SERVICE QUALITY PERCEPTION & PREFERENCE FOR PUBLIC BUS USERS IN DHAKA CITY THROUGH THE LENS OF GENDER

by

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Dedication

I would like to dedicate this thesis to my family and all my teachers who brought me up to this moment.

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Abstract

Industrialization and technological advancement has opened the window of opportunities for females in the job market. Dhaka, being the financial and technological epicenter of Bangladesh, generates the more trips than any other regions. Due to huge population growth and limited land opportunities, most of the people here depend on public transport. In conservative countries like Bangladesh, females do not feel safe using public transport and they face additional difficulties due to existing social norms, religious fanaticism, patriarchal society. From an engineering perspective, passenger perception, service quality, design, etc. impact such problems. The current service quality of the bus is questionable. Moreover, recent unwanted incidents have researchers wondering why females are having issues. Thus, this research has addressed to explore the service quality perception and preference with redesigning the interiors of public buses in Dhaka city based on gender.

The research initially adopted text mining based on 20 relevant research papers to identify keywords. From the keywords and based on two service quality models (SQM), "SERVQUAL" and "RESCA", later Focus Group Discussion (FGD) was performed on 50 samples (M = 25, F = 25). Based on the FGD, a customized SQM was developed considering seventeen different subcriteria under five criteria. In addition, three alternatives were proposed: a) separate buses for male and female bus users, b) same buses for both genders, and c) redesigning existing buses for more accessible to female passengers. Finally, two separate ANP models (one for males and another for females) were developed. Based on the ANP models, pairwise comparisons were performed via a questionnaire survey.

Moreover, using the SERVQUAL and RESCA models, three distinct FGD were performed (Group 1: 15 females, Group 2: 15 males, and Group 3: a combination of the same 30) considering interior design aspects, their problems, and alternative solutions for redesigning of the public buses. From the FGD, a customized SQM was generated with three criteria and 18 subcriteria. Two separate AHP models were developed and analyzed for male and female to compare preferences and weighted priorities of attributes. The AHP model generated 60 pairwise comparison questions, which were answered by 10 male and 10 female. Later, a third survey questionnaire

with multiple-choice options based on FGD was developed, with 150 bus users, equally distributed between males and females, responding to evaluate the most preferred redesign alternative under each attributes. By analyzing the data from the survey questionnaire, it was discovered that for various attributes and alternative design options, each gender had a different weighted preference. Lastly, sketches of the most popular redesign alternatives are presented according to female priority options.

The findings revealed that female passengers expect separation from male when they travel. Moreover, females prioritize redesigning the interior of buses more than males. Females are more sensitive about safety, security, comfort, and how people behave with them and less sensitive about the reliability and affordability of the public bus service as compared to men. Besides, females ranked safety and security first, followed by responsiveness and empathy, and comfort. Conversely, men prioritized safety and security over the other criteria, though they preferred comfort over responsiveness and empathy. Results of the survey based on the AHP suggested that female passengers consider redesigning the existing interior bus designs.

The findings not only evaluate the problems according to the current context but also identified the proposed alternatives from the users. Policymakers and transportation planners can assess the feasibility of introducing separate buses based on preferences. Also, policymakers and governments can improve the service quality criteria of public buses identified by gender. Finally, several redesign recommendations suggested can be trialed on a pilot basis to check the feasibility.

CHAPTER 1: INTRODUCTION

1.1 Background of the study

In a sustainable transportation environment, using public transportation has numerous substantial benefits over using private automobiles. Traveling by public transportation has several advantages for individuals, society, and cities in terms of decreasing traffic congestion, sustainable mobility, energy conservation, social fairness, and environmental effect (Gronau and Kagermeier, 2007) and impacts on local, regional, and global environments (Polk, 2004). An efficient transport system is essential for the sustainable economic development of the country by playing a significant role in promoting national and global integration. Improving the performance of public transportation networks is critical in today's economy for the quick development of company efficiency, which contributes to regional prosperity (Kozlak, 2017). According to Wane et al. (2001), a sustainable public transportation system allows city dwellers to access economic activities, facilitates family life, and aids in the formation of social networks.

Consequently, nowadays, the service quality of public transportation has become a topic of attention and importance in both developed and developing nations. Improvements in public transportation service quality are critical in efforts to reduce demand for private automobiles, attract new passengers, and maintain travel satisfaction. For retaining the current public transport users and attracting new ones, there is no alternative to improving the service quality of public transport (Eboli and Mazzulla, 2021). The case is even more sensitive for women in developing countries as they are generally forced to alternative inconvenient modes due to a lack of quality public transport services (Redman et al., 2013). Hence, the service quality of public transport has been an important issue to address in the transportation industries (Govender, 2014; Wijaya, 2009; Giannopoulos, 1989).

The majority of women rely on public transport for transportation purposes due to their low socioeconomic status or limits on the usage of any available personal vehicle in their household. Males in these households, usually, hold the priority to use the family car as they are also more likely to hold a driver's license (Turner and Fouracre, 1995). Although in the past most women were shaped by their domestic and childcare responsibilities (Wachs, 1999), these days more women are joining the workforce and contributing to the economic growth of their nations. As a result, this trend, particularly among young women, has led to women making more trips than before (Tilley and Houston, 2016). Greater employment and study opportunities compared to the past have led to an increased rate of female trips over the last decade (Rosenbloom, 2006). It is also true for the women in Dhaka city as nowadays the female labor force participation has risen steadily. The majority of women in Bangladesh participate in social, cultural, economic, and political activities, necessitating the use of public transportation to meet basic needs (Rahman, 2010).

According to the comparative research of gender-based transportation practices and behaviors, women's transportation expectations and experiences differ from men's in both developed and developing nations as women tend to play multiple roles as professionals and primary caregivers of children (Duchene, 2011). Women, on average, have different travel patterns than men (McGuckin and Murakami 1999) due to household roles, employment status, occupation, income, or residential location (Bowman and Ben-Akiva, 1997). Even in the same household, the travel patterns vary between the male and female members due to a greater variety of social classes, economic conditions, and cultural backgrounds in the urban area of developing countries (Peters, 2001; Riverson et al., 2006). Because of women's distinct travel patterns, women tend to prioritize and value time differently, which is portrayed by their complex daily travel patterns than men's (Rosenbloom, 2006). Major differences contributing to travel behavior are employment, income, licensing, automobile ownership, etc. (Pooley et al., 2006, Al-Jameel and Kamel, 2016). Moreover, men tend to travel farther than women due to greater access to private vehicles, less constrained domestic activity schedules, and higher pay and employment rates, and this gender difference in mobility has been well documented (Pooley et al., 2006). For

instance, such gender-based differences in mobility and travel modes have been observed in cities like Manchester and Glasgow in the UK, where females preferred walking, buses or trams, and public transportation compared to males, while males preferred cycling and car use (Pooley and Turnbull, 2000a).

The preferences of women and men differ in the case of service quality perception where women expressed lesser satisfaction and tend to rate service quality lower than their male counterparts. For example, in the marketing literature (Snipes et al., 2004; Tan and Kek, 2004; Zeithaml et al., 2006; Lin et al., 2001); the tourism sector (Kwok et al., 2016; Samakosh et al., 2014); Banking sector (Teeroovengadum, 2020); sports sector (Lee et al., 2011); municipal management (Mokhlis, 2012); fast-food sector (Oluseye, 2009); job sector (Burbano et al., 2020) and many more. Even in the transport sector, existing studies suggest that men and women have different service quality preferences. A study from Italy demonstrated that women's expectations and minimum acceptable level of service from public transport are higher than men's, highlighting one of the main reasons for women's modal shift from public transport could be attributed to this finding (Arabikhan et al., 2016). Although women in Dhaka city prefer safety and comfort (Shefali, 2000), the exact service quality preferences of the genders are not identifiable. Additionally, recent studies indicate clearly that the existing public bus service is unpleasant for female passengers in terms of perception and preference for the service quality of public buses (Rouf et al., 2018).). Female bus users of Dhaka city are concerned about service quality attributes of the public buses and identified the boarding-alighting status and harassment issues as the most important variables which greatly influence the safety, security, and comfort-related issues of female commuters (Islam et al., 2020).

Nowadays researchers, policymakers, and transport planners are now providing substantial emphasis on gender issues in the transport sector (Wachs, 2010). As a result, in response to the many issues faced by women, some countries have introduced women-only coach service, a segregated sub-service, that presents a safer and more comfortable riding option for females. However, the findings of a case study of "KTM Komuter Malaysia" suggest that a significant number of respondents were not satisfied with the limited capacity of the coaches, and they also felt unsafe due to

the presence of some male passengers onboard (Bachok et al., 2014). Moreover, 'women-only' buses at times face severe criticism. Gekoski et al. (2015) argued that 'women-only' buses can only be a short-term intervention as its inherent mechanism implies putting the onus on women in safeguarding the perpetrators and fails to leave any long-term impact on the minds of the offenders as it does not contribute to changing their behavior. As a result, while improvements in public transportation services and infrastructures may improve people's perceptions and experiences, neglecting these aspects may increase the likelihood of people being dissatisfied with the services (Vilakazi and Govender, 2014). Polk (2001) defined that for sustainable development of the transportation sector, gender equality plays a vital role. In the last few years, it is well documented that gender equality has had a significant influence on transportation policy (Polk, 2004). In the context of the present discussion, the relationship between gender and transportation is an emerging topic of interest and concern for politicians, policymakers, and planners (Polk, 2004; Shefali, 2000; Wachs, 2009; Peters, 2001).

1.2 Problem statement

Dhaka, the capital of Bangladesh, is one of the world's fastest-growing and densely populated megacities, with around 1.9 million passenger trips every day (Mahmud and Haque, 2008). The rate of women's education and employment in Dhaka city, the study area, is increasing day by day. More women are now participating in the labor force than before and their literacy rate grew simultaneously. A study on Dhaka city suggested that arise in the empowerment of women, their greater participation in the labor force, and increased educational opportunities lead to a higher number of trips (Shefali, 2000).

Currently, buses are the dominant and most widely available mode of mass public transit in Dhaka city. Yet, making trips using the existing public buses is a difficult and unpleasant experience for both genders, especially females (Rouf et al., 2018). Also, females find the current bus transport services in Dhaka to be insecure and unsafe. Previous studies narrated that the existing transport system fails to address the unique needs of women in Bangladesh and as a result puts additional restrictions

on their already constrained mobility (Shefali et al., 2000). Besides, this increasing number of women are traveling with discomfort in overly crowded buses due to the lack of women-friendly public transport options (Zohir, 2003). A combination of Bangladeshi society's restrictive attitudes toward female mobility and bus providers' focus on maximizing returns has created a public transport system that is especially unsafe, inaccessible, unreliable, and expensive for young female commuters (Shefali, 2000). In addition, due to cultural sentiments, it's a struggle for women to get on crowded buses and compete with men for limited standing or seating spaces (Shefali, 2000).

Recent observations involving the female bus users in Dhaka city, Bangladesh, suggested that women face more acute issues with the service quality of public buses than men (Rouf et al., 2018). Consequently, the studies postulate that women in Dhaka city simply avoid any attempt to board a heavily-crowded bus. Unlike men, they would rather wait for the arrival of a less-crowded bus and the opportunity of availing a seat when they board it. Findings of a recent qualitative study focusing on female bus users of Dhaka city suggested that women felt concerned about service quality attributes of the public buses such as reliability, comfort, service, responsiveness and empathy, and safety and security; on the other hand, they cared less about affordability and vehicle access (Rouf et al., 2018). Apart from the problems of crush loading, women in developing countries also suffer more seriously from the poor design of existing buses and the erratic maneuvering (Rouf et al., 2018). For example, while boarding the public buses in Dhaka city (**Fig 1.1**), the height of entry steps combined with the absence of holding rails cause women to carry shopping bags, travel with young children, or dressed in everyday traditional attires such as the saree (a long garment draped around the body) great distress (Turner and Fouracre, 1995).

(a) A woman competing with men to board a bus

(b) A woman boarding a moving bus

(c) A woman boarding a crowded bus

Fig 1.1: The boarding scenario for women in public buses in Dhaka city

In Dhaka city, few 'women-only' bus services exist among which the majority of the users (about 71%) reported many problems related to the service. Some common complaints include insufficient space, poor seat conditions, obstacles to mobility inside the bus, water leakage through the roofs during rainfall, problems with windows, the absence of fans or sufficient ventilation, and lack of female bus drivers and conductors (Rahman, 2010). In addition, the service was reported to be active for only a specific period on a few routes in Dhaka city which is insufficient considering the current trip demands of female passengers (Rahman, 2010). The existing transportation system is ineffective at meeting the primary demands of women, limiting women's economic involvement and contribution to society to its full potential. Hence, for the increasing trip demands of young women, the differences in their trip characteristics, lack of service quality, and poor design of public transit, it is now imperative to investigate if and how their preferences for service quality differ from their male counterparts in case of using public buses in Dhaka. However, since the existing 'women-only' buses in Dhaka city have not performed well (Rahman, 2010), design modifications to existing bus services, alternative design options, and other policy recommendations can then be proposed based on this knowledge to ensure equal opportunity for female bus users to access public transport and to improve their overall service quality.

1.3 Purpose and objectives

The main purpose of this study is to evaluate the service quality perceptions and preferences of male and female public bus users in Dhaka City to identify opportunities to improve the overall bus users' experience. The specific objectives of this study are:

a. To develop a qualitative framework to assess the service quality of public buses in Dhaka city accommodating the needs of female passengers.
b. Utilizing the framework to identify and order the preferences of both female and male public bus users.
c. Propose a strategy to provide female trip makers equal opportunity to use the public bus.
d. Recommend design improvements to existing bus interiors to improve the accessibility of female passengers to public buses.

1.4 Study area

Dhaka, the selected study area for this study, is the capital and the most populated city of Bangladesh (Bangladesh Bureau of Statistics, 2011). It is situated at the center of the country and lies towards the lower reaches of the Ganges Delta, covering a total metropolitan area of 315.98 square kilometers (Population and Housing Census 2011, BBS) (**Fig 1.2**). According to a recent Dhaka Urban Transport Network Study (DTCB, 2010), approximately 21 million trips occur in Dhaka on an average working day. The study area generates 20.9 million trips by men and 9.1 million trips by women per day. Dhaka is one of the ten mega-cities in the world (World Bank, 2007) and 73% area is developed without any planning and guidance resulting in huge transport problems (Hasnat and Hoque, 2016). The density of this city is 28185 per square kilometers (Population and Housing Census 2011, BBS). Moreover, as of 2016, the greater Dhaka area has a population of over 18 million making it one of the most populated regions in the world. The city itself has a population estimated at 8.5 million which has increased by an estimated 4.2% per year. Nonetheless, only 1,286 km of roadway exists within the city corporation area

which covers just about 6% of the overall city area (Mahmud and Haque, 2008). The accessibility of key highways in the city is considered to be excessively short when compared to other important cities in developing nations, either in terms of km per thousand inhabitants or km per square kilometer of land. According to STP (2005), although around 7,100 buses are operating in Dhaka on fixed routes, the current demand for public buses is much more than that. Every day, public bus users in Dhaka city make an estimated 1.9 million passenger trips (Mahmud and Haque, 2008). However, in terms of trips, buses currently have a modal share of approximately 60% in the city (RSTP, 2015).

