description
1.00 – 1.24	Insignificant
1.25 – 1.74	Negligible
1.75 – 1.99	Low
2.00 – 2.49	Moderate
2.50 – 2.99	Medium
3.00 – 3.49	Significant
3.50 – 3.99	High
4.00 – 4.49	Very High
4.50 – 5.00	Extreme

Appendix B. Culture cards for Japan

JAPAN

Characteristics

Traditional characteristics

Polite	Grouping	Etiquette
Punctual	Formal	Discipline
Kind	Clean	Self-control
Hard-working	Perfectionism	Self-Suppression
Respectful	Conservative	Collective
Shy	Being strong	

1

JAPAN

Characteristics

The promised land of niches

In general, Japan is the promised land of niches. Contrary to the claims often heard – that the Japanese people are a homogenous group – we claim that Japan is a promised land of niches. There are great differences between Japanese people, the most obvious differences being defined by gender and age. For instance, younger generations are looking for more individuality in clothing styles and design preferences.

2

JAPAN

Other

Holidays and peaks

Several countries have certain main holidays such as Golden Week in Japan (April 29th - May 5th). Many travel at that time, and in a country of few holidays these holidays are even more important.

3

JAPAN

Behaviour

Private and considerate

Japanese people appreciate privacy. Because of this they usually have their cellphones set on silent mode with the vibration function activated not to disturb others. Also, speaking on the phone in busses, trains and some other public spaces is considered rude in some parts of Japan. It is not an uncommon sight to see Japanese people writing several emails with their handset while riding a train since this way they can communicate with their peers even when they won't be able to speak on the phone.

However, Asians seem to be wore will to share their personal space with others. People live close together and are used to having people around them all the time. Wanting to be by oneself is considered kind of strange.

4

JAPAN

Behaviour

Creating own personal space

With personal space being so hard to find in Japan the concept of privacy is more of state of mind than a condition of being alone. The Japanese are very good at shutting out the world around them and making their own privacy by losing themselves in reading a comic book or sleeping while they are surrounded by people. But even that is not enough for some people. All over Japan, you see men parked in their cars sleeping or reading, sometimes for hours at a time.

5

JAPAN

Behaviour

Rituals and codes, formality over spontaneity

The Japanese tend to hang out with people they work with or have known for a long time. They don't make new friends easily and are more comfortable with formality and rituals than spontaneity. Social events, like weddings, in which people who don't know each other are thrown together, tend to be very structured and scripted so people don't feel pressure to make awkward conversation with strangers. Many students say they join clubs at school because they have difficulty making friends otherwise.

Rituals and codes are are also part of showing respect to others.

6

JAPAN

Behaviour

Bonding and people valued over activity or location

The Japanese are fond of having photographs taken of themselves with their friends. Teenagers form long lines behind photo machines and adults on hiking trips seem to do more photo-taking than hiking. This is because the Japanese treasure their friends and the memory of good times, and the value of an activity is often measured more in the bonding that takes place than with the activity itself, plus they get enjoyment from posing and looking at the photos later on. Photos without people in them are often considered boring.

7

JAPAN

Behaviour

Technology-savvy

Japanese constantly check up on the latest technology. They value the latest technology high and are impressed of technical details.

8

JAPAN

Behaviour

Advanced in using mobile technology and services

Ever since the 90's Japan has been light years ahead of the Western world when it comes to mobile technology and services. The Japanese were surfing the Internet with their mobile handsets already in the beginning of 21st century when the rest of the world was still focused on calls and text messages.For this reason, there is a considerable number of Japanese people who do not own a computer, since they have been using their handsets to access all necessary information on the web. Japanese cellphones have been using email from day one and the functionality to support SMS messages was not added until fairly recently.

9

JAPAN

Characteristics

Collectivism

One of the biggest difference between Japanese and foreigners is that Japanese people are more collective than individual. In order to have a good relationship with other people, they often have to care about the others. Therefore, it seems that they put more emphasis on harmony with others rather than having their own determined attitude.

Japanese people are also unlikely to attract attention in order to maintain their harmony.

10

JAPAN

Characteristics

Conformity

Conformity is a strong force in Japan. Japanese hate to miss out on something that their neighbors, friends or coworkers are doing. If a certain shrine has been deemed the place to be during the cherry blossom season then everyone wants to go and the shrine is suffocatingly mobbed.

One of the worst fears of a Japanese individuals is to be excluded from a group. Office workers feel obligated to do things socially with their coworkers and mothers go through great lengths to be accepted by other mothers in their neighborhood.

11

JAPAN

Society

Hierarchy

Hierarchy in Japan is a thing you do not want to mess around with. Although for most Westerners hierarchy rules might seem trivial and absurd, you cannot ignore them in Japan. In a business context, hierarchy is displayed through various ways: who speaks, how business cards are placed on the table,who is addressed, what kind of language is used and so forth.

The older you are the higher you are in the hierarchy ranking.