Dhaka city has one of the messiest traffic systems in the world. The continually increasing number of city dwellers over the past decade has adversely affected the already present traffic congestion in the city. As a result, its transport services are no longer able to keep up with the travel needs of the rapidly growing residents. Likewise, the increasing demand has not been matched by sufficient investments in transport infrastructure, services, and management. Hence, traffic and public transport conditions in Dhaka have seriously deteriorated, characterized by daily traffic congestion, long delays, and a high incidence of road crashes. Lack of planning, insufficient roads, defective traffic signaling systems, inadequate manpower, narrow road spaces, overpopulation, lack of law implementation, and unplanned stoppage or parking are a few of the never-ending factors of this situation. The mean travel time at peak hours is 7.05 minutes whereas at off-peak hours it is 7.42 minutes, that is, it is quite difficult to differentiate between peak and off-peak traffic conditions in Dhaka city due to severe traffic congestions throughout the day (Anwar, 2010). People pay dearly for this daily congestion- about 1.3 man-hours per day and 20.74 BDT per person (Mahmud et al., 2012). In addition, traffic jams impede economic growth, negatively affect public health, and cause air and noise pollution, worsening the overall environmental condition of the city (Mahmud et al., 2012).

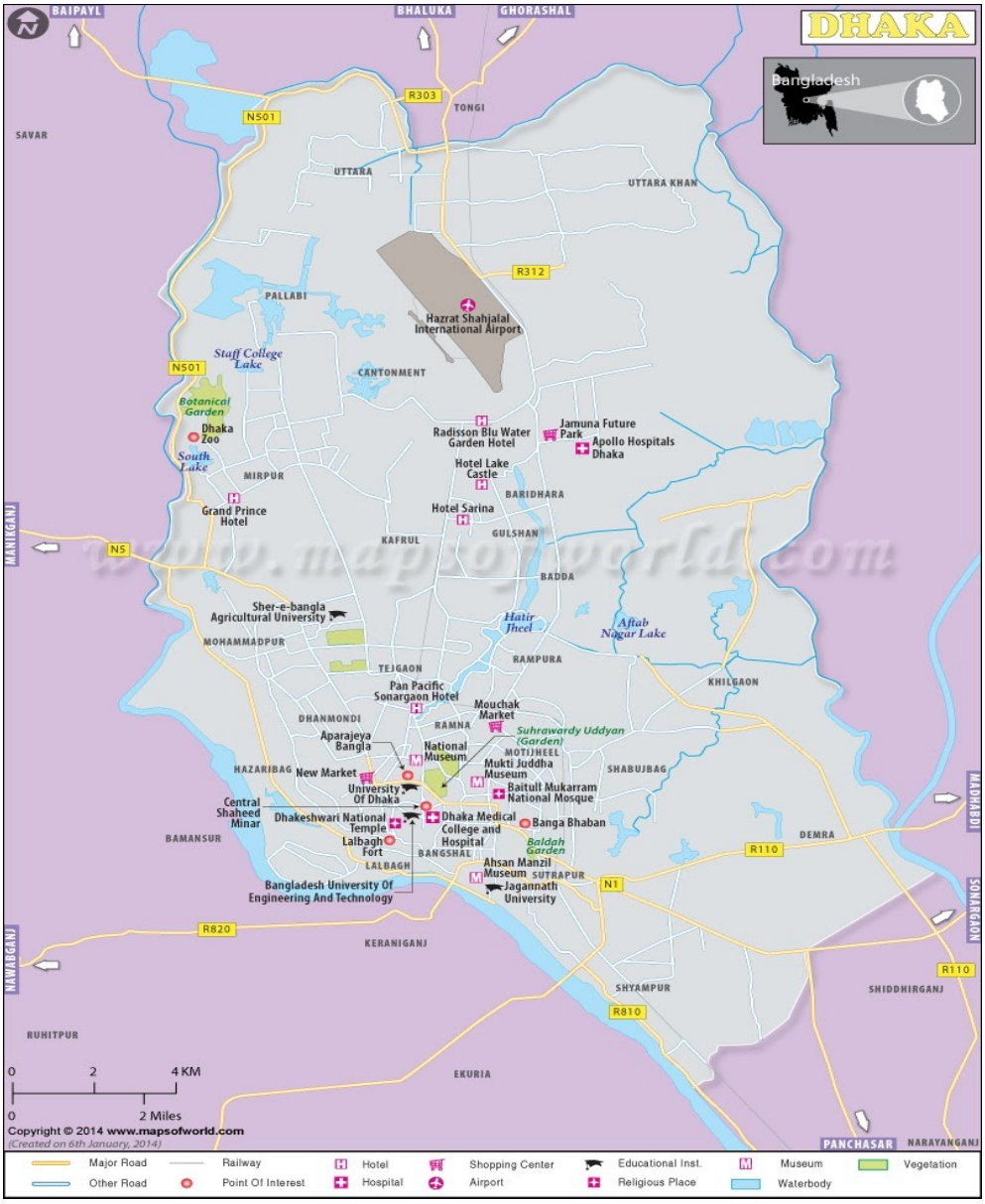


Fig 1.2: Study area (Source: Maps of the world, 2017)

From 2011 to 2016, the female labor force participation in Bangladesh increased from 42% to 43.19%, and the female literacy rate accelerated from 46.74% to 69.89% (World Bank Report, 2016) indicating development in women's sectors. However, due to the lack of adequate service quality of public buses, females are opting to travel nearly 70% of all trips either by walking, rickshaw, or non-transit modes (Mahmud and Haque, 2008). Females' trip-making experiences using the existing public buses are more difficult and unpleasant (Islam et al., 2020). Moreover, women find the current bus transport services in Dhaka to be insecure and unsafe. In addition, an evaluation of the Bangladesh Road Transport Corporation buses in Dhaka

revealed that both the dignity and security of women get compromised when they have to travel on crowded buses (Olosson and Thynell, 2004). They face the dangers of harassment and gross misbehavior from the male passengers or the bus employees (driver and conductor).

The aforementioned discussion suggests that the mobility of the passengers in Dhaka city, especially women, is in dire strait due to insufficient amount of sustainable modes of transport and poor service quality of the existing modes.

1.5 Significance of the study

Despite the fact that a large percentage of passengers rely on Dhaka's public buses, relatively few research have examined their service quality from the perspective of female users. Rahman (2010) evaluated the present route, frequency, and service quality of the 'women-only' bus in Dhaka city and the reasons for not sustaining the service in the past. Khan and Chakma (2015) emphasized female passengers' dissatisfaction with their safety as well as the behavior of bus drivers and male passengers. Some prior research shows that some studies have utilized service quality perception and preferences toward women in Dhaka city to examine the quality of transportation service (Islam et al., 2020; Rouf et al., 2018), but no research based on gender has been done to emphasize the differences between men and women in their perceptions of the level of service they want. The study would help future researchers to expand knowledge on public transport services in Dhaka city and help to promote gender equality in the transportation sector. It would also assist to investigate if and how the preferences differ for the female from their male counterparts in the case of using the public bus in Dhaka. It is expected that by providing conclusive pieces of evidence on the priorities of preferences in service qualities of male and female passengers, this study would guide the policymaker and management to take an informed decision on how to improve the service quality of public buses keeping in mind the needs of the ever-increasing female trip makers. Alternative design options and design modifications to existing bus services, proposed in this study could aid policymakers, government agencies, and transport companies to come up with much-needed upgrades and policy changes for the interiors of public

buses to make them more accessible to all passengers- especially the female passengers. Lastly, it will help researchers to identify possible areas for further research, to be used as an additional reference to researchers on quality service improvement of public buses based on gender.

1.6 Organization of the thesis

This thesis is organized into five chapters. **Chapter 1** continues with a comprehensive introduction that serves as the foundation for the entire thesis. Additionally, this chapter introduces readers to the problem statements, the purpose of the research, and the precise milestones the study seeks to accomplish, which are denoted by objectives. Moreover, this chapter explains the study area, establishes research significance, and provides a framework for the organization of this thesis. **Chapter 2** conducts a complete literature analysis to establish the condition in this field of research, which will ultimately result in the identification of research needs. **Chapter 3** describes the methodology used in this study in detail. This chapter not only presents the overall methodology approach with the workflow diagram to explain how each activity conducted in this research integrates, but it also provides a brief overview of each model and the sample size required in this study. **Chapter 4** provides the data analysis and results derived from the models discussed in Chapter 3, as well as sketches out the interior redesign of an existing public bus based on the results. Finally, in **Chapter 5**, conclusions and recommendations are forwarded. This Chapter compiles the key findings of the research and addresses policy interventions that could be considered to improve the quality of public bus service through the lens of gender, as well as redesigning the interior of existing public buses. Additionally, the final chapter concludes by highlighting the study's limits and future potential.

CHAPTER 2: LITERATURE REVIEW

This chapter has outlined the issues of women's multiple positions in society and their empowerment around the world, which tends to increase their mobility as revealed by many studies. Furthermore, this chapter reviews the literature on public transport facilities in the developing country followed by women in the transportation sector and its quality of service, and finally gender-based preferential differences in service quality in public transport. The source of literature has been based on the relevant field of scientific databases of manuscripts, conference records, books, research papers, articles, dissertations, etc.

2.1 Female transport mobility

Globalization of production and the associated supply chains are the primary drivers of increased transportation demand. Enhancing the performance of the transportation system can be essential in sustaining productivity growth across a country's various sectors, which can result in regional development (Kozlak, 2017). The transport mobility for females is increasing frequently nowadays as a result of the opportunities for economic development provided by certain societal trends such as globalization, urbanization, motorization, and socio-demographic transitions in many nations (Rosenbloom and Plessis-Fraissard, 2009).

Service quality has been viewed as identifying and categorizing various quality variables, assessing passenger satisfaction with these characteristics, and assessing their relative importance. Service quality plays an important role in the transportation sector with some moderate variables and it would be beneficial to improve the service quality when feedback from passengers is received (Khurshid et al., 2012). In developing countries, women are discouraged to travel by public transport due to its lack of performance in different sectors especially the quality of service (Redman et al., 2013). This is particularly true for those countries with conservative social structures and religious traditions (Shefali, 2000). As widely documented in several works of literature, male and female preferences differ in terms of service quality perception and preferences across various sectors. This is especially

true in the transportation industry, where females have higher expectations and levels of satisfaction with service quality than men do (Arabikhan et al., 2016).

Thus, this study attempts to determine opportunities to enhance the overall bus user experience by improving service quality performance in accordance with their needs, as female transportation mobility continues to grow.

2.2 Female role in society

Gender equality is being practiced in the labor market more than ever before, which is significantly contributing to economic development and poverty reduction (ILO, 2018). As a result of the higher involvement of females than before, graduate studies experience a larger number of students in the last four decades (Taylor, 2003). Grimshaw and Rubery, (2015), believed that women greatly increase their level of human capital, like education and work experience, than before. This shows how women's willingness and ability to enter the labor market can have a big global impact. Therefore, education is essential for women because it provides them with the necessary identification for employment, increases their potential earning power, and promotes positive attitudes toward women's traditional roles in the home and the workplace (Ahituv and Lerman, 2007; Benavot, 1989; Bianchi, 2011; Carnoy, 2006; Carnoy et al., 2012; Crompton et al., 2007).

According to the World Bank Report, (2021), between 2010 and 2020, the global literacy rate of female youth aged 15 to 25 increased from 87.29% to 90.73% (Leathwood and Read, 2008). Currently, UNESCO, 2020 conducts empirical research, which tends to begin with an understanding of how the world's progress on the female education level over the last 25 years has been uneven. Since 1995, the global enrolment rate for girls has increased from 73% to 89%, with significant gains in Sub-Saharan Africa and Central and Southern Asia. Globally, 115 million women were enrolled in tertiary education in 2018, a threefold increase from 1995. In 2018, over 180 million female students were enrolled in primary and secondary education, indicating an increase in the percentage of girls participating in secondary school (58%) during the last 25 years. Similarly, women's participation in higher education has increased from 39% to 56.4% in North America over the last 40 years, from 39%

to 56.4% in Western Europe, from 34% to 51.3 % in East Asia and the Pacific, from 35% to 56.3% in Latin America and the Caribbean, from 21% to 32.8% in South and West Asia, and from 22% to 45.6% in Sub-Saharan Africa (UNESCO, 2016). As the rate of female education begins to rise, their potential earning power and labor force participation start rising, and so do changes in fertility behavior and family structure (Ahituv and Lerman, 2007; Carnoy, 2006; Gilbert, 2014; Gottard et al., 2015; Stevenson and Wolfers, 2007; Weston, Qu, and Parker, 2004). Studies discovered that highly educated women in Turkey are more motivated to participate in the labor force than their less-educated counterparts (Tansel, 2001), which is also true for women in India (Bhalla and Kaur, 2011) and Nigeria (Aromolaran, 2004). Women's participation in higher education has increased their mobility, as has the demand for public transportation.

Nowadays, the number of young women employed or seeking employment is increasing day by day as a result of their increasing literacy rate, resulting in substantial changes in the global labor market which helps to improve a country's economic growth (World Economic Forum, 2014). According to the International Labor Organization (ILO), (2018), the last two decades have seen some improvement for women in the workplace and in terms of gender equality in society. Mothers with small children (82% of single mothers with children) and 71% of married women are employed outside the home (Bureau of Labor Statistics, 2001), indicating increased female labor force participation (Bureau of Labor Statistics, 2004). Studies indicate women, in the past were less reliant on private cars over the generations and relied more on walking while carrying children, groceries, or other burdens as they traveled fewer miles than men (Bostock, 2001). However, over the last three decades, all categories of women's travel and auto mobility have seen significant increases, reflecting women's high educational growth and increased participation in paid jobs in various industries (Root et al., 2002; Islam et al., 2020).

According to the International Labor Organization (ILO), (2018), gender disparity in the labor force in developed and developing nations is almost nonexistent. In a developed country, at a paid job, women have fewer restrictions owing to social standards, and these countries have near-equal educational attainment for men and

women (ILO, 2017a). In 2018, the gender gap in the participation rate was 11.8, the smallest in developing countries, and it is predicted to remain constant throughout the 2018–21 timeframe. However, it is noted that approximately 69.3% of women in this country group are employed, which is the greatest number ever recorded (ILO, 2018). Women's economic participation is connected to their mobility and transportation needs. To maintain sustainability, public transit with better service quality is expected to meet a large portion of these needs.

A developing country like Bangladesh has a female literacy rate of 65.3% for those aged 15 and older, and 74.3 percent in urban areas, where 69.8% of working-age people inhabit (BBS, 2018). Women in Bangladesh's labor force participation increased from 9.8 million in 2003 to 16.8 million in 2013(World Bank, 2016). The number of women in the paid workforce increased from 17.2 million in 2010 to 20 million in 2017, indicating that more women are becoming economically active than before (BBS, 2017). In urban areas, more female youth (41%) are employed with paid labor ships than their male youth peers (28.8%). Furthermore, the female informal employment rate is 91.8%, which is higher than the male employment rate of 82.1% (BBS, 2018). In addition, among the total number of the female labor force in Dhaka city, the garment sector alone employs almost 70% of the city's female labor force, 60% of whom walk to work, spending roughly two hours per day traveling (Shefali, 2000).

As more women enroll in higher education and enter the labor sector, the likelihood of making more trips, traveling more miles, and relying on a car or public transportation increases. Besides females travel more frequently than males (Lee et al., 2007), both for job and non-work purposes (Michelson, 1983; Rosenbloom, 1987; Rosenbloom and Burns, 1993). Women's travel choices are influenced by their occupations and household duties (Sarmiento, 2000), and women are more likely than males to rely on public transportation (Goel et al., 2022; Hanson and Johnston, 1985; Koppelman et al., 1980; Michelson, 1983; Pickup, 1985).

As female education and labor force, participation rates continue to rise in Dhaka, female demand for public transportation increases. The aim of the study is to

analyze the service quality of public buses in Dhaka that accommodate female customers' needs.

2.5 Public transportation in a developing country

Social infrastructural development depends on transportation, one of the main components of welfare systems, which has a profound effect on every element of daily life (Odufuwa, 2012). The city's transportation system sometimes referred to as the "lifeblood" of city life, facilitates the movement of people and goods within and outside of the metropolitan region. High-capacity modes of transportation are essential for urban transit because of their cost-effective and energy-efficient features (Vuchic, 2003). Public transportation is essential to the urban population as it provides chances for city people to be involved in economic activities, facilitates family life, and contributes to the formation of social networks (Wane, 2001). This system benefits those looking for a cheap mode of transportation, increased mobility, and those who do not have access to other modes of transportation such as cars or motorcycles (Rahman and Nahrin, 2012). As most people do not own an automobile, public transportations are the most efficient and cheapest way to travel (Hoque et al., 2012). Therefore, a well-functioning transportation system is essential to the smooth operation of any city. It is especially true for Dhaka city of its rapid growth and changing land-use patterns (Haque et al., 2012).

The public transportation system offers a wide range of transit options for every citizen such as buses, subways, and light rails. The goal is to provide and increase access and reduce traffic congestion. Besides, the public transportation system is affordable and encourages geographical integration between employment opportunities and residential hubs. In addition, public transportation is much cheaper than private cars (Beirão and Cabral, 2007). It also reduces congestion as a minibus or bus can carry several people without taking much space on the road. Furthermore, it plays a crucial role in reducing oil consumption and air pollution, ensuring better land-use policies.

In developing countries, the sector of the urban transportation system has gone through significant change toward private motorization because of different political,

economic, and social reasons. In the majority of developed countries' urban regions, public transportation is provided by either public or private providers (Finn and Mulley, 2011). In urban areas, typical public transit modes include bus, trolleybus, light rail transit (LRT), metro, and regional rail, all of which operate on predetermined lines/routes according to fixed and stated schedules (Vuchic, 2003). Bus services are considered the leading mode of public transport in the city. Moreover, bus networks are the most flexible and the cheapest mode of public transportation that may accommodate a lot of access needs in a different locations throughout a metropolitan region (Rahman et al., 2017). Additionally, buses are regarded as the most cost-effective means of transportation for lightly traveled lines (Vuchic, 2002). Bus transportation plays a significant role in the movement of people in developing cities, which are experiencing rapid urbanization (Rahman et al, 2017). Despite the vital role that buses play in any metropolitan area, services are typically insufficient to fulfill demand and are often poor (Ali, 2010). Bus commuters sometimes experience insufficient service, poorly organized timetables, a lack of facilities, such as bus stops and shelters, and infrequent service, particularly during off-peak hours, compromising the convenience of these services significantly (Mashiri et al. 2010). Consequently, over the last two decades, developing countries have experienced huge population expansion (Buhaug and Urdal, 2013). As the population in developing countries rises fast, the demand for enough public transportation is growing analogous to that. If the transportation infrastructure is unable to keep up with demand, wait for times and congestion on public transportation and city streets increase (Samek Lodovici and Torchio, 2015).

In several emerging nations throughout Africa, Asia, and the Middle East, the urban passenger transport sector has shifted significantly toward private motorization for a variety of economic, political, and societal reasons (Sen, 2016). Cities in developing countries such as India, Nepal, Bangladesh, Afghanistan, Iran, Maldives and Bhutan, and Sri Lanka face severe transportation and mobility challenges these days (Jain, 2013). In these countries, the public transportation system is mostly used by common people, which is often overcrowded and unfortunately quite unsafe in some cases, such as crimes like eve-teasing, snatching, and pick-pocketing. Buses are not safe for the disabled and elderly too (Jain, 2013). Besides, in South Asia, public

transit is frequently vandalized during strikes and has a high accident rate, eve-teasing, crimes, and exclusion of the disabled (Jain, 2013). One of the primary functions of the transportation system is to provide mobility for people and meet transportation demands. However, this is not achievable in developing countries such as Bangkok, Manila, Mexico, Shanghai, etc., owing to traffic congestion (Gwilliam, 2010). Congestion develops as a result of an excess of motorized vehicles, an inadequate traffic management system, and huge population movement during work hours (Pacione, 2001).

Dhaka, Bangladesh's capital, is the epicenter of all economic, administrative, and educational activity, and is the home of almost one-third of the total population. Dhaka's transportation system is primarily road-based (Rahman and Nahrin, 2012), with a variety of transit modes - both motorized and non-motorized (Haque et al., 2012), and only little usage of rivers and trains. The transportation system of Dhaka city is mostly dependent on road-based vehicles such as cars, buses, rickshaws, CNG, motorcycles, etc. According to the strategic transportation plan, around 7100 buses are running on fixed routes in Dhaka (STP, 2005). The fleet includes 500 large buses, of which 250 are high capacity buses and the remainder are regular, 5000 minibuses, and 1600 microbuses (Olosson and Thynell, 2004). Dhaka has an estimated 240,000 motor cars, which equates to approximately 30 motor vehicles per 1000 residents. This compares to about 700 per 1000 residents in the United States (Olosson and Thynell, 2004). In research by BRTA, (2012), a limited number of public buses (about 3% of total motorized vehicles) operate on the route. As a result, the current state of passenger transport in this metropolitan city demonstrates the inability of existing bus services to meet expanding demand (Rahman et al., 2017). As the City lacks efficient transportation for the mass, it has to suffer from revolting situations every day.

Public buses are the only significant mode of public transit that is currently operating in Dhaka city. However, this is the least preferable mode of transport for the Dhaka populace because of its lack of reliability, speed, safety, and comfort (Hoque et al., 2012). The fragmented ownership of buses, the prevalence of operator companies, the poor condition of buses, a lack of maintenance, the growth of private operators, the inaccessibility of bus stops, and the lack of passenger information and

safety all contribute to the bus service being the least appealing option for city dwellers (Khan and Chowdhury, 2014). Despite having a low level of motorization, Dhaka streets are plagued with traffic congestion and a deteriorating traffic system. In addition, the public buses are poorly maintained, not technologically advanced, and don't offer much comfort and safety for the populace.

Although buses and minibuses are the cheapest transportation system in Bangladesh, they are not popular among the masses due to their poor service condition, delayed schedule, overloading, and inconvenient bus stop facility. As a result, this transportation system has lost reliability, service quality, and operational safety. Furthermore, buses often fail to maintain a timing schedule, which causes psychological and physical strains (Hoque et al., 2012). Buses in Dhaka are operated by both the government and private companies. However, private companies contribute more in this situation and they provide monopoly service (Hasan et al., 2010). Moreover, the numbers of these buses aren't adequate (Dhaka Tribune, 2018).

Additionally, regardless of which bus service is discussed, there are insufficient seats for women on every bus; only six seats in the front. In addition, these seats aren't for women only; these are also for the disabled and children. According to a government decision taken in 2008, all city buses should offer nine designated seats for women, children, and people with disabilities (Hossain, 2015). Meanwhile, minibuses are supposed to have six such seats (Hossain, 2015) but such facilities are not found.

The Public bus service of Bangladesh has an appalling reputation of being untrustworthy, derisory, congested, and slow. Moreover, this system is also unsafe, one of the main reasons behind its negative reputation (Khan and Chowdhury, 2014). There is a massive shortage present between the supply and demand of public transport. This shortfall worsens user-friendliness, service level, safety measures, comfort, and operational capability, initiating augmented expenditure, waste of time, air pollution, and psychosomatic stress, and declaring a relentless threat to the economic sustainability of Dhaka and its environment.

This study is focused to investigate the passengers' perspectives on the existing problems and identify and order the service quality preferences in the bus system of Dhaka city.

2.6 Women, transportation, and the global south

In developed and developing countries, there are a lot of significant differences that are well documented in the characteristics of trips made by females and males. As females are involved not only in outside jobs but also in family duties, women's travel patterns in all countries are significantly more complex than men's (Duchene, 2011; Cao and Chai, 2007). Women frequently need to make more outside trips with different destinations than males because of the complexity of their travel chains and two folds responsibilities. However, Polk (2001) stated that there is a significant difference between men and women in terms of travel patterns, travel perceptions, and time consumption. Men took more trips per day and went longer distances in the global south, but women used more public transit, connected more journeys, and traveled shorter distances. Because of their biological and social reproduction roles, women are more likely to be confined to the home, to have access to education, health care, and shopping facilities in urban areas, all of which have a significant impact on their travel patterns (Turner and Fouracre, 1995). Another study found that there is a difference in travel patterns between men and women (McGukin and Nakamoto, 2004) in developed and developing countries, as defined by their age, global location, socioeconomic class and culture, employment, and parenthood status (Hamilton et al., 2005, Riverson et al., 2006). Women's daily travel patterns are more complicated and varied than men's (Sarmiento, 2000), indicating that women's journeys are shorter, more frequent, and characterized by multiple trips, such as combining multiple purposes and several destinations in a single trip. Women also tend to use public transport more than men do and at different times of the day, most often off-peak (Rosenbloom, 2006). According to research conducted in Brazil (Schmink, 1982), 41% of women's travels were for health reasons, 19% were for domestic goods, and 19% were social, with these journeys usually occurring during 'off-peak' hours. The author also said in his research that women were responsible for

only one-third of all work-related journeys, although the Swedish Transport and Communication Research Board (KFB, 1995) discovered that men took the majority of work-related trips and took longer work trips than women (Gordon et al., 1989). As a result, women prioritize flexibility and cost savings over time savings when making travel plans. Due to their complex trip chain, women are more dependent on public transport for their transport needs which is not even safe for them (Duchene, 2011).

Travel behavior can be described by analyzing several characteristics that influence individual behavior, including car ownership, trip distance, mode of transport choice (e.g. private car, public transportation, or walking), and journey purpose (e.g. commuting, shopping, or pleasure) (Al-Jameel and Kamel, 2016). Additionally, sociodemographic (age, household location and composition, income, gender, and car ownership) and lifestyle characteristics may have an effect on people's travel behavior (Choocharukul et al., 2008; Curtis and Perkins, 2006). In developed countries, women are more reliant on the private car than men since they make more non-work-related trips, complicating their trip chain. Though women are increasingly licensed to drive (Rosenbloom, 2006), the perception that having a license does not equal driving contributes to a gender divide in mode choice (McGuckin et al., 2011). Several studies have shown that women's car ownership or access to a car depends on their higher incomes and better employment outcomes (Baum, 2009; Cervero et al., 2002; Rogalsky, 2009). Women's economic presence is important for gaining access to private transportation (Dobbs, 2005). According to Duchene (2011), women own or have access to fewer automobiles than men in all European countries, with males owning 70% of cars in Sweden and women owning 60% in France. Women worldwide have fewer advantages to access better transportation modes and new technologies, which is significantly worse in the global south, where women face greater transportation challenges than in the global north (Riverson et al., 2006; Rosenbloom and Plessis-Fraissard, 2009; Peters, 2013; Peters, 2001). Women in the global south are poorer than men and less likely to have access to motorized modes of transport, resulting in greater disadvantages and disparities than women in developed countries (Rosenbloom, 2009). As women's paid work is lower in the global south than in developed countries, they also lack access to more advanced

modes of transport, such as a private automobile. Comparing two frequently referenced studies from Kenya and Brazil, it is found that although 24% of Kenyan men and 23% of Brazilian men-owned private vehicles, just 9% and 6% of their female counterparts could afford to do so (Levy, 1990). Women are more often confined riders and mostly depend on public transport than men as their modal choice is less flexible (Hanson and Johnston, 1985; Rosenbloom, 1987; Buhr, 1999; Preissner and Hunecke, 2002; Hunecke, 2000; Heine et al., 2001; Nobis and Lenz, 2004). As in the Global South, women are more dependent on public transport for their lower incomes, creating fewer opportunities to access better modes of transport. In addition, women generally use less expensive modes of transport for their travel than men (Duchene, 2011). According to Venter et al. (2007), low-income women who are unable to access all modes of transport face additional difficulties when choosing a mode of transport. Understanding women's transportation requirements are essential to introducing new policies and redesigning facilities that help women access public transportation.

Men are more likely than women to travel further distances because they have more access to private automobiles, less time devoted to domestic duties, and better incomes. As a result, about two-thirds of public transport passengers in European countries like France and Sweden are made up of women (Duchene, 2011). Similarly, in Santiago de Chile, women account for 51% of public transportation users (ITF, 2019). In developing countries, transportation resources are insufficient, as seen by the massive insufficiency of public and private transportation services (Ipingbemi, 2010). According to Adetunji et al. (2013), public transit is the primary means of transport for women in Nigeria, whereas men prefer to go by private transport. In Dhaka, the majority of people rely significantly on public transportation, as a considerable portion of the population cannot afford personal vehicles due to low-income levels (Rahman and Nahrin, 2012). According to Peters et al. (2013), women in Dhaka are more reliant on public transportation or just walking for their trip purpose than males as women use less expensive modes of transport. In summary, the main difference between transport behaviors of women in developed and developing countries is that the latter is more restricted in terms of access to geographical areas,

and their mobility conditions are more penalizing although they prefer less expensive modes of travel (Duchene, 2011).

All women in developed and developing countries are concerned about their safety issues, particularly for trips on foot or by public transport (Duchene, 2011). According to the World Bank and the World Resources Institute at the recent Transforming Transportation (2018) conference, transportation is not gender-neutral; over 80% of women are victims of sexual harassment and are fearful of accessing public transportation. They are more susceptible to being victims of sex crimes such as rape and sodomy compared to men; they are also more exposed to unwanted touching and rubbing in crowded public buses (Smith, 2008). Women have also been found to suffer more from robbery and hijacking (Smith et al., 1986). In a study regarding pickpocketing (a stealth crime) victims on the New York City subway, women victims were a greater percentage than men (Smith et al., 1986). Likewise, in the US, women from low-income families living on the fringes preferred not to take long bus rides to the city alone for fears of theft and sexual assault (Anderson and Panzio, 1986). Women are also concerned about their safety at night (Sham et al., 2012), due to insufficient lighting and narrow lonely routes connecting their homes to bus stops enhance their risk of sexual harassment while walking or using public transportation (Anand and Tiwari, 2006). In France, women developed avoidance behavior in the transit environment as a result of their greater sensitivity to and fear of safety and security than males, affecting their well-being and mobility (Condon et al., 2007; Jaspard, 2011; Lieber, 2008). Women's ability to travel independently in urban areas is hampered by concerns about their personal safety and security (Krieg et al., 2009). These concerns include the possibility of sexual assault, violence, robbery, harassment, and verbal abuse (Buvinic et al., 1999). In New work city, female college students are the victim of sexual harassment in their subway shuttle while going to college or vice versa (Natarajan et al., 2016). It is found that in India women face sexual harassment on the public bus which limits their accessibility (Kartikeya et al., 2017). In Dhaka city, the female passenger has to deal with the most awful experience of sexual harassment in public transport almost every day (The Daily Star, 2015). Though women in Dhaka city are highly dependent on the public bus, around 13% of women keep away themselves from it due to the misbehavior of

the staff bus, male passengers, and sexual abuse (Khan and Chakma, 2015). Conductors standing in front of the door blocking boarding and alighting and continually touching female passengers were identified as the primary cause of sexual harassment by female passengers in Dhaka city (Rouf et al., 2018).

According to Duchene (2011), developed countries often address gender issues in comparable terms, whereas developing countries do not. This is particularly true for those countries with conservative attitudes toward social structure and religious standards. Women's accessibility demands vary significantly, as public transportation is not gender-neutral due to societal culture and religious beliefs, ineffective planning and policies, and insufficient investment (Sen, 2016). The social convention has a significant impact on women traveling, restricting their mobility (Wachs, 2009). Women in Novi Sad are less interested in traveling by passenger automobile than other means of transport due to conventional societal beliefs and low economic conditions (Republic of Serbia) (Basarić et al., 2016). In many Muslim majority cities, women have to maintain the religious and social institution of 'purdah' (privacy of women from men), a religious barrier that defines separate places for men and women (Peters, 1999; Shefali, 2000). Traveling through public transport has been inaccessible to women as they have to share the crowded buses where they are the victim of being touched by male passengers (Duchene, 2011; Peters, 1999). Though public transport is not gender-sensitive, women face a problem of traveling because of the religious dogma of the purdah, or social seclusion of women. Harassing behavior from drivers, ticket collectors, and other male passengers often hinder women from sharing a crowded bus in Dhaka (Rahman, 2010; Islam et al., 2016). Women have historically been denied access to buses, making it impossible for women to enter without being touched by other passengers. Due to this type of harassment, women prefer to go by bus in the company of police officers, personnel, and conductors (Loukaitou-Sideris, 2010).