12

JAPAN

Society

Group-orientation

Most Japanese are part of some group, either through their work, school, club or community. These groups are central to their lives and loyalty to group is often considered a virtue above all others. These groups are often in competition with one another. This partly explains why Japanese sometimes seem distant and rude to strangers and people outside their group.

13

JAPAN

Society

Classless but with social differences

Japanese society has been portrayed as being essentially classless or as having a class structure in which very tiny elite groups and underclasses bracket an enormous number of middle-class people. However, there are significant social differences among rural and urban residents, including family composition, educational attainment, and labor force participation. Within the urban population, social differentiation exists between the white-collar, salaried "new middle class," blue-collar industrial workers, and the self-employed petty entrepreneurial classes of shopkeepers and artisans.

14

JAPAN

Values

Traditional values

The Japanese have traditionally valued harmony, civility, conformity, respect for elders, modesty, self-control, not being critical of others, integrity, loyalty, honesty, humility, industriousness, patience, persistence, hard work, commitment to education, belief in order and stability, emphasis on obligations to the community rather just individual rights, and preference for consultation and consensus over open confrontation and an avoidance of conflict at all costs. These values are generally shared by other Asians and are drilled into children from nursery school onward.

15

JAPAN

Values

Culture and mindset

Traditional values accompanied with an element of the supernatural are major themes of classic Japanese literature and theater. On the difference between the Asian mindset and the Western one, Japanese writer Haruki Murakami told the Daily Yomiuri, "There is a different sense of time. A kind of patience. And an attention to sound, to silences."

16

JAPAN

Values

Moving towards western values?

The younger generation has less reverence towards traditional Japanese values than the older generation and the behavior and values of many young Japanese isn't all that different from young Westerners. Young Japanese are much more individualistic than older Japanese. They have been called the "bean sprout generation." like bean sprouts they grow fast but in the dark so they have no strength.

Many scholars believe that traditional Japanese group society is collapsing and being replaced by a more individualistic one.

17

JAPAN

Values

Happiness

According to the World Values Survey happiness for the Japanese "comes from fulfilling the expectations of your family, meeting your social responsibilities, self-discipline, cooperation and friendliness." When asked what makes them happiest, many Japanese say a delicious meal. When asked who are the happiest, many say the elderly.

18

JAPAN

Values

Losing face is the worst fear

Face has been equated with "dignity, prestige and reputation." It has been said that "face is more important than truth or justice." Losing face if often people's worst fear. Japanese go out of their way to be polite and accommodating, to maintain dignity in a variety of situations and avoid disputes, conflicts and embarrassment in their pursuit to avoid losing face

19

JAPAN

Values

Morality

Japanese morality is based in many ways on trust, mutual respect and inner reflection.

Trust, reliance on others and knowing that others won't let you down are regarded as particularly important in Japanese culture.

20

JAPAN

Food

Diet and eating habits

Since World War II, consumption of dairy products, beef, bread, and other Western foods has increased dramatically. Eating habits have been reshaped by changes in domestic life. Families eat fewer meals together, and sophisticated kitchen appliances have transformed domestic cooking. Food manufactures have created vast numbers of prepared dishes.

21

JAPAN

Economy

Living standards, markets and sectors

The wholesale, retail, and service sectors have grown dramatically as domestic standards of living have risen. Despite economic problems in the 1990s, Japan continues to be a major financial market. Primary sectors such as agriculture, fishing, and forestry have declined enormously since World War II. In 1999, less than 5 percent of the labor force was employed in agriculture, compared to 21 percent in manufacturing, 23 percent in the wholesale and retail sectors, and 26 percent in service industries.

22

JAPAN

Culture

Printed books, magazines, and newspapers still relevant

Popular culture includes manga (comic books) and anime (animation), both of which are extremely popular and have gained an international audience. New electronic media have diminished the popularity of books, magazines, and newspapers, but the publishing industry is still enormous and rates of readership remain high.

23

JAPAN

Demographics

Evenly shared wealth and a big middle class

Japan is home of one of the world's wealthiest and most egalitarian societies. Wealth is spread relatively evenly. Not long ago 90 percent of Japanese referred to themselves as middle class. The gap between the highest and lowest incomes is the smallest among advanced nations. Many factory workers and construction brokers fit comfortably in the middle class, able to afford nice houses and cars

24

JAPAN

Demographics

Domestic Unit

Most families, especially in urban areas, are nuclear, consisting of the parents and their children. Slightly extended families, such as an elderly parent living with a married couple and their children, are not uncommon, but in general extended kin groups no longer play a major role in people's daily lives.

25

JAPAN

Air travel preferences

Seating comfort driven by seat design

Only 23% of Asian travelers (regardless of height) said they would appreciate more legroom. Only 12% (regardless of weight) said they would prefer more seat width. But 30% said they want the seats to be more comfortable… Seat comfort, in Asia, is therefore driven more by the design of a particular seat than its location in the cabin or the relative cabin density.

26

JAPAN

Air travel preferences

Comfort over separation from others

Asian passengers also value the more abstract concept of greater separation from fellow passengers less than more comfortable seats. Only 12% responded that this separation is a critical factor for their passenger satisfaction. North American and European passengers value this measure of personal space, slightly higher (15% of passengers in both regions list it as a priority).