Thus, the study will try to explore a method for ensuring equal access to public transportation for female trip makers as well as design improvement of the existing bus for more accessibility to all passengers- especially the female passengers.

2.7 Service quality and transportation

Service quality has been defined by a comparison of customer belief and perception of service (Parasuraman et al., 1988; Gronroose, 1984), and in most circumstances, it relates to how well a given service satisfies a customer's expectations (Lehtinen and Lehtinen, 1982; Parasuraman et al., 1985). Quality public transport can increase mobility by enabling people to participate in social and economic development (Govender, 2014a, 2014b), which indicates that the most comprehensive measure of the efficiency of transportation systems (Amponsh and Adams, 2016). Customer satisfaction, passenger choice, passenger demand, investment decisions, and income are all influenced by the quality of service provided by all businesses, including public transportation agencies (Anderson et al., 2013). Therefore, customer loyalty is generally considered as being built on the foundations of service quality, consumer satisfaction, and value, as these variables might influence a customer's decision to choose a certain mode of transportation (Lai and Chen, 2011).

Public transportation is an important part of solving national economy, energy, and environmental challenges, and thus contributes to enhancing the higher quality of life (Ali, 2010). Besides the growing importance of public transportation is associated with its dual role in meeting customer needs as well as economic and urban sustainability (Aidoo et al., 2013; Randheer et al., 2011; Ali, 2010). Despite the important role that public transportation plays in urban areas, its services are sometimes insufficient to fulfill demand, and even when they are, they are typically inefficient, resulting in low productivity (Ali, 2010). As a result, Moufoulaki et al. (2007) believe that transportation research should transition from purely theoretical analysis to an empirical approach to aid in the identification of practical methods for improving the quality of service.

Improving public transportation services has become a demanding issue (Wijaya, 2009). Various studies have indicated that improving public transportation service quality perceptions and satisfaction helps to retain existing customers while also attracting new users to the system (Bamberg et al., 2003; Beirao and Cabral, 2007). According to de Oa et al. (2021), it is essential to improve the knowledge of

service quality perceptions, satisfaction, and behavioral intentions toward transit to attract car users to public transportation services in an urban and metropolitan context, thereby contributing to sustainable mobility in cities. Hence, researchers and policymakers throughout the world focus on public transportation service quality and customer satisfaction as one of the most challenging issues for the transportation industry (Giannopoulos, 1989; Wijaya, 2009; Fonseca et al., 2010; Eboli and Mazzulla, 2012).

Substantial studies have found a correlation between passenger behavior and public transit quality (de Oña et al., 2015, 2016, 2020; de Oña 2020, 2021; Machado-Leon et al., 2016, 2018; Lai and Chen 2011). Lai and Chen (2011) investigated the links between passengers' behavioral intentions about public transit and several characteristics affecting service quality in Taiwan, including perceived value, contentment, and involvement. Additionally, Caro and Garcia (2007) discovered that the public transit company (Correos) had a poorer perceived service quality than some of its main competitors, including Seur, MRW, and Nacex, in a study of Spain's public transportation system. South African commuters are dissatisfied with the quality of public transport services, which suggests that public passenger transport service providers in South Africa must perform continual perception surveys in order to meet passenger needs (Govender, 2014). On the basis of 2,787 respondents in Sweden, Friman (2004) investigates the impact of increases in service quality on customer satisfaction and finds that the level of satisfaction people has when using public transportation services is influenced by quality improvements.

Service quality has been identified as one of the numerous variables influencing customer satisfaction (Hokanson, 1995), where public transit service is defined by a variety of characteristics. The Transit Capacity and Quality of Service Manual (TRB, 2003) categorizes service quality characteristics into two broad categories: availability and comfort and convenience. Service coverage, scheduling, capacity, and information are all considered availability factors; on the other hand, passenger loads, reliability, journey time, safety and security, cost, appearance, and comfort are considered comfort and convenience factors. These attributes were deemed vital by the passengers, and if they were not delivered to a suitable standard,

passengers expressed dissatisfaction (Samson and Thompson, 2007). Numerous studies have demonstrated that performance factors can vary according to geographical and socioeconomic conditions. The primary public transport service quality attributes highlighted in the Indian city of Ahmadabad are (a) cost (b) time attributes for all journey legs - access-egress, wait, and onboard travel - and (c) on-board comfort, ease of transfers, and route information availability (Sinha et al., 2020). Research conducted by the Scottish Department of Transport revealed more than 30 distinct criteria, ranging from service punctuality and reliability of the service to station cleanliness, and were deemed vital by the passengers, and if they were not delivered to a suitable standard, passengers of Scotland expressed dissatisfaction (Samson and Thompson, 2007). Additionally, Fellesson and Friman (2008) conducted a cross-national study on perceived service satisfaction with public transportation using 9,452 respondents from eight European countries. This study used factor analysis to identify four characteristics of satisfaction: system, comfort, staff, and safety, which were present in the majority, but not all, of the cities. Besides, Drea and Hanna (2000) conducted two studies on the quality of public transportation in the United States, examining comfort, cost, timing (ability to travel when and where I want), transit productivity (ability to work while traveling), as well as cost, convenience, parking availability, comfort, seat comfort, ride, seating area cleanliness, and onboard courtesy. Moreover, Al-Ayyash and Abou-Zeid (2019) investigated whether satisfaction with public transportation in Beirut was explained by only three public transportation attributes (cost, bus travel time, and shared taxi travel time) and one socioeconomic variable (number of vehicles in the family). The findings documented that, terminals and stops, vehicles, and transfer points are also major elements of an efficient public transportation system (Tyrinopoulos and Antonious, 2008).

Women nowadays are heavily reliant on public transportation as a means of transportation in Dhaka city for increasing their empowerment. As a result, enhancing the quality of public transportation services has been a rising issue in the context of gender dimension throughout the last few decades (Wijaya, 2009). Numerous studies on the quality of public bus service have been conducted in Dhaka city but have neglected the gender dimension. On the other hand, some studies have concluded that

current services of buses are characterized by long wait times and longboarding times due to overcrowding, considerable distances between bus stop locations and the homes and workplaces of passengers, and so on (Karim and Mannan, 2008; Rahman, 2010; Haque, 2000). Andaleeb et al. (2007) examined the Dhaka city bus system and discovered that the five most important attributes of bus service are comfort, the need to change buses, staff behavior, government supervision, and waiting facilities; however, the quality of the ride, co-passenger behavior, and feelings of insecurity are not significant predictors of passenger satisfaction with bus service in Dhaka. However, fares, frequency of service, waiting times, travel times, and other factors can also be considered when evaluating the quality of a bus service. Besides, Sumon (2005) evaluated travel time, waiting for time, accessibility or load factor, service reliability, and comfort to assess the quality of some selected bus services operating on two Dhaka City routes (Uttara and Motijheel). In another study on bus service in Dhaka city, Rahman and Nahrin (2012) discovered that the availability of a bus, less time traveling and waiting time, a confirmed seat, the interior environment, and the behavior of the staff are the five most important factors for female passengers. Moreover, another research evaluated that, passengers believe that the current state of the bus service is insufficient in terms of quality, reliability, safety, and security. When it comes to bus quality, many individuals believe that the bus's body and seating arrangement are uncomfortable. In terms of safety and security, passengers are dissatisfied with unsafe driving practices, poor boarding, and alighting facilities, and lack of law enforcement agency surveillance. In terms of reliability, passengers are dissatisfied with irregular bus service, regular overcrowding, poor bus standards, and lack of cleanliness (Rahman et al., 2017). In Bangladesh, service quality issues involving public buses in Dhaka are poorly addressed. As service quality in public transportation is an important component of a sustainable transportation system that takes into account passenger priorities and requirements, numerous researchers have highlighted the importance of service quality and measurement based on passengers' perceptions and preferences. However, only a few researchers have attempted to learn more about service quality from the perspective of women and the subject of service quality measurement through a gender lens remains largely undeveloped. This

research aims to examine this component as well as to focus on the interior design of public buses.

The poor service quality of public buses in Dhaka city affects passenger mobility. Researchers and policymakers are under-researching women's access to public buses and issues about service quality in Dhaka. Thus, this study will explore public bus service quality perceptions and preferences from a gender viewpoint.

2.8 Gender-based preferential differences in the use of public transport

Little emphasis has been paid to the role of gender on perceived service quality, with a few notable exceptions. Previous studies indicated that gender affected perceptions of service quality due to socialization in gender roles, decoding ability, differences in information processing, personality factors, and the relative importance put on core or peripheral services (Brody and Hall, 1993; Dittmar et al., 2004; Mattila et al., 2003). Hence, there are compelling reasons to believe that gender moderates the effects of service quality dimensions on customer satisfaction, based on existing empirical research on gender differences in consumer information processing and behavior (Sun and Qu, 2011) and supporting theories (Sharma et al., 2012). Hoyer and Macinnis (2010) stated that gender roles may be significant throughout the evaluation stage and so appear to account for a greater level of satisfaction, particularly in response to the assessment of perceived service quality.

Several types of research on gender preferential deference's across a variety of industries and sectors have been conducted recently. For instance, a study conducted in Southern Thailand to examine the relationship between municipal service quality and customer satisfaction for each gender group discovered that male respondents evaluated perceived service quality higher than female respondents. For three of the categories, namely empathy, tangibles, and reliability, there was significant gender discrimination, with male customers placing a higher priority on these factors than female customers, sending a clear message to municipal management that these distinctions must be taken into account if service providers

wish to improve customers' views of service quality (Mokhlis, 2012). Similarly, in marketing literature, previous research suggested that female customers tend to rate service quality lower when a comparison is made between genders (Snipes et al., 2004; Tan and Kek, 2004; Zeithaml et al., 2006). Lin et al. (2001) also emphasized the same result in marketing literature in Taiwan where female consumers are less satisfied with service quality than their male counterparts. In the Malaysian tourism context, it was found that the level of satisfaction difference between male and female tourists in response to perceived service quality was not equal. As a result, female visitors are more conscious of service quality than male tourists, and they seek out current technology and appealing facilities during their travels (Kwok et al., 2016). In the fast-food industry of Nigeria, the researcher tried to evaluate a significant difference between customers' expectations and perceptions of service quality in the fast-food industry of Nigeria based on gender (Oluseye, 2009). By investigating gender variations in consumer ratings of service performance, Snipes et al. (2004) discovered that male customers evaluated the fairness dimension of service quality higher for given services than female customers. Apart from the fact that women analyze information more than males, they tend to provide lower service quality ratings or report lower satisfaction. When a comparison was made between the responses of the genders regarding the quality of services in the tourism sector of Mazandaran in Iran, it was seen that women expressed lesser satisfaction than men. Men scored higher than women in the response component, indicating that men were more satisfied with the reaction to the quality of services in the health plan of Mazandaran's sea centers (Samakosh et al., 2014). Burbano et al. (2020) attempted to clarify gender preferences for meaning at work in the United States of America, stating that men and women have distinct preferences for meaning at work, which reveals itself in not just course selection, but also job industry placement. In Mauritius' banking sector, environmental quality has a greater impact on male customers' satisfaction than on female customers' contentment (Teeroovengadum, 2020). Numerous research has established gender disparities in the evaluation of service qualities. Danaher (1998) reports that women consumers place a much higher interest rate on their interactions with service staff than males do. In a study of the public service sector, Mokhlis (2012) discovered that male respondents placed more

importance on tangible variables than female respondents. Lee et al. (2011) also attempted to investigate the effect of consumers' perceptions of service quality on satisfaction, revisit intention, and the role of gender in the scenario of a high-profile golf club business in the Korean golf sector. Male golfers had some higher levels of quality perception in Tangibles (physical facilities, equipment, and appearance of employees), whereas female golfers exhibited significantly greater levels of quality perception in Empathy (Caring, individualized customer attention provided by industry). Mittal and Kamakura (2001) and Sun and Qu (2011) concluded that the physical environment component of service quality is more essential to male customers than it is to female customers.

These previous literature reviews revealed that several studies on gender-based perceptions of service quality have been conducted across industries, where the transport industry is not an exception. Without a gender lens, "neutral" transportation planning does not allow women to easily access public services, limiting their connectivity options based on their mobility needs (ITF, 2019). Also, physical differences between men and women, as well as gender differences in power and vulnerability, all have an impact on the differences in transportation use between men and women (Hamilton et al., 2005). These differences in transportation use between men and women lead to preferential differences in service quality (Hamilton et al., 2005). A few studies have examined the quality of public transportation from the perspective of gender disparity and discovered that men and women have different service expectations and their criteria of adequate vary across all aspects. Compared to women, men's expectations of transit service in Reggio Calabria, Italy, were lower, and it would be easier to improve the transit system to satisfy men's expectations than to fulfill women's expectations (Arabikhan et al., 2016). In Castilla y Leo'n, one of Spain's least densely inhabited regions, a modeling gender perception of quality in interurban bus study was carried out. The result is that significant variations between men and women emerged for some factors such as road safety, bus seat comfort, and punctuality, which women valued the most; men, on the other hand, prioritized journey duration, noise, and bus cleanliness (Rojo et. al., 2011). Besides, Gomez (2000a,b) conducts a pioneering study in Lima, Peru, evaluating gender issues concerning a bus corridor and a bicycle pilot project. In the Brazilian city of Curitiba,

a notable study examined the effect of gender on overall and attribute satisfaction, as well as the relative importance of public transportation, concluding that women are more critical of expected and provided service. As a result, the factor analysis revealed that men prioritize service performance attributes such as reliability, service frequency, and travel time, whereas women prioritize comfort attributes such as vehicle interior conditions, fleet conditions, bus stop infrastructure, safety and security, and crowding conditions (Silveira et. al., 2019). In another research, Tsami and Nathanail (2021) investigate the impact of gender on transit travelers' quality assessment by taking into account the importance and performance ratings of 26 indicators in three Greek cities. According to the findings of the study, women place a higher value than men on route and service characteristics, cleanliness, safety and security indicators, the availability of shelter and benches at stops, the ease of purchasing tickets, and the use of environmentally-friendly vehicles. Similarly, women place a higher value on the ease of purchasing a ticket (Tsami and Nathanail, 2021). In the Delhi Metro system, the study's findings indicate that males prioritize passenger convenience, whilst females prioritize service availability when it comes to explaining overall service quality. Females are less concerned with passenger convenience and seamless connectivity than males, but safety and security are the most critical factors in improving public transit services for all genders (Mandhani et. al., 2021).

However, in the context of research in Dhaka, some research has been conducted on access to public transit from a gender perspective, but the exact service quality perception and preferences of the genders are unknown. Paul-Majumder and Shefali (1997) conducted a gender study for the World Bank's Dhaka Urban Transport Project, which Shefali (2000) updates with an assessment of the needs and priorities of male and female commuters in Dhaka. Another research study by Rouf et al. (2018) examines how female bus passengers view the level of service they receive in Dhaka, Bangladesh. The findings indicate that passengers are concerned about the reliability, level of comfort, quality of service, responsiveness, and empathy of service providers, as well as the safety and security of Dhaka city's public bus services, but had fewer concerns about the fare structure and physical accessibility of buses. According to Islam et al. (2020), over 67% of female respondents were dissatisfied with their

overall trip experience in public buses in Dhaka city. Women's safety, security, and comfort are highly impacted by the boarding and alighting status (refusing female passengers to board when all the female-only seats are taken, picking up people hurriedly) and harassment issues.

The previous study reveals that some studies have used service quality perception and preferences toward women to analyze transit service quality, but no gender-based research has been done to highlight the variations between men's and women's perceptions of how many levels of service they want. According to previous research, implementing non-discriminatory company-level policies is an effective way to improve gender equality. Gender-based analysis of public bus services may therefore be a useful tool for enhancing the quality of service and maximizing resources in order to promote a more sustainable transportation system. However, this research aims to take advantage of differences in the level of satisfaction and weighted priorities with respect to service quality between men and women as well as recommend design changes to existing bus services and new design options to improve female passenger accessibility.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology and model development used in this thesis. The research has been conducted by combining a qualitative research approach and quantitative methodologies from the field of information science. First, this chapter presents the overall approach of methodology with the workflow diagram for evaluating service quality perception and preferences for public bus users and redesigning the interior of the public bus according to the contest of research, which will summarize the overall idea of the methodology. A brief description of text mining and the focus group discussion method is followed after. To measure service quality attributes a customized service quality model was introduced based on the two popular service quality models, SERVQUAL and RESCA. The main section of this chapter presents the ANP and AHP frameworks, as well as their actual procedures and applications, in order to reveal the analysis and results from the perspective of this research. Apart from presenting the overall workflow of the methodology, this chapter provides a text mining procedure followed by a customized service quality method, Analytical Network Process, and finally Analytical Hierarchy Process.

3.2 Overall approach

The study commences with conducting text mining on existing literature on the service quality of public transport and women in the transportation sector. Then it attempts to fit the major keywords identified in the text mining on established qualitative service quality models, such as SERVQUAL (Parasuraman et al., 1988) and RESCA (McKnight et al., 1986) by a focus group discussion involving both male and female participants. The service quality attributes of public buses are evaluated by the development of a customized model that combines the two models discussed previously. Dimensions are derived from this customized model that accurately represents the dimensions according to the context of the research. Also, alternatives are generated to improve services which emerge as solutions to existing problems

regarding the service quality of public buses, following ANP survey questionnaire was developed based on the outcome of the customized service quality model and focus group discussion where the survey data was collected from an equal number of male and female public bus users. Finally, the study applies the Analytic Network Process (ANP) model by using the outcome of the data collected by the survey questionnaire to separately investigate service quality preferences and priorities them based on gender.

For redesigning the interior of existing public buses, first, three focus group discussions (FGDs) (Group 1: 15 females, Group 2: 15 males, and Group 3: a combination of the same 30 females and males) were conducted based on two SQMs and intensive literature review. Additionally, a customized Service Quality Model (SQM) was developed combining two widely used service quality models for the transportation sector – SERVQUAL (Parasuraman et al., 1988) and RESCA (McKnight et al., 1986). The customized SQM consisted of 3 criteria and 18 sub-criteria to meet the research objectives. During the focus group discussions, the participants talked about the relevant existing interior features of the public buses. Besides, they proposed some alternative options as solutions for the direst problems faced by each gender under each sub-criterion to make the buses more comfortable and accessible to passengers of both genders.

In the next step, using all the attributes (criteria and sub-criteria) of the newly formulated SQM, a survey questionnaire was developed and modified into the structure of the Analytic Hierarchy Process (AHP) by using super decision software. There were 60 pairwise comparisons questions in the developed questionnaire, completed by 10 females and 10 males – all aged between 20-35 years – who are Dhaka dwellers and regular bus users. All relative priority or weights of all criteria and sub criteria are developed from the AHP model by analyzing the survey questionnaire as well as ranking them to compare the service quality preferences and priorities of the gender from the perspective of the interiors of the existing buses.

Following, a third survey questionnaire (multiple-choice questions) was developed based on the alternative options proposed during the focus group discussion. With the help of this survey questionnaire, the most selected design option

(with the highest percentage value) under each sub-criterion for each gender was obtained based on the responses received from 75 female and 75 male respondents. For each gender, the highest percentile value of the most selected option under each sub-criterion (obtained from the third survey questionnaire) was multiplied by the weight of the relevant criterion and sub-criterion (obtained from the AHP model) to determine the option's global weight and rank them for each criterion in order to compare the gender preferences. Finally, based on the perceptions and preferences of both genders, sketches of the highest priority options for the redesign of the interiors of existing buses were added as a visual representation of the findings. In other words, the proposed redesign of the interiors of existing buses to make the buses more accessible to female passengers without compromising the requirements of the male users was translated into pictorial form. The following subsections briefly elaborate on each of the major activities carried out in this research. The overall workflow of the methodology is given below in **Fig 3.1**.

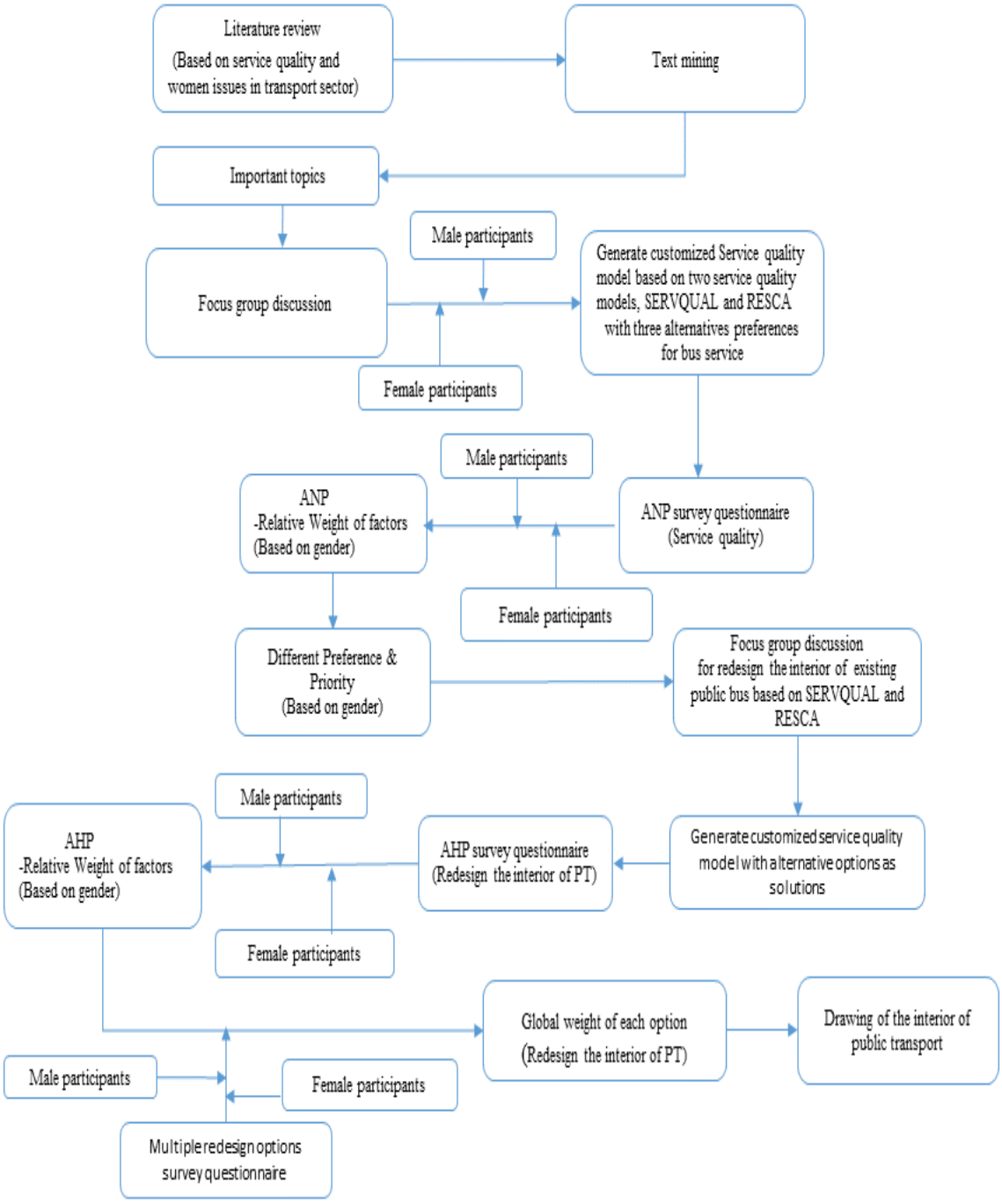


Fig 3.1: Overall workflow

3.3 Text mining

Text Mining is an important step of the knowledge discovery process (Talib et al., 2016), which refers generally to extracting interesting and significant patterns to explore knowledge from textual data sources (Fan et al., 2006). Text mining, also known as Text Data Mining (TDM) and Knowledge Discovery in Textual Database (KDT) (Feldman and Dagan, 1995), extracts hidden information from unstructured to semi-structured data by automatically extracting information from different written resources (Hearts, 1997). Extracting knowledge from the intermediate document will be different relative to what representation a document has. Document-based representation is used for clustering, categorization, and visualization, while concept-based representation is appropriate for association detection, automatic thesaurus building, and some things related to concepts (Das et al., 2016). For visualization bar plots, word cloud, and word association plots from the corpus of documents are used.

There are five basic text mining steps as mentioned: Collecting information from unstructured data, Converting this information received into structured data, Identifying the pattern from structured data, Analyzing the pattern, Extracting the valuable information, and storing it in the database.

In this study, the text mining technique is applied to turning unstructured textual data into high-level information and knowledge, dealing with the extraction of patterns, data retrieval, summarization from a large number of documents found in twenty selected papers focusing on the service quality of public transit and women's issues in the transportation sector (Odufuwa et al., 2012; Shefali, 2000; Zohir, 2003; Sicat,2007; Bachok et al., 2014; Smith, 2008; Duchene, 2011; Turner and Fouracre, 1995; Tilley and Houston, 2016; Susnienė, 2012; Román et al., 2014; Redman et al., 2013; Ojo, 2019; McKnight, 1994; Lang, 1992; Högström, 2016; Tyrinopoulos and Antoniou, 2008; Rosenbloom, 2006; Rahman, 2010; Wachs, 2010). These papers were selected based on the following criteria: Generic reviewer instructions, Rating schema, Contribution/Significance, and Relevance. This text mining method facilitates the identification of the most significant service quality attributes of public buses mentioned in these papers from the perspective of women passengers (Talib et

al., 2016). Additionally, this method can find the important and interpretable patterns of unstructured textual data and focuses on the construction of networks and interactions to discover new relationships between discovered attributes (Yogapreethi and Maheswari, 2016). Text Mining (TM) and Knowledge Discovery in Text (KDT) are two emerging research areas that aim to address the problem of information overload by combining techniques from data mining, machine learning, natural language processing (NLP), information retrieval (IR), information extraction (IE), and knowledge management. Basic Text Mining Technologies as mentioned below:

Information Retrieval

The process of information retrieval (IR) involves the extraction of relevant and associated patterns from a given set of words or phrases. The term-based method was used to indicate that a term in a document is a word with semantic meaning. Polysemy and synonymy are issues with term-based techniques (Salton and Buckley, 1988). Polysemy refers to the fact that a word can have several meanings, whereas synonymy refers to the fact that multiple words can have the same meaning. Thus, document retrieval is followed by a step of text summarization that is focused on the user's inquiry, or by a stage of information extraction (Patel and Sharma, 2014). Google and Yahoo search engines are increasingly utilizing information retrieval systems to extract relevant documents from the Web.

Information Extraction

To obtain more relevant results, the information extraction method requires in-depth and complete information on the relevant field (Steinberger, 2012). The term "Information Extraction" refers to the process of extracting useful information from enormous amounts of text. IE systems are used to extract and establish the relationships between specific attributes and entities contained inside a document (Dang and Ahmned, 2015). The extracted corpus is saved in a database and processed further. Tokenization, identification of named entities, sentence segmentation, and part-of-speech assignment are all tasks associated with information extraction. Statistical methods and neural networks are the most often used performance-based algorithms. Statistical techniques are based on whatever data are available from the text, such as word frequency and word co-occurrences. Previously it has been

demonstrated how some concepts from Data Mining can be applied to Text Mining systems (Hearst, 1999).

Consider a set of words $A = \{w_1, w_2, ..., wn\}$ and also a collection of indexed documents $T = \{t_1, t_2, ..., t_n\}$,i.e. each t_i is associated with a subset of A, denoted by $t_i(A)$.

Let $W \subseteq A$ be a set of keywords, the set of all documents *t* in *T* such that $W \subseteq t(A)$ will be called *covering set* for *W* and denoted *[W]*.

Any pair *(W,w)*, where $W \subseteq A$ is a set of keywords and $w \in A \setminus W$ will be called association rule, and denoted by $R : (W \Rightarrow w)$.

Given an association rule $R : (W \Rightarrow w)$:

$\mathbf{S}(R,T) = |[W \cup \{w\}]|$, is called the **support** of R with respect to collection T. ($|X|$ denotes size of *X*)

$\mathbf{C}(R,T) = \frac{|[W \cup \{w\}]|}{\{w\}}$, is called the **confidence** of R, with respect to collection T.

By $\mathbf{C}(R,T)$ we mean the probability of a text to be indexed by keyword *w* if it is already indexed by keyword set *W.*

Natural Language Processing

NLP performs a variety of analyses, including Named Entity Recognition (NER) for abbreviation and synonym extraction to determine their associations (Laxman and Sujatha, 2013). Co-referencing techniques and NER are often used in NLP to extract synonyms and abbreviations from textual data. However, this technique lacks a complete dictionary list for all named entities required for identification (Henriksson, et. al., 2014; Laxman and Sujatha, 2013). To obtain satisfactory results, complex query-based algorithms must be applied. In this study, the original text from published research papers has been assumed to be written in proper English grammar, so using a dictionary corpus would be a great way to find out about the topic**.**

Summarization

Text Summarization is the way of eliminating a document's length and content while keeping its most significant elements and overall meaning. It is the automated process of generating a compacted version of a given text that contains helpful information for the user (Mukhedkar, et. al., 2016). Pre- processing, and processing operations are conducted to prepare the raw text for summarization. Pre-processing techniques like tokenization, stop word removal, and stems are used. Lexicon lists (Named Entities, Terminology, Time Expressions) are formed during the text summarizing processing stage.

Text mining was performed by Python language. In the first step of the text mining process, title, abstract, problem statement, objectives, study area, variables, methodology, key findings, and limitations are extracted from each of the twenty research papers and listed in an excel file to form a single unstructured data from a large group of textual sources. To prepare the final corpus, the abstract followed by key findings, methodology, objective, and problem statement data is taken into an in-memory database where irrelevant words are screened out and the topic was associated with terms. Finally, a summarization technique was done with the topic and its occurrence which was exported as a word cloud for the five distinct sections. In the word cloud, the large font size of words indicates that the words appear more frequently in the source texts, whereas words with small font sizes indicate the lower frequency of a topic’s appearance. Also, the size of the words indicates their relative importance in the literature. To identify stop words, the "nltk" library of Python was used for natural language processing (NLP). An English dictionary-aware corpus from the "nltk" library was used for topic identification. The topic cloud was exported as an image format using the "Word Cloud" package.