27

JAPAN

Air travel preferences

Immersion in in-flight entertainment

The APEX study found that Asian passengers are significantly more likely to lose themselves in the joys of in-flight entertainment than travelers anywhere else in the world. Measured among top priorities for passenger experience improvements, 22% of Asian passengers surveyed listed entertainment, whereas only 8% in North America and 15% in Europe felt the same.

IATA has previously determined, that Asian passengers are very particular about the details of their cabin experience, and especially critical of the modernity of the electronic in-flight entertainment systems they find onboard.

28

JAPAN

Air travel preferences
Trend

Multiscreening between own devices and seat-back screens

A dominant trend that airlines should consider before tearing out their seat-back screens: passengers like to multiscreen in the air as they do at home. Watching a movie on the seat-back screen while using personal electronic devices for other activities is not uncommon, in Asia or elsewhere.

29

JAPAN

Consumer behaviour

Customer is the king or queen

People treat customers as if they were gods.

30

JAPAN

Consumer behaviour

Quality is highly valued. Brand consciousness has been high, but is now decreasing.

Japanese consumers are said to be extremely brand conscious being ready to spend money on expensive design; clothes, accessories, electronics and interior design. This is apparently true, but the recent economic recession and changes in consumer behavior in Japan have started to slow down Japanese people's expenditure on luxury goods. Younger women have started to prefer lesser- known brands instead of Vuitton, for example.

However, the importance of high quality of products and services are still extremely important for Japanese customers and cannot be emphasized too much.

31

JAPAN

Consumer behaviour

Design awareness

Design in Japan is ubiquitous and people are relatively aware of matters related to design (e.g. accessibility, aesthetics and so forth). Thus, design in the Japanese context should definitely be seen as a potential source for competitive advantages, as the consumers are so well aware of and interested in design.

32

JAPAN

Consumer behaviour

World of visuals and stories

Japanese value the intangible aspects of a product, and in such market background information and stories behind the company and the product become important. Combine associations and emotions with your product/service.

In Japan, as in many other countries, people are increasingly looking for more individual and personalised brands and design items. In such markets the solid concept and all of the more intangible aspects of the product – such as background information and story behind the company and the product – become important.

33

JAPAN

Trend

Quality is highly valued. Brand consciousness has been high, but is now decreasing.

Japanese consumers are said to be extremely brand conscious being ready to spend money on expensive design; clothes, accessories, electronics and interior design. This is apparently true, but the recent economic recession and changes in consumer behavior in Japan have started to slow down Japanese people's expenditure on luxury goods. Younger women have started to prefer lesser- known brands instead of Vuitton, for example.

However, the importance of high quality of products and services are still extremely important for Japanese customers and cannot be emphasized too much.

34

JAPAN

Trend

All the cool kids are using Line

One question to ask when visiting a new country is: "What apps and websites is everyone using here?" In Japan, the answer is "Line," a messaging service that syncs with the contacts in your phone. Many businesses have signs up to explain how you can follow and engage with them on Line. E.g. Facebook is very popular in Japan as well.

35

JAPAN

Trend

Societal changes

The collapse of lifetime employment, low birthrates, and the withdrawal of young adults from society is causing profound, fundamental changes in Japan that some experts have said are as profound as those in the United States in the 1960s and 70s.

36

JAPAN

Trend

Aging population

As of 2015 the population estimate was 127,110,000 making it the world's tenth-most populous country at the time. Since 2010, Japan has experienced net population loss due to falling birth rates and almost no immigration, despite having one of the highest life expectancies in the world at 81.25 years of age as of 2006.

Japan's population will keep declining by about one million people every year in the coming decades, which will leave Japan with a population of 86 million in 2060. By that time, more than 40% of the population is expected to be over age 65.

37

JAPAN

Trend

Environmental pressure

Also related to economic growth is the reality that Asia will continue to put enormous pressure on the environment. With limited resources, the region is already the world's largest market for imported petroleum products. Forests and water supplies are under tremendous pressure, in part because of the growth in industrial use, but even more because of changing agricultural demands.

Japan is one of the leading countries in recycling.

38

JAPAN

Trend

Hunting for value

Japanese consumers are reducing costs and questioning their famous inclination to pay for convenience: a September 2009 MyVoice Internet survey found that 37 percent had cut overall spending, while 53 percent declared themselves more likely to "spend time to save money" rather than "spend money to save time.

What's more, sales of private-label products are booming. Experience in many North American and Western European markets suggests that once people switch to private brands, they rarely change back. Japan is in the early stages of this transition: until recently, the private-label penetration rate was just 4 percent, compared with the global average of 20 percent.