3.4 Customized SQA model and FGD for evaluating service quality of public bus

SERVQUAL (Parasuraman et al., 1988) and RESCA (McKnight et al., 1986) are two of the most widely used models to measure service quality and passenger satisfaction in the transportation sector. They are used in this study to evaluate service quality perception and preference of public bus users in Dhaka city based on gender. The SERVQUAL model consists of five distinct dimensions (Parasuraman et al., 1988):

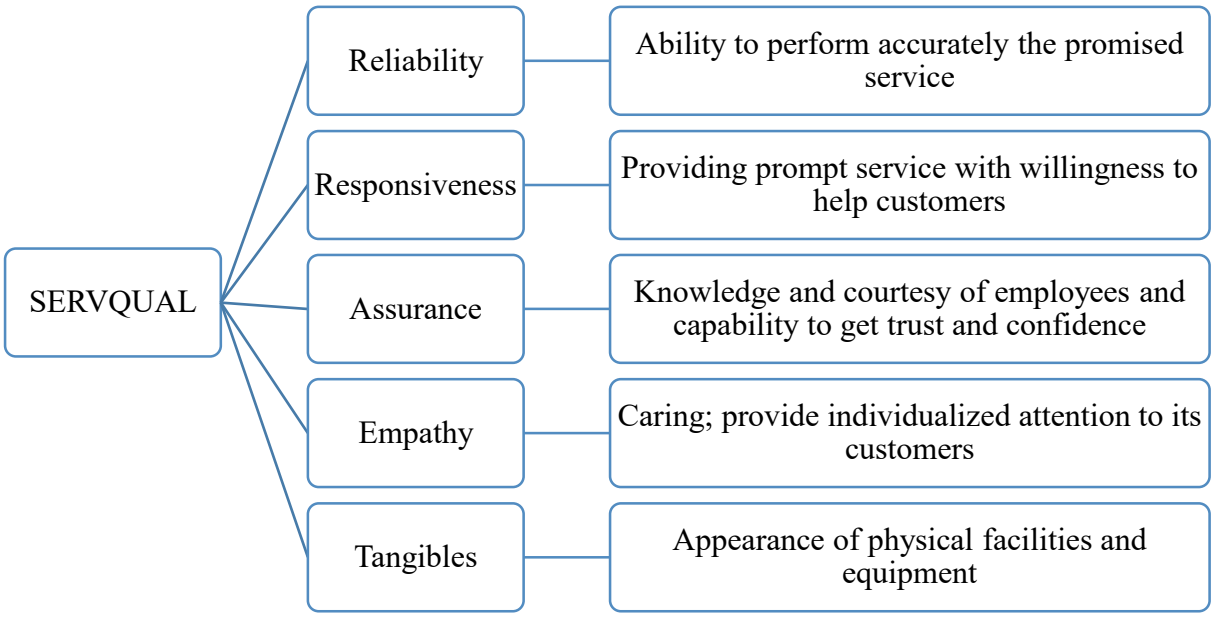


Fig 3.2: SERVQUAL model (Source: Parasuraman et al., 1988)

Similarly, the RESCA model also has five dimensions (McKnight et al., 1986):

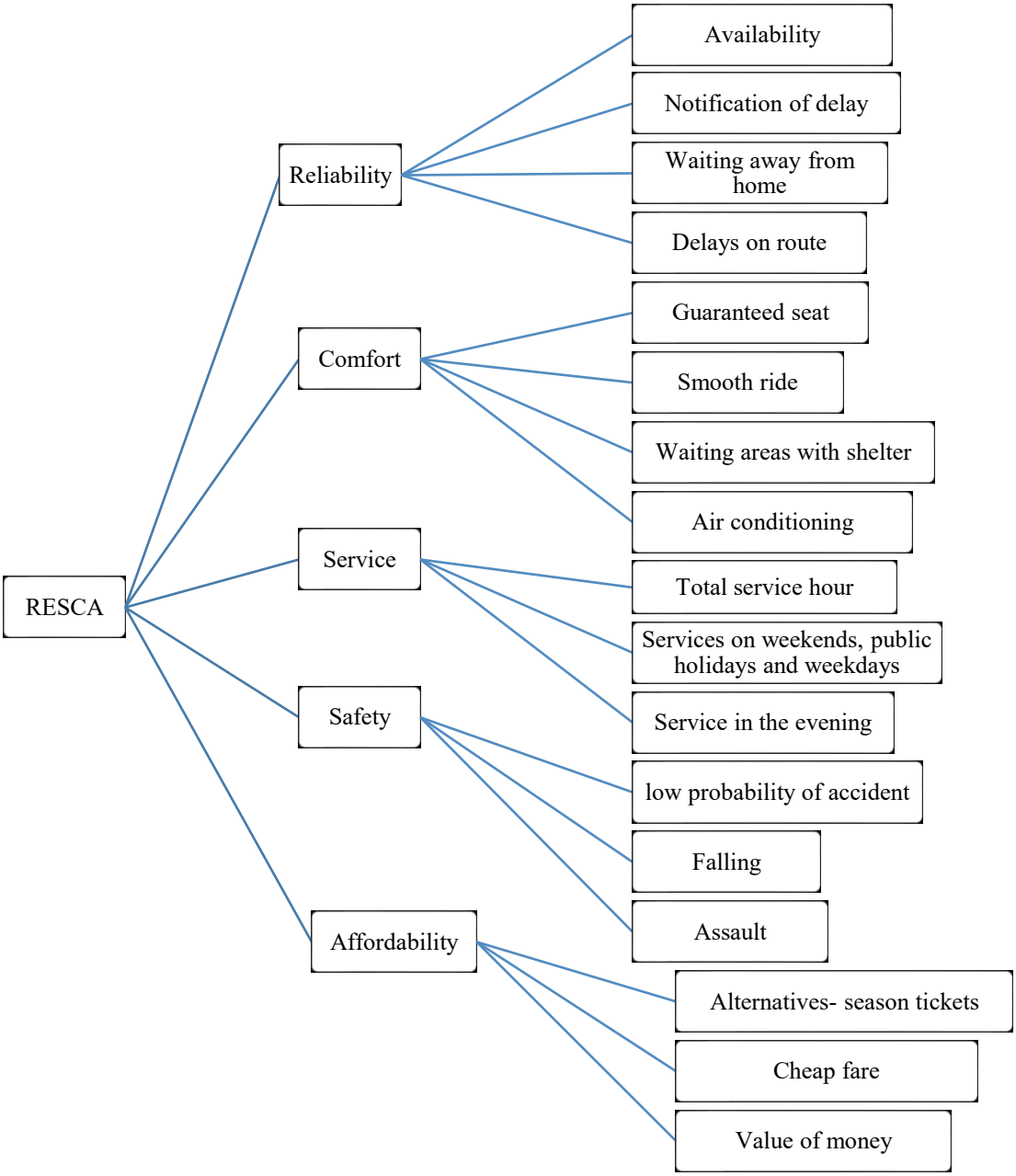


Fig 3.3: RESCA model (Source: McKnight et al., 1986)

Consequently, two focus group discussions were conducted involving 50 young individuals aged between 20 and 40 years old - 25 males and 25 females (15 university students and 10 jobholders) - based on the outcome of the text mining and service quality analysis model. The outcomes of the FGDs were then evaluated to identify the efficacy of SERVQUAL and RESCA to individually assess the perceptions of public bus users in Dhaka city and their preferences. It was found that

a customized service quality model developed by combining the two SQMs could better evaluate their efficacy in representing the service quality of public buses in Dhaka city. The snowball sampling method (Hossain, 2017) was applied to choose the participants for the FGD. Snowball sampling is also known as chain-referral sampling is a sampling technique in which an initially selected research participant recruit's other participants in their network for a test or study. The selection and participation steps are asked to be repeated by the next participants until the expected sample size is reached. Accordingly, in this study, a young university-going female student (well known by one of the authors and a regular user of the public bus service in Dhaka city) was selected and briefed about the study and the information required for the interview. At the same time, she was asked to tag some of her female friends so that they could also express their perceptions and preferences about public buses in Dhaka city. Next, they were requested to attend a focus group discussion (FGD) based on the service quality models, SERVQUAL and RESCA, and the outcome of text mining to develop a customized service quality model for public buses. Likewise, the same strategy was applied to choosing respondents from different jobs or service sectors. It is to be mentioned here that all the participants in the FGDs attended willingly without receiving any payment in return.

The selected age range was of particular interest for this study since females of this age range represent women empowerment, making an increasingly higher number of trips due to their increased opportunities and participation in the labor and educational sectors (Shefali, 2000). Another reason is that young females are also often the victims of safety, security, and verbal and sexual harassment issues while traveling compared to older females (Shefali, 2000). Moreover, since university students and job holders, in general, are expected to make frequent bus trips, they were selected to easily capture a wide range of regular bus trip experiences. No distinction between the purpose of the trip or the occupation of participants was included for data analysis. Besides, males of the same age range and equal sample size were selected to identify if there existed any gender-based differences in their preferences or priorities compared to females. From the outcome of each focus group discussion, a customized service quality assessment (SQA) model is developed by grouping seventeen different service quality and passenger satisfaction attributes

under five dimensions. Besides, during the interview, as part of a solution to the problems that are specific to female road users, the respondents discussed three alternatives to improve bus services to make the buses more accessible to female passengers.

3.5 ANP model development for evaluating service quality of public bus

To compare the gender-based preferences and priorities a decision-making model, the Analytic Network Process (ANP), has been applied. A survey questionnaire is designed based on the aforementioned three alternatives and the customized SQA model's dimensions and attributes, which can be used as an analysis tool in those problems where there are interactions and dependencies among the elements of the system (Saaty, 1999). It is used as it allows two-way communication among its elements (criteria/sub-criteria). Analytic Network Process (ANP) is a relatively new MCDM method (Saaty, 2008) that can deal with all kinds of dependences systematically. Multi-criteria decision-making (MCDM) methods are noted to be especially helpful when making complex decisions that require consideration of all different aspects that affect the decision. ANP is a relatively new but popular MCDM method that can systematically deal with all kinds of dependencies. While other MCDM methods cannot deal with the interdependence among too many elements in multi-variable systems, ANP employs pairwise comparison for determining the weights of a large number of elements. ANP is noted to be especially helpful when making complex decisions. The resulting priorities enable one to take the necessary actions and make investments in resources. In the ANP model, most assessments are evaluated in terms of what is important and what is observed as preferred in making a decision. The feedback structure resembles a network of influences connected with the elements and clusters, enabling them to determine what must be done to reach the goal (Saaty, 1999). Therefore, based on these advantages, the ANP is used for modeling and making comparisons in this research. The dimensions obtained from the proposed service quality model are used as criteria, and the attributes related to the dimensions are used as sub-criteria. These

criteria, sub-criteria, and alternatives have generated the clusters (a group of attributes under each dimension) of the system to build a network model structured around connections between the elements of clusters, and thus the ANP model was developed. In this research, the model is made up of six clusters. From these six clusters, the five groups of clusters were the major criteria which include: "Reliability" (Subciteria: "Availability", "No start-up delays", "Few delays while on the vehicle"), "Affordability" (Subciteria: "Cheap fare", "Occasional fare change", "No extra fare"), "Comfort" (Subcriteria: "Available seat", "Smooth & comfortable ride", "Air condition and good ventilation", “Proper cleanliness”), "Safety and security" (Subciteria: "No stealing", "No sexual harassment", "Less crash probability", "No probability of injury or falling when passengers have to board and alight from bus"), and "Responsiveness and empathy" (Subciteria: "Pleasant behavior of bus employee", "Willingness of bus employee to help", "Need procedures to follow-up on complaints"). The final one is the alternatives cluster which includes three alternatives options ("Separate buses for male and female", "Accommodate both genders on the same buses", "Redesign the interior of buses for more accessible to female passengers"). Two types of connections are evident in the model: the one-directional arrow represents one-way dependency and the bi-directional arrow represents a two-way dependency among the elements. The connection of an Analytic Network Model is shown in **Fig 3.4** where C_1, C_2, C_3, C_4 indicates clusters and “0” indicates elements.

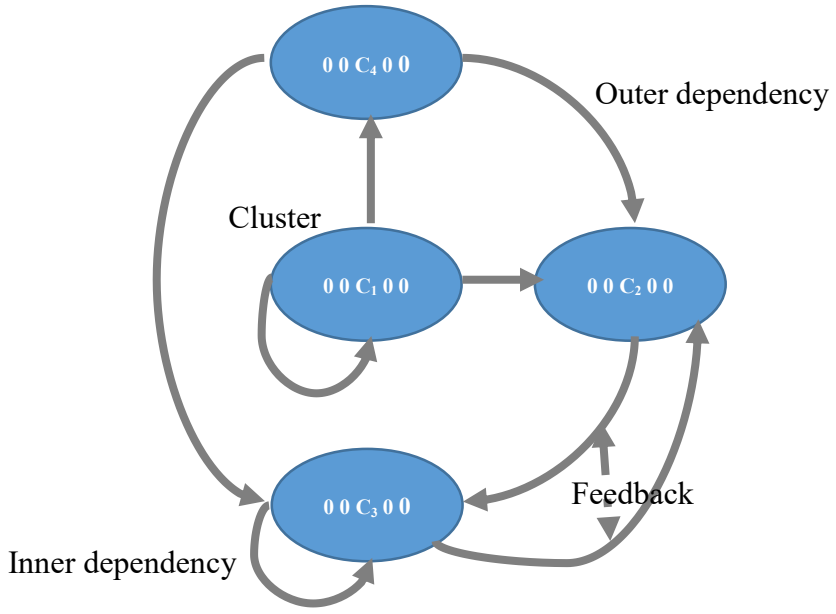


Fig 3.4: Analytic Network Model (Reproduced from the source: Saaty, 1999)

ANP involves a sequence of steps along the lines to build a network model, outlined in **Fig 3.5**.

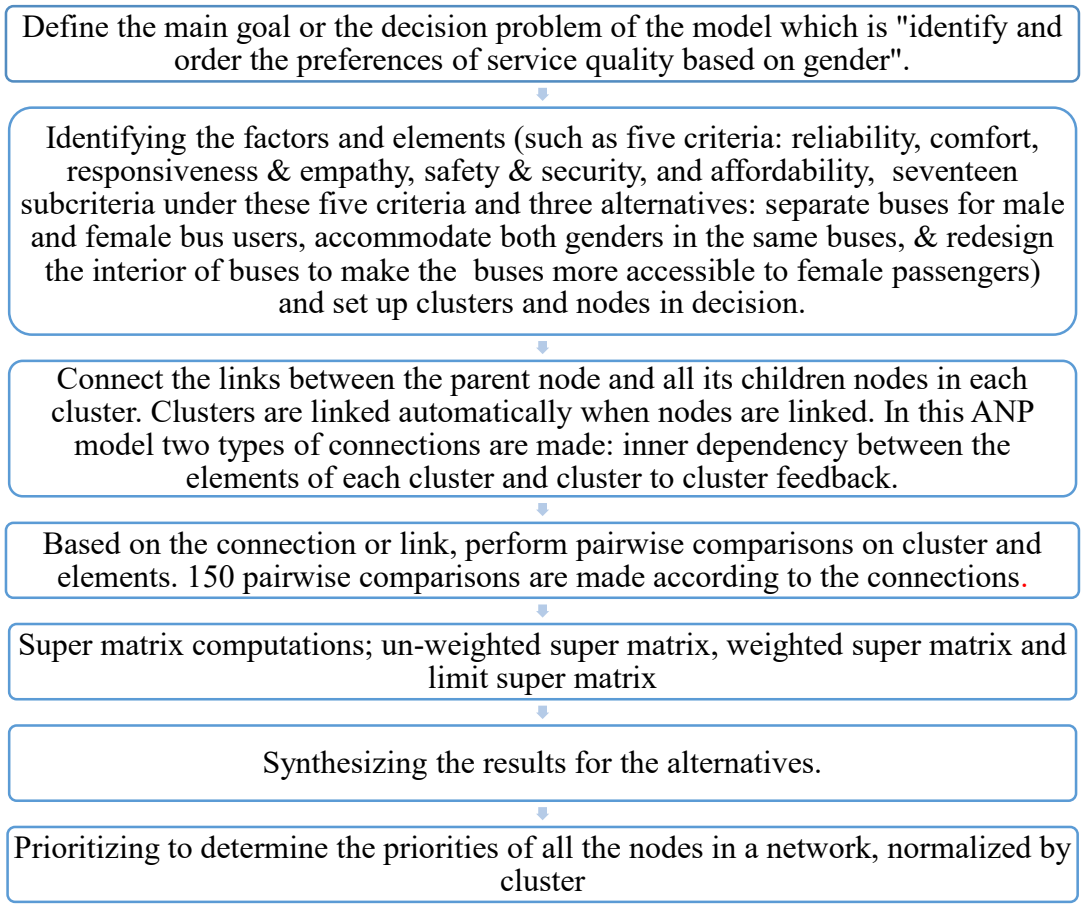


Fig 3.5: Steps followed in the Analytic Network Process (Source: Adapted from Saaty, 2008)

The ANP model itself was developed in four steps.