39

JAPAN

Trend

Spending more time at home

The Japanese used to spend little time at home, as a result of factors such as long work hours and small living quarters. Yet almost 50 percent of a representative sample of consumers across a range of age groups and geographies are now spending somewhat or significantly more time there. The suddenness of this behavioral change has prompted a term for it: sugomori, or "chicks in the nest." In fact, a September 2009 MyVoice Internet survey found that the top four ways people chose to spend their days off were surfing the Internet, watching television or reading the newspaper, sitting around the house, or listening to music.

40

JAPAN
Trend

Traveling for shopping

Japanese consumers are changing not only what they buy but also how they buy it. Long given to shopping near their homes, they are now more willing to travel. They are also deserting department stores in unprecedented numbers, preferring to spend their time in malls and stand-alone specialty shops. Asked by a March 2009 MyVoice Internet survey to explain their defection from department stores, they cited expensive products, "annoying staff," and an "inability to shop at my own pace." Consumers are favoring venues that satisfy needs beyond shopping, such as eating and entertainment.

41

JAPAN
Trend

Online shopping growing popular

While Japan has one of the world's highest broadband penetration rates, it has lagged behind developed markets such as United Kingdom and the United States in the willingness of its consumers to shop online. Many explanations have been advanced for this peculiarity: Japanese consumers love the physical shopping experience; mobile-phone screens are too small; the density of retail establishments means that online shopping has less of a convenience advantage; credit card penetration is low.

Whatever the root causes, **Japan has shrugged off its reluctance**: according to an April 2009 MyVoice Internet survey, more than 50 percent of consumers are buying more online than they were just 12 months ago. "Mobile technologies are empowering consumers to make smarter decisions about what they buy,"

42

JAPAN
Trend

Online shopping:
Ability to choose is empowering

It's worth underscoring the tight relationship between online shopping and broader shifts in consumer behavior. In a consensus-driven society where individual choice and expression have historically been frowned upon, the ability to browse products, compare prices, and make purchases relatively anonymously is creating new attitudes and empowering consumers. An interesting example is health care, where the Japanese have traditionally been deferential to authority figures such as physicians. Yet according to a nationwide January 2009 Nomura Research Institute survey, 89 percent of Japan's people are somewhat or very interested in managing their own health care decisions.

43

JAPAN
Trend

Being health-conscious

Japan has always been perceived as one of the world's healthiest societies, thanks to a combination of lifestyle, diet, and genetics, and Japanese consumers are increasingly conscious of their health. A September 2009 MyVoice Internet survey suggests that spending on health, sports, and recreation, for example, has held up better than virtually any other retail category.

44

JAPAN
Trend

Being environment-conscious

Environmental consciousness has been emerging for some time. A survey conducted last year by the global advertising agency J. Walter Thompson found that 51 percent of Japanese consumers are somewhat or much more focused on the environment than they were a year ago (2008); only 7 percent were less focused. A November 2009 McKinsey survey found that 84 percent of the respondents preferred to buy environmentally friendly everyday consumer products, and that preference is translating directly into business success.

Despite such success stories, Japanese consumers, like their counterparts in many other markets, have hard-nosed attitudes about paying for green goods and services. Just 16 percent of Japanese respondents to a recent McKinsey survey expressed a willingness to pay more for them.

45

JAPAN
Trend

The emergence of a new generation with radically different attitudes

This generation—people in their 20s—has grown up through Japan's difficult economic climate, never knowing the boom times the two previous ones experienced. Its lifestyle has prompted the nickname the hodo-hodo zoku, or "so-so folks" (or, even worse, "slackers" or "herbivore men"). Many shun corporate life and material possessions and are more pessimistic and more likely to be unemployed than their elders.

In addition, these consumers tend to be more willing to spend money on services than products and on technology than other goods.

46

JAPAN
Trend

Economic downturn

Just as European and US consumers have become more frugal, so have the Japanese. There's also a longer-term trend at work: Japan's economy has been relatively weak for nearly two decades. The changes that has wrought—such as the disappearance of life-long jobs and the increase in part-time and temporary labor—is fuelling consumer anxiety.

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JAPAN
Trend

Traveling despite of recession

Despite falling in and out of recession in the past three years, Japanese overseas tourism is projected to grow in the next ten years. In 2012, when the yen rose to record levels, the number of overseas travelers reached an all-time high of 18.49 million, or around 150 times the 1964 figure. The increase of direct flight routes by popular airlines such as JAL and ANA as well as lowering costs of flying are expected to contribute to increased overseas travel. In fact, a survey has found that Japanese people are preferring to travel overseas in spite of economic recession.

Although Japanese outbound tourism is expected to grow slower relative to neighboring countries (especially China), they're still one of the largest groups of tourists outside of Asia and cannot be overlooked.

48

JAPAN
Trend

Online bookings and the big ageing segment traveling

Japan saw a large increase in travel bookings made via smartphone and tablet in 2015, with travellers referring to social media, review sites, and forums to plan their trips. It's also worth remembering that Japanese mobile users spend more on app downloads than any other country.

There's been much said about the ageing population of Japan, also known as the Dankai generation, but what some travel companies haven't realised is that this has also led to an increase in travel spend amongst this segment. The older generation is less likely to use the internet, and mainly use traditional channels to book travel

49

JAPAN
Trend

Inbound travel

The estimated number of international visitors to Japan in March 2016 reached to 2.01 million (+31.7% from 2015), recording the highest figure on a monthly basis, and exceeded 2 million for the first time in history.

19 countries except Russia saw an increase compared to March 2015. With the Sakura season approaching and Easter Holidays, the need of visiting Japan was increasing among various markets, especially China increased by 47.3% to 498,000 visitors and its accumulated number by March has exceeded 1 million following South Korea.

50

JAPAN
Trend

Outbound travel

In Asia, Japan is ranked just behind China in terms of the number of outbound travelers. There were more than 17 million Japanese tourists traveling abroad in 2013, and of that, 3.7 million travelled to the US, representing nearly 22% of all outbound travelers. The US is the most popular international destination for Japanese travelers, just surpassing China in 2012. Other popular destinations for Japanese tourists include South Korea, Italy, France, Taiwan and Hong Kong.

51

JAPAN
Trend

Domestic travel

Gross sales of domestic travel package tours was 71.9 billion yen, an increase of 4.2% from the previous year

52

JAPAN
Trend

Women traveling

Although women in their mid-30s are generally thought to be the keenest on overseas travel, a survey done in 2009 revealed surprising results. When asked about leisure activities they would like to pursue, women across all income groups and ages (from 20 to 60) on average ranked "overseas travel" at the top. When split by age group for overseas travel, those in their 20s and 60s turned out to be the keenest on traveling.

- This segment sees a higher rate of online purchases than other groups – 68% order tickets online and 80% reserve hotels online
- Mobile devices are the primary device used for information discovery
- This segment responds well to visually attractive marketing materials when it comes to selecting hotels

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JAPAN
Trend

Elderly traveling

Although it might seem immediately obvious that older generations browse and purchase online less, there's actually still a significant portions of 65+ senior citizens in Japan who use the internet regularly. In fact, this figure has nearly doubled in the span of five years, between 2008 and 2012, from 37.6% to 62.7%.

- Don't look for travel information on the internet as often and are more reluctant to book online
- Tend to use Yahoo! more than Google
- Primary information discovery is via word of mouth and printed media
- Quality of information and presentation by travel agent is very important as travel agents have a large influence on purchase
- Customer service expectations are the highest out of all segments
- Quality of food is a strong influencer of destination choice

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Source: Mäkinen et al. (2017)

Appendix C. Demographics and supplementary data collected

Table C-1.*Sociodemographic data collected in the survey*

Sociodemographic data	
Information	**Options**
Age	18-24
	25-34
	35-44
	45-54
	55-64
	65+
Gender	Female
	Male
Occupation	Working full time
	Working part-time
	Student
	Temporarily unemployed
	Retired
	Other (permanently unemployed)
Level of income	Low (<JPY 2,000,000)
	Medium(JPY 2,000,000 – JPY 5,000,000)
	High (JPY 5,000,000 – JPY 8,000,000)
	Very high (>JPY 8,000,000)
Level of education	Lower secondary school
	Upper secondary school
	Associate degree
	Bachelor degree
	Master degree
	Ph.D degree
Height	Short (Male: <160cm; Female: <150cm)

	Average (Male: 160cm-175cm; Female: 150cm-160cm)
	Tall (Male: >175cm; Female: >160cm)
Weight	Light (Male: <60kg; Female: <47kg)
	Average (Male: 60kg-75kg: Female: 47kg-60kg)
	Heavy (Male: >75kg; Female: >60kg)
Nationality	Japanese
	Other

***Table C-2**. Supplementary data collected in the survey*

Supplementary data	
Information	**Options**
Frequency of travel (annually)	0-2
	2-6
	6-10
Usual reason of travel	Leisure
	Relative visit
	Business
	Study
Usual flight length travelled	0-3 (Short-haul)
	3-6 (Medium-haul)
	6-12 (Long-haul)
	12+ (Ultra long-haul)
Usual flight destination	Domestic
	International (Regional (Asia))
	International (Out of Asia)
Majority of time spent during a flight	Sleeping

	Reading
	Working
	Listening music
	Watching movies
	Playing games
	Chatting
	Watching scenery
Level of comfort during sleeping	Very low/cannot sleep (0)
	Low (1)
	Medium (2)
	High (3)
	Very high (4)
Reason for discomfort when sleeping	Seat position/uncomfortable seats
	Lack of head rests
	Noise
	Lighting
	Temperature
	Other
Level of comfort during eating	Very low/cannot eat (0)
	Low (1)
	Medium (2)
	High (3)
	Very high (4)
Reason for discomfort when eating	Seat position/uncomfortable seats
	Lack of room on the tray
	Inadequate/low quality foods
	Vibration
	Health reasons
	Other
Level of comfort while using tray table	Very low/cannot use (0)

	Low (1)
	Medium (2)
	High (3)
	Very high (4)
Reason for discomfort when using tray table	Lack of space
	Unstable tray table
	Hygiene
	Other
Interaction with mobile devices (hours/day)	0-2
	2-6
	6-10
Time spent on internet (hours/day)	0-2
	2-6
	6-10