Step 1: Model construction and build a network

This step involves building the structure of the decision-making process. In the first step, the structure of the decision-making process was developed by defining the main objective or goal of the decision-making problem and identifying groups (clusters) constituted by various elements (nodes) that influence the decision and the options (alternatives) to choose from. Elements or nodes belonging to the respective clusters also need to be identified for making the model. In this research, six clusters and nineteen nodes in their corresponding clusters were built. The structure which was more suitable in the decisional context was selected, and then the relationships between the different elements of the network were identified. All the elements in the

network could be related in different ways since the network could incorporate feedback and complex interrelationships within and between clusters, thus providing more accurate modeling of complex settings.

Step 2: Pairwise comparison among elements and determination of local priority

The second step involved pairwise comparisons to establish the relative importance of the different elements concerning a certain component of the network. In this step, the relative importance of each criterion concerning the others is carried out. Comparative or relative judgments were made on pairs of elements to ensure accuracy. Pairwise comparisons are fundamental building blocks of the ANP. In the ANP model, pairwise comparisons are performed after setting up the network model and the relations between the elements- criteria, sub-criteria, and alternatives. A survey questionnaire was developed according to the connections between clusters and nodes by using the ANP comparison scale and discovering how many times an element dominates another element (Saaty, 2001). ANP employs a ratio scale with values from 1 to 9 to rate the relative preferences for two items which is a well-established numbering method (Saaty, 2001). The valuation scales in the pairwise comparisons are as follows in **Table 3.1**. In other words, the two items are kept equally separated by [9 – 7 – 5 – 3 – 1 – 3 – 5 – 7 – 9]. Hence, a value of 1 on this scale is reserved for the case where the two items are judged to be equally preferred.

Table 3.1 Saatys ratio scale for pairwise comparison (Saaty, 2004)

Intensity of importance	**Definition**	**Explanation**
1	Equal importance	Two items contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience suggests that one be slightly favored over the other
4	Moderate plus	
5	Strong importance	Experience suggests that one be strongly favored over the other
6	Strong plus	
7	Very strong importance	Item strongly favored and its dominance demonstrated in practice
8	Very, very strong	
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If activity i has one of the above nonzero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i	A reasonable assumption

It is important to highlight that there are two levels of pairwise comparisons in the ANP: the cluster level which is more strategic and the more specialized node level. In cluster comparisons, a cluster is involved to compare one another. While there is a paired comparison at the node level, two stages of comparisons occur. When the comparisons are carried out by the elements in their cluster is called inner dependency. Besides, paired comparisons on the elements within the clusters

themselves are performed according to their influence on each element in another cluster, they are connected to, which is called outer dependency. Aside from these levels, alternative comparisons are carried out whereby all the alternatives are compared to each of the elements within components. In this research, according to the connection of the ANP model four levels of comparisons occur, which are given below,

a. Comparison between Cluster to cluster
b. Comparison between nodes or elements under each control criterion (inner dependency)
c. Comparison between alternatives under each node or elements
d. Comparison between nodes or elements of each cluster under each alternative (backward connection)

Finally, the pairwise comparison is completed by the ratio scale. The priority weight vector is computed by calculating the eigenvector. For calculating the eigenvector, firstly the fraction is converted into decimal value and then square by the matrix. After that, each row's total is summed and finally normalized by dividing the row sum by the row totals. This value represents the local priorities of each element. A consistency ratio of less than or equal to 0.10 or 10% is acceptable. If CR is greater than 10%, the pairwise comparisons need to be revised. A measure of consistency is then calculated using **equations (3.1)** and **(3.2)** respectively to capture uncertainty in judgments:

$$CI = \frac{\lambda \max - \mathrm{n}}{n - 1} \qquad (3.1)$$

$$CR = \frac{CI}{RI} \qquad (3.2)$$

where CI and CR are Consistency Index and Consistency Ratio, respectively, λmax is the largest priority of the pairwise comparison matrix and n is the number of classes. RI is the Ratio Index. The value of RI for different n is given in **Table 3.2**.

Table 3.2 Ratio Index for different values of n (Saaty, 2008)

Order (n)	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

Step 3: Supermatrix formation

After the weights or priorities have been initiated from the pairwise comparison matrix, the next step contains the progressive formation of three supermatrixes: the unweighted supermatrix, the weighted supermatrix, and the limit supermatrix. The results of all the pairwise comparisons were entered in the unweighted supermatrix.

The unweighted supermatrix contains the local priorities derived from the pairwise comparison throughout the network. Once all the pairwise comparison matrices (weights obtained from the reciprocal matrixes) were filled in, the totality of the related priority vectors at the node level formed the un-weighted supermatrix. The unweighted supermatrix contained all the network clusters and nodes, which represented its interrelationships and was based on the flow of effect from one element to another or from a cluster to itself as in the loop. The column for a node contained the priorities of all the nodes that were compared pairwise with respect to it and influence with respect to the control criterion. A two-dimensional matrix of elements by elements is formed, which builds the supermatrix by organizing all the values from the pairwise comparisons in appropriate columns. Each element is represented in one row and one respective column according to the connection of the network. The computed eigenvector of the sub-element with respect to the parent element is placed in the column representing the parent element and the rows representing the sub-elements. A general structure of the supermatrix is given in **Fig 3.6**.

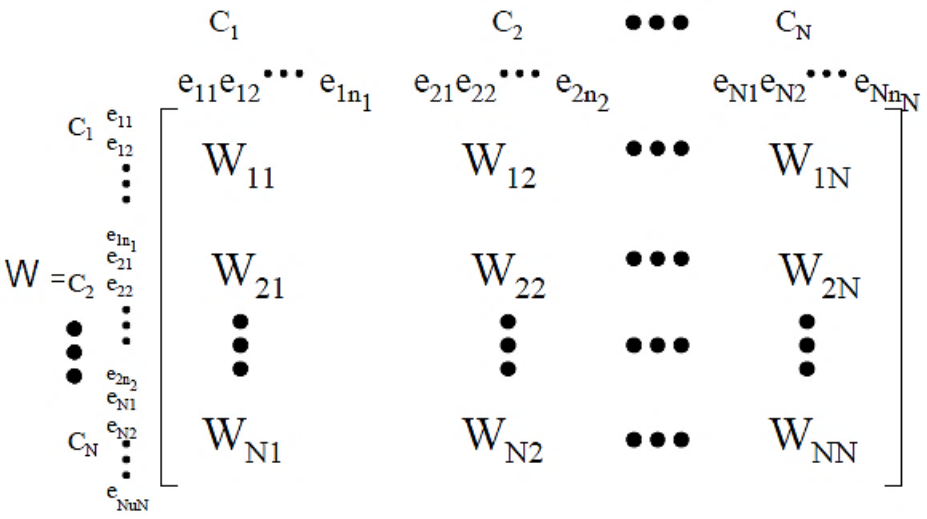


Fig 3.6: General structure of a supermatrix (Source: Saaty, 2008)

From the general structure of supermatrix, the component C_1 represents the "parent" node in the C_1 cluster where C_2….. C_n indicates the parent node of their respective clusters. The supermatrix represents the influence priority of an element (which represents by "e") on the left of the matrix on an element at the top of the matrix for a particular control criterion. The value of W depends on the linkage of component C and elements e. For example, if there is no linkage between components C_1 and C_2, then W_{12} would be zero. However, if there is some relationship, then the entry would be non-zero. So the column of a supermatrix is either a normalized priority with possibly some zero entries or all of its block entries are zero depending upon the linkage or connection in the network model. This supermatrix is not weighted and is called the unweighted supermatrix, which may not be stochastic. In general, the supermatrix is rarely stochastic because, in each column, it consists of more than one eigenvector which each sums to one, and hence the entire column of the matrix may sum to an integer greater than one.

By multiplying all the elements of the unweighted supermatrix by the corresponding cluster weight or cluster matrix, the unweighted supermatrix was transformed by the matrix of cluster priorities into a column stochastic matrix (columns added to one) called the weighted supermatrix. Each column was normalized so that the entries sum to 1 to ensure the matrix is column stochastic. For generating the cluster matrix, each cluster in turn (as the parent) was taken and all the

clusters it connects to for importance for their influence on it were pairwise compared. Concerning the goal, the priorities are generated from the cluster level comparison.

The limit supermatrix is then obtained by raising the weighted supermatrix to limit power such as **equation 3.3**, by multiplying it times itself. When the column of numbers was the same for every column, the limit matrix was reached, and the matrix multiplication process was halted. Unweighted supermatrix converges into a limit supermatrix which contains all columns equal. The values in the limit matrix are the final priorities of the decision-making problem.

$$\lim_{k\to\infty} W^k \tag{3.3}$$

Where, W = weighted supermatrix and k = the number of successive powers through which the weighted supermatrix is raised. The limit matrix provides the relative importance weights for every element in the model. For ANP, the unweighted supermatrix weighted supermatrix, and limit matrix was calculated by the Super Decisions software.

Step 4: Determining final priorities

In the last step, the final values (weights) of the elements were determined by their prioritization with respect to the structure of the whole system. The final priority weights which account for component (element) interactions could be extracted from the limiting matrix and could be read from any column since they were all the same. The normalized value can be obtained from the limiting matrix by normalizing each element of the respective cluster. Finally, the alternatives for the network are prioritized.

The survey questionnaire was built by pairwise comparisons where Saaty's fundamental ratio scale of 1–9 was used to compare any two elements where the scale had its relative importance. The developed questionnaire which had 150 pairwise comparison questions was used to collect responses from 200 young public bus users, equally distributed between males and females. The data collection was done between June and July of 2017. Each respondent took on average half an hour to complete the questionnaire. All the respondents were either university-going students or service holders aged between 20 to 40 years. The survey respondents were selected by a

choice-based sampling technique where the number in the sample selecting each alternative is predetermined, i.e., the sample is based on the outcome of a behavioral choice process. The respondents were selected randomly from different universities and offices within Dhaka city. As the questionnaire is significantly different from the normal questionnaire, samples were informed and guided each time.

Although the occupational status of the respondents could be an important explanatory variable, it was not considered for the analysis in this study as it would have further increased the complexity of the ANP based survey questionnaire. However, its main drawback, particularly in the practical application of ANP, is a large number of comparisons that need to be done based on the network connection with the feedback structure. A greater number of comparisons is exacerbated by the number of evaluation criteria, sub-criteria, and alternatives. Due to this, the sample size is usually kept at 20 to 30. In this study, 150 pairwise comparison matrices were obtained for the whole model which required respondents to put intensive effort and time into filling up the questionnaire. As a result, the sample size for this study was restricted to 200. The 200 collected responses were analyzed separately to compare gender-based priorities and preferences.

3.6 Customized SQA model and FGD for the redesign of public bus

To redesign the interior of the public bus, a customized service quality model was developed from two widely used service quality models (SERVQUAL & RESCA) to evaluate the perceptions of public bus users in Dhaka city and their preferences for the interiors of the public bus users. Three FGDs were administrated by a semi-structured open-ended discussion involving questions generated around SERVQUAL and RESCA models. The customization was achieved through intensive literature review and interviewing young public bus users using a snowball sampling method (Hossain, 2017).

At first 15 females, followed by 15 males, and finally, a combination of all of them (selected by choice-based sampling method) participated in the FGDs and

expressed their perceptions and preferences. The discussion was guided by the authors which were governed by the customized SQM and related literature review. All participants were public bus commuters and college/university-going students aged between 20 and 35. The students were from both undergraduate and graduate schools, i.e., some of them were job holders as well. Additionally, during the interviews, as part of a solution to the interior design problems specific to female passengers, the respondents proposed alternative options for the redesign of the interior of existing buses to make them more accessible to female passengers. It is relevant to mention here that, a professional artist produced illustrations of the preferred alternatives to existing interior facilities of public buses as guided by the participants. This incorporated two-fold benefits – a) the discussions became more engaging, and b) the authors could be sure that they comprehended the alternative preferences accurately.

3.7 AHP model development for the redesign of public bus

Analytic Hierarchy Process (AHP) was applied to develop the survey questionnaire to compare the gender-based preferences and priorities for the criteria and sub-criteria of the customized SQM for redesigning the interior of the public bus. AHP is an effective tool to deal with complex decision-making related to defined priorities. ANP is built on AHP and is also an extension of AHP, a theory of measurement in which pairwise comparison questions are developed and priority scales are derived based on the judgment of experts. Using a scale of absolute judgment, comparisons are made based on how much an element dominates over another element for a given attribute (Saaty, 2008). For making a decision or evaluating a problem this method adopts a hierarchical structure where AHP assumes independence between the elements of the same level and between different levels (upper levels from lower levels), while the ANP assumes interdependence of the elements and decision criteria.

In this case, hierarchy indicates a relationship between elements of one level with those of the level immediately below (**Fig 3.7**). This relationship continues down to the lowest levels of the hierarchy resulting indirectly or indirectly connected elements. Due to the advantage of developing such connections, AHP was used for modeling and making comparisons in this research. The AHP model was developed by dividing the criteria and sub-criteria (derived from the customized SQM) into clusters to build a hierarchy model structured around the connections between the elements of a cluster.

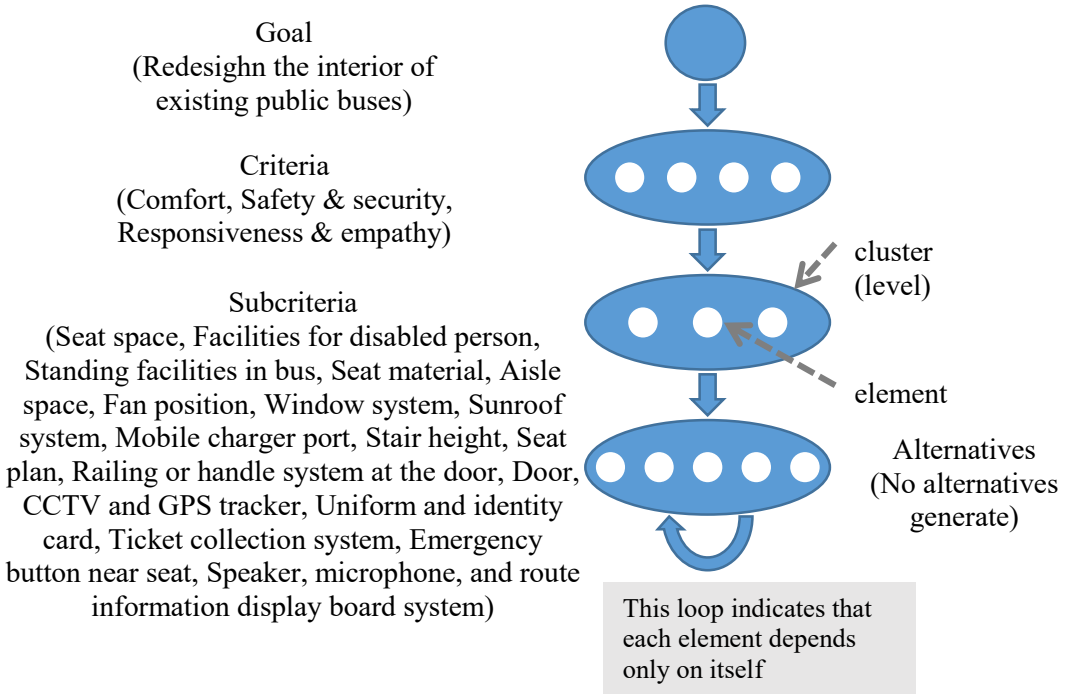


Fig 3.7: Analytic Hierarchy Model (Reproduced from the source: Saaty, 1999)

For deciding by AHP, to build a hierarchy model, the following steps are needed

a. Define the problem or the main goal of the decision.
b. For making the structure of hierarchy, the goal of the decision should be at the top, then the intermediate level, the objectives from a broad perspective (Criteria and sub-criteria on which elements depend). The alternatives are usually set at the lowest level.
c. A set of pairwise comparison matrices is built by making a comparison between the elements. Each element in an upper level is used to compare the elements in the level immediately below it.

d. To weight, the priorities in the level immediately below, use the priorities found from the comparison and make sure it is for every element including consistency checking. Then for each element in the level below add its weighted values and obtain its overall or global priority. For getting the final priorities of the alternatives to continue this process of weighing and adding. Also, provide a priority ranking of all alternatives in terms of their overall preference.