Appendix D. Themes for user trends and characteristics

Table D-1. *Themes and codes*

Comfort	Seating	B1-1	Using footrests and cushions
			Using massage tools
	Environment	B1-2	Preferring quieter cabins
			Control of lighting in the cabin
			Using eye masks
			Need for blankets
	Storage	B1-3	Stowing is problem in winter
			Wanting their belongings close
	Movement	B1-4	Walking to the back of the cabin to stretch
			Walking to galley to stretch
			Stretching parts of body quite often
Entertainment	Mobile devices	B2	Playing games on mobile devices
			Younger passengers bring laptops to watch shows and movies
			Reading books on e-readers
Hygiene	General hygiene	B3-1	Wearing surgical masks
			Carrying toiletry bags and a small towel
			Placing plastic bags on the floor to place feet
	Toilets	B3-2	Expecting very clean restrooms
			Expecting pleasant scents in the restroom
Communication	Complaints	B4-1	Complaining after the flight not directly to the cabin crew
			Preferring to complain to Japanese staff
			Not actively complaining

			Not reflecting dissatisfaction
	Instructions and information	B4-2	Looking for written instructions and brochures Requesting information in their language Following guidelines and instructions
	Respect	B4-3	Respectful to cabin crew Saying "thank you" and showing appreciation
	Requests	B4-4	Less likely to ask for more water or food Low frequent demands Quiet passengers
	Social	B4-5	Avoiding other passengers Not staring at other passengers Complaining to cabin crew instead of to other passengers Expecting permission to recline the seat
Food	Variety	B5	Requiring various options for meals
Etiquette	Politeness	E1	
	Patience and tolerance	E2	
	Complaints	E3	
	Respect	E4	
	Discipline	E5	
Condition	Aging population	C1	
	Urbanisation	C2	
	High income	C3	

National Culture	Power distance	H1
	Individualism	H2
	Masculinity	H3
	Uncertainty avoidance	H4
	Long term orientation	H5
	Indulgence	H6

Appendix E. Stated preference survey

Airline Cabin and Passenger Comfort Survey

Every airline passenger experiences different outcomes during their flights as a result of certain aspects of the cabin interior and in-cabin services. This reflects their satisfaction levels based on the flight comfort, service, and overall in-cabin experience. This survey is designed to analyse air travel choice behavior of passengers in Japan. It is part of a collaborative research project that Cranfield University (UK) is taking part in with Japan and European countries.

You will be asked to make choices among flight options provided to you in Section 1 regarding to several flight characteristics of the defined airline alternatives. Then, in Section 2, you will be asked about some information about you and your previous flight experiences. All the information collected is anonymous. Completing the survey should take about 10 minutes.

Thank you for your participation!

Section 1

In this section, different flight options with different origin and destinations will be presented to you. You are expected to choose the best option based on your own judgement and necessities. There are 6 scenarios provided with three different origin and destination pairs.

Upon completing each scenario, you are asked to state your reasoning by selecting *up to three* most appealing reasons through the options provided.

Domestic Flight - Scenario 1

You are to fly to Sapporo from Tokyo one-way, a 1.5 hours flight. Below, you will find three alternatives provided for the flight. Based on your needs and preferences, pick the best alternative and state your reason.

	Airline 1	***Airline 2***	***Airline 3***
Flight Time	1.5h	1.5h	1.5h
Adjustable Headrests	Yes	No	No
Seat Pitch	78.7cm	83.8cm	73.7cm
Seat Width	48.3cm	40.6cm	43.9cm
Carry-on Baggage Size Allowance	55×40×25cm	61×43×25cm	55×40×25cm
Inflight Entertainment	Interactive (Personal Screen)	BYOD* (On demand content over Wi-Fi)	None
Wireless	None	Paid	Paid
Power Supply	Yes	No	No
Food and Drinks	Complementary Meal Service	Complementary Meal Service	Limited Meal Menu for Purchase
Price	¥ 24,590	¥ 22,690	¥ 17,090
Preference	□	□	□

**BYOD: Bring your own device*

Please select *up to three* reasons for choosing the alternative above:

Reasons		**Reasons**	
Adjustable Headrest	□	*Carry-on Baggage Size Allowance*	□
Seat Pitch	□	*Inflight Entertainment*	□
Seat Width	□	*Wireless*	□
Food and Drinks	□	*Power Supply*	□
		Price	□

Domestic Flight - Scenario 2

You are to fly to Sapporo from Tokyo one-way, a 1.5 hours flight. Below, you will find three alternatives provided for the flight. Based on your needs and preferences, pick the best alternative and state your reason.

	Airline 1	***Airline 2***	***Airline 3***
Flight Time	1.5h	1.5h	1.5h
Adjustable Headrests	Yes	No	No
Seat Pitch	73.7cm	73.7cm	83.8cm
Seat Width	43.9cm	43.9cm	40.6cm
Carry-on Baggage Size Allowance	61×43×25cm	61×43×25cm	55×40×25cm
Inflight Entertainment	BYOD* (On demand content over Wi-Fi)	BYOD* (On demand content over Wi-Fi)	BYOD* (On demand content over Wi-Fi)
Wireless	Paid	Paid	Free
Power Supply	No	No	Yes
Food and Drinks	Full Meal Menu for Purchase	Full Meal Menu for Purchase	Limited Meal Menu for Purchase
Price	¥ 19,670	¥ 16,990	¥ 14,990
Preference	□	□	□

**BYOD: Bring your own device*

Please select *up to three* reasons for choosing the alternative above:

Reasons		**Reasons**	
Adjustable Headrest	□	*Carry-on Baggage Size Allowance*	□
Seat Pitch	□	*Inflight Entertainment*	□
Seat Width	□	*Wireless*	□
Food and Drinks	□	*Power Supply*	□
		Price	□

Domestic Flight - Scenario 3

You are to fly to Sapporo from Tokyo one-way, a 1.5 hours flight. Below, you will find three alternatives provided for the flight. Based on your needs and preferences, pick the best alternative and state your reason.

	Airline 1	***Airline 2***	***Airline 3***
Flight Time	1.5h	1.5h	1.5h
Adjustable Headrests	No	No	Yes
Seat Pitch	83.8cm	73.7cm	83.8cm
Seat Width	43.9cm	48.3cm	48.3cm
Carry-on Baggage Size Allowance	55×40×25cm	55×40×25cm	55×40×25cm
Inflight Entertainment	None	Interactive (Personal Screen)	BYOD* (On demand content over Wi-Fi)
Wireless	Paid	None	Paid
Power Supply	No	No	No
Food and Drinks	Complementary Meal Service	Limited Meal Menu for Purchase	Complementary Meal Service
Price	¥ 17,690	¥ 19,190	¥ 24,790
Preference	□	□	□

**BYOD: Bring your own device*

Please select *up to three* reasons for choosing the alternative above:

Reasons		**Reasons**	
Adjustable Headrest	□	*Carry-on Baggage Size Allowance*	□
Seat Pitch	□	*Inflight Entertainment*	□
Seat Width	□	*Wireless*	□
Food and Drinks	□	*Power Supply*	□
		Price	□

International Flight - Scenario 1

You are to fly to Taipei from Tokyo one-way, a 3.5 - 4 hours flight. Below, you will find three alternatives provided for the flight. Based on your needs and preferences, pick the best alternative and state your reason.

	Airline 1	***Airline 2***	***Airline 3***
Flight Time	3.5 - 4h	3.5 - 4h	3.5 - 4h
Adjustable Headrests	Yes	No	Yes
Seat Pitch	73.7cm	78.7cm	78.7cm
Seat Width	40.6cm	40.6cm	43.9cm
Carry-on Baggage Size Allowance	61×43×25cm	55×40×25cm	61×43×25cm
Inflight Entertainment	Interactive (Personal Screen)	BYOD* (On demand content over Wi-Fi)	None
Wireless	None	Paid	None
Power Supply	Yes	Yes	Yes
Food and Drinks	Complementary Meal Service	Limited Meal Menu for Purchase	Full Meal Menu for Purchase
Price	¥ 68,890	¥ 29,990	¥ 44,890
Preference	□	□	□

**BYOD: Bring your own device*

Please select *up to three* reasons for choosing the alternative above:

Reasons		**Reasons**	
Adjustable Headrest	□	*Carry-on Baggage Size Allowance*	□
Seat Pitch	□	*Inflight Entertainment*	□
Seat Width	□	*Wireless*	□
Food and Drinks	□	*Power Supply*	□
		Price	□

International Flight - Scenario 2

You are to fly to Taipei from Tokyo one-way, a 3.5 - 4 hours flight. Below, you will find three alternatives provided for the flight. Based on your needs and preferences, pick the best alternative and state your reason.

	Airline 1	***Airline 2***	***Airline 3***
Flight Time	3.5 - 4h	3.5 - 4h	3.5 - 4h
Adjustable Headrests	Yes	Yes	Yes
Seat Pitch	83.8cm	78.7cm	78.7cm
Seat Width	43.9cm	48.3cm	43.9cm
Carry-on Baggage Size Allowance	55×40×25cm	61×43×25cm	55×40×25cm
Inflight Entertainment	Interactive (Personal Screen)	None	Interactive (Personal Screen)
Wireless	Free	Free	None
Power Supply	No	Yes	Yes
Food and Drinks	Limited Meal Menu for Purchase	Complementary Meal Service	Limited Meal Menu for Purchase
Price	¥ 22,390	¥ 57,390	¥ 62,230
Preference	□	□	□

Please select *up to three* reasons for choosing the alternative above:

Reasons		**Reasons**	
Adjustable Headrest	□	*Carry-on Baggage Size Allowance*	□
Seat Pitch	□	*Inflight Entertainment*	□
Seat Width	□	*Wireless*	□
Food and Drinks	□	*Power Supply*	□
		Price	□

International Flight - Scenario 3

You are to fly to Taipei from Tokyo one-way, a 3.5 - 4 hours flight. Below, you will find three alternatives provided for the flight. Based on your needs and preferences, pick the best alternative and state your reason.

	Airline 1	***Airline 2***	***Airline 3***
Flight Time	3.5 - 4h	3.5 - 4h	3.5 - 4h
Adjustable Headrests	Yes	No	Yes
Seat Pitch	83.8cm	78.7cm	83.8cm
Seat Width	40.6cm	48.3cm	48.3cm
Carry-on Baggage Size Allowance	55×40×25cm	55×40×25cm	61×43×25cm
Inflight Entertainment	BYOD* (On demand content over Wi-Fi)	None	BYOD* (On demand content over Wi-Fi)
Wireless	Paid	Free	Free
Power Supply	Yes	Yes	No
Food	Complementary Meal Service	Limited Meal Menu for Purchase	Complementary Meal Service
Price	¥ 87,770	¥ 32,870	¥ 70,890
Preference	□	□	□

**BYOD: Bring your own device*

Please select *up to three* reasons for choosing the alternative above:

Reasons		**Reasons**	
Adjustable Headrest	□	*Carry-on Baggage Size Allowance*	□
Seat Pitch	□	*Inflight Entertainment*	□
Seat Width	□	*Wireless*	□
Food and Drinks	□	*Power Supply*	□
		Price	□

This is the end of Section 1.

Section 2

In this section, you will be asked to provide us with some information regarding you and your flight experiences to help us understand more about your expectations. All the information collected is anonymous. You are expected pick one answer in each segment.

Demographic Information

Below, select *one option* that best describes your situation.

How old are you?
□ 18-24
□ 25-34
□ 35-44
□ 45-54
□ 55-64
□ 65+
What is your gender?
□ Female
□ Male
What is your occupation?
□ Working full time
□ Working part-time
□ Student
□ Temporarily unemployed
□ Retired
□ Other (permanently unemployed)
What is your annual level of income?
□ Low (<JPY 2,000,000)
□ Medium (JPY 2,000,000 – JPY 5,000,000)
□ High (JPY 5,000,000 – JPY 8,000,000)
□ Very High (>JPY 8,000,000)
What is your level of education?
□ Lower secondary school
□ Upper secondary school

- Associate degree
- Bachelor degree
- Master degree
- Ph.D degree

What is your height?

- <150 cm
- 150 cm – 175 cm
- >175 cm

What is your weight

- <60 kg
- 60 kg – 75 kg
- >75 kg

What is your nationality?

- Japanese
- Korean
- Chinese (Mainland)
- Chinese (Hong Kong)
- Other (Asian Countries)
- Other (Non-Asian Countries)

How many hours are you interacting with your mobile device daily?

- 0-2 hours
- 2-6 hours
- 6+ hours

How many hours are you spending time on internet daily?

- 0-2 hours
- 2-6 hours

- 6+ hours

Flight History

Below, select *one option* that best describes your situation.

How frequently are you travelling by air per year?
□ 0-2 times
□ 2-6 times
□ 6+ times
What is the usual cabin class you travel in?
□ Economy Class
□ Premium Economy Class
□ Business Class
□ First Class
What is your usual reason for travel?
□ Leisure
□ Relative visits
□ Business
□ Study
How long is your usual flight?
□ 0-3 hours
□ 3-6 hours
□ 6-12 hours
□ 12+ hours
What is your usual flight destination?
□ Domestic
□ International (Regional Asia)
□ International (Out of Asia)

In-cabin Comfort

Below, select *one option* that best describes your situation.

How do you spend the majority of time during a flight?
□ Sleeping
□ Reading
□ Working
□ Listening music/podcasts
□ Watching videos/movies
□ Playing games
□ Chatting
□ Watching scenery
What is your level of comfort when sleeping?
□ Very Low/Cannot sleep
□ Low
□ Medium
□ High
□ Very High
Can you identify the reason below if you are not fully comfortable?
□ Seating position/uncomfortable seats
□ Lack of headrests
□ Noise
□ Lights
□ Temperature
□ Other
What is your level of comfort when eating?
□ Very Low/Cannot eat
□ Low

- Medium
- High
- Very High

Can you identify the reason below if you are not fully comfortable?

- Seating position/uncomfortable seats
- Lack of room on the tray table
- Inadequate/Low quality foods
- Vibration
- Health reasons
- Other

What is your level of comfort when using tray table for your own utility?

- Very Low/Cannot use
- Low
- Medium
- High
- Very High

Can you identify the reason below if you are not fully comfortable?

- Lack of space
- Unstable tray table
- Hygiene
- Other

Are you comfortable with the overall space provided in the cabin?

- No
- Doesn't bother me

- Somewhat comfortable
- Comfortable

Are you comfortable with the space provided in your seat?

- No
- Doesn’t bother me
- Somewhat comfortable
- Comfortable

End

Thank you for taking part in our survey!