The construction of the dominance hierarchy in which an item at the topmost level dominates the items at the next lower level and so on (up to the lowermost level). As a result, at the topmost level of the developed hierarchy is the main objective (redesign of the interiors of the existing public buses), which is followed by the next lower level comprising the three sets of criteria and the lowest level containing a distribution of the 18 sub-criteria. For an example, for evaluating the goal "redesign the interior of existing public buses", what should be the relative importance of consideration of criteria "comfort" over "safety and security" and "responsiveness and empathy"? Also, in terms of "comfort" criteria, how important should the subcriteria "seat space" be compared to "seat material", "aisle space", "facilities for disable", "standing facilities", "fan position", "window system", "sunroof system" and "mobile charger port"? It means criteria are compared with each other concerning the objective; sub-criteria are compared with each other concerning the criteria in the level directly above. Due to the outcome of the focus group discussion, it is evaluated that, no alternative has been shown in the AHP model. This top to down approach is a key element in the application of the AHP model. If there are n elements that are compared, the comparison results create matrix form A = a_{ij} with dimension n x n, where i, j means number of elements.

$$A = (a_{ij}) = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} \qquad (3.4)$$

a) aij > 0 for i, j = 1, . . . , n, and
b) aji = 1/ aij for i, j = 1, . . . , n.

The importance of element i in comparison to element j is represented by the entry in the i^{th} row and j^{th} column of matrix A. For example, $a_{12} = 6$ indicates that the first element is six times more important than the second element. Pairwise comparison matrix can be described in the following way where element $a_{i,j}$ of the matrix is the measure of preference of the item in row *i* when compared to the item in column *j*. AHP assigns 1 to all elements on the diagonal of the pairwise comparison matrix. AHP obtains the preference rating of $a_{j,i}$ by computing the reciprocal (inverse) of $a_{i,j}$ (the transpose position). matrix A that satisfies condition (a) is defined to be a positive matrix. If A satisfies condition (b), then it is said to be a reciprocal matrix. The elements of the matrix or ratio between compared criteria are expressed by the formula. Let w_i be the (unknown for the time being) weight of objective i:

$$a_{ij} = \frac{w_i}{w_j} \tag{3.5}$$

The pairwise comparison matrix A of a consistent decision-maker has the following form

$$A = \begin{bmatrix} 1 & \frac{w_1}{w_2} & \dots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & 1 & \dots & \frac{w_2}{w_n} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \dots & 1 \end{bmatrix} \tag{3.6}$$

Pairwise comparisons of all the attributes were performed using the AHP model in which hierarchy and the relations between all the elements (criteria and sub-criteria) were already defined. Following, a survey questionnaire was prepared using the resulting cluster-node connections and the AHP comparison scale that helped to identify how many times a given element dominates over another given element concerning a component of the defined hierarchy structure (Saaty, 2001). Like ANP, in this scale, values 1 to 9 were used to quantify a participant's relative preference for a pair of items which is given in **Table 3.1**. Once the matrix of pairwise comparisons has been developed according to the hierarchy model, the priority of each of the

elements, such as the priority of each subcriterion on a specific criterion; priority of each criterion on the overall goal, priority of each alternative on specific subcriterion being compared can be calculated by weight vector W. The procedure to estimate the relative priority vector W for each element is referred to as a synthesization that involves the computation of eigenvectors, which can solve by a different procedure. As mentioned before, the eigenvector can be solved by the procedure which is briefly described in ANP. Besides, the following three-step procedure provides a good approximation of the synthesized priorities (Saaty and Vargas, 2001).

- **Step 1:** Sum the values in each column of the pairwise comparison matrix.
- **Step 2:** Divide each element in the pairwise matrix by its column total. The resulting matrix is referred to as the normalized pairwise comparison matrix B= [b_{ij}]. The elements of the matrix B are calculated as:

$$b_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \qquad (3.7)$$

- **Step 3:** Compute the average of the elements in each row of the normalized matrix. These averages provide an estimate of the relative priorities of the elements being compared. The result is usually represented as the (relative) priority vector of the criteria and subcriteria.

$$W_i = \frac{\sum_{j=1}^{n} b_{ij}}{n} \qquad (3.8)$$

For the development of alternative priority ranking, each alternative with respect to its criteria and subcriteria is multiplied and summarized for getting final priority. It can be described as the sum of the product of the criterion and subcriterion priority (with respect to the overall goal) times the priority of the decision alternative with respect to that criterion and subcriterion. For i th objective, the AHP generates a weight wi, and for i th objective and the k th alternative, the AHP obtains a weight s_{ik} of the k th alternative on i th objective. The total weight of the k th alternative is then computed by the following formula:

$$\sum_{i=1}^{n} w_i \, s_{ik} \qquad (3.9)$$

After the total weight of all alternatives has been calculated, the decision-maker should choose the alternative that has the highest total score. As mentioned earlier in this research, no alternative was introduced, this step is not required for calculation. In this research, all the relative priority or weights of the elements (criteria and subcriteria) are generated by the computation of the eigenvector which is the outcome of AHP.

According to saaty, 1987, there is an infinite number of ways to derive the vector of priorities from the matrix (a_{ij}). But the emphasis on consistency leads to an eigenvalue formulation. For consistency of the Comparison Matrix, if a_{ij} represents the importance of alternative i over alternative j and a_{jk} represents the importance of alternative j over alternative k then a_{ik}, the importance of alternative i over alternative k, must equal $a_{ij}a_{jk}$ for the judgments to be consistent. The problem becomes $A'w' = \lambda_{max}\, w'$, where λ_{max} is the largest or principal eigenvalue of $A' = (a'_{ij})$ the perturbed value of $A = (a_{ij})$ with $a'_{ji} = l/aij$ forced. To simplify the notation, it should be continued to write $Aw = \lambda_{max}\, w$, where A is the matrix of pairwise comparisons. It turns out that A is consistent if $\lambda_{max} = n$ and that we always have $\lambda_{max} \geq n$.

$$\begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \cdots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \cdots & \frac{w_2}{w_n} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \cdots & \frac{w_n}{w_n} \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} = n \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} \qquad (3.10)$$

In order to obtain the term $n \times w$ the matrix is multiplied by w on the right. More compactly, given that w is the column vector of the relative weights $w_i = 1,2, \ldots . . n$, A is consistent if:

$$AW = nW \qquad (3.11)$$

For the case where A is not consistent, the relative weight w_i is approximated by the average of the elements of row i in the normalized matrix.

$$\sum_{j=1}^{n} a_{ij} w = \lambda_{max}\, w \qquad (3.12)$$

Letting be the computed average vector, it can be shown that $\overline{W}$

$$\frac{A\bar{W}}{w} = \lambda_{max} \qquad (3.13)$$

In this case, the closer is to n, the more consistent is the comparison matrix A. For estimating the consistency ratio, compute the consistency index (CI).

$$CI = \frac{\lambda_{max} - \mathrm{n}}{n-1} \qquad (3.14)$$

Where n is the number of items being compared. The ratio is designed in such a way that values of the ratio exceeding 0.10 are indicative of inconsistent judgments.

Then compute the consistency ratio (CR):

$$CR = \frac{CI}{RI} \qquad (3.15)$$

Where RI is the random index, which is the consistency index of a randomly generated pairwise comparison matrix. It can be shown that RI depends on the number of elements being compared and takes on the following values. The value of the ratio index was shown in table 3.2.

"Super decision software" is used in this research to calculate the priority or weight of the criteria and subcriteria of this AHP model. By using Super Decisions software, the AHP questionnaire is analyzed. The results should meet the desirable consistency index (CI) and consistency ratio (CR) values in the hierarchy comparison analysis, being less than 0.1; which is the acceptable deviation range.

The developed questionnaire has 60 pairwise comparison questions. The survey questionnaire is equally distributed between 20 male and female college/university-going students aged between 20 and 30 who were regular public bus users, selected by a choice-based sampling method. The questionnaire was deemed to be too complicated for participants to complete without sufficient guidance as it was very different fundamentally from the 5-point Likert-type scale system commonly used in survey questionnaires. Therefore, every survey questionnaire was collected in person with a proper explanation of the scaling system so that the participants (not familiar with the AHP model) understood it properly.

3.8 Evaluating alternative design options for the redesign of the public bus

Another survey questionnaire having multiple-choice questions was developed with the proposed alternative interior design options. The questionnaire included pictures of each alternative based on the outcome of three focus group discussions so that the respondents could recognize the alternatives properly. Data were collected (using a choice-based sampling method) from 150 young bus users, equally distributed among males and females (aged between 20 to 30 years and either university students or jobholders). The survey respondents were selected randomly from different universities and offices in Dhaka city. The alternative design option which was most chosen by the respondents under each sub-criterion was selected for analysis. For each gender, the highest percentile value was multiplied by the weight of the relevant criterion and sub-criterion to find the option's global weight. Later, based on the global weights, the selected options under each sub-criterion were ranked for each criterion. From these findings, illustrations for the redesign of the interior features of the public buses, incorporating the most preferred design alternatives, were prepared based on the perspectives of both genders.

CHAPTER 4: ANALYSIS AND RESULT

This chapter is divided into two sections. The first section explains gender-based perceptions and preferences of public bus users by text mining, a customized SQA model, and the ANP method. In the second section, a second SQA model was elaborately discussed and analyzed, identifying the major criteria, sub-criteria, and alternatives were introduced for evaluating the redesign of the interior of existing public buses. Later, the AHP model was developed and analyzed with the help of a customized SQA model. The preferred redesign alternatives for the existing bus interiors for male and female passengers were then examined using the results of multiple redesign survey questionnaires. Finally, the sketches of alternatives to the proposed redesign of the interiors, based on female perspective and priority were developed.

4.1 Gender-based perception and preferences of public bus users

4.1.1 Text-mining and word cloud

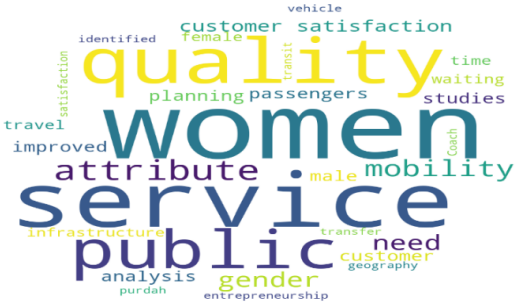
In this research, text mining is conducted based on the five distinct sections (abstract, key finding, methodology, objectives, and problem statement) of twenty research papers generating word clouds as illustrated in **Fig 4.1**. Words with the largest dimension indicate that, from the perspective of public transit, the researchers give importance to these topics. For example, the font size of the words “women”, “public”, “service”, and “quality” is the largest in the word clouds for (a) and (b). In the word cloud for (d), the same words appear the largest except for the word “quality”, instead of which the word “gender” appears. “Public” and “women” also appear to be the largest besides “men”, “mobility”, and “social” in the (e) word cloud. On the other hand, “mobility” again appeared the largest in the (c) word cloud along with the words “data”, “analysis”, and “review”. The larger words in the cloud indicate the most commonly appearing topics that the majority of the authors of the

selected twenty papers consider important from the perspective of studying the service quality of public transit.

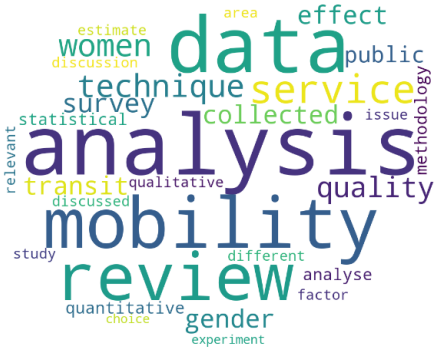
Accordingly, the words “women”, “public”, “service”, and “quality” point toward the trends of problems appearing in public transit for women. It represents that the service quality of public transport plays an important role in sustainable development, especially for women. Whereas, “social”, “mobility”, and “men” describe the different social obstacles to mobility that women commonly compared to men. The topics related to “Mobility” highlighted the obstacle to women's travel mobility due to the lack of service quality of public transit. Hence, the availability of efficient public transport services will enhance the mobility of passengers. Likewise, the words “gender” and “analysis” describe the need for analysis from genders’ perspectives due to the different service quality perceptions of men and women which is not done before, and the importance of improved and gender-based transport practices. With the word “travel”, most of the researchers discuss passengers’ travel patterns and behavior which is found to be different for men and women as well as travel dissatisfaction of women due to the lack of service quality of public transport.

In addition, the word “improved” and “need” mostly represent the concept and need for improvement of service quality of public transit. Researchers are now providing substantial emphasis on the word “improve” which represents the service quality improvement of public transit. Lack of service quality distracts the passengers and forces them to rely on another mode of transport. Service quality improvement must be needed for passengers' satisfaction and to increase their mobility. Besides, some other topics which also occur in the word clouds are “passengers”, “satisfaction”, “attribute”, “issues”, “better”, “infrastructure”, and so on. Like most of the largely appearing words in the word cloud, these topics are also related to gender perspective and service quality issues of public transit. In short, in line with the problem statement and main objective of this study, the word cloud of the literature indicates that the availability of efficient public transport and improved service quality of public buses is expected to enhance passenger satisfaction and mobility.

(a) Abstract



(b) Key finding



(c) Methodology

(d) Objectives

(e) Problem statement

Fig 4.1: Word cloud of the most frequently used terms in (a) Abstract (b) Key finding (c) Methodology (d) Objectives and (e) Problem statement

4.1.2 SQA model and focus group discussion

From the outcome of each focus group discussion, a customized Service Quality Assessment (SQA) model is developed by grouping seventeen different service quality and passenger satisfaction attributes (see **Table 4.1**) under five dimensions (reliability, comfort, responsiveness & empathy, safety & security, and affordability).

Table 4.1 List of criteria and sub-criteria from SQA model

Dimension	**Attribute**	**Symbol**
Reliability	Arriving on time/availability	1A
	No start-up delays	2NSD
	Few delays while on the vehicle	3FDWV
Comfort	Guaranteed seat	1GS
	Smooth and comfortable ride	2SCR
	Air conditioning and good ventilation	3ACGV
	Proper cleanliness	4PC
Responsiveness and Empathy	Pleasant behavior of bus employee (bus driver and conductor)	1PBBE
	The willingness of bus employees to help	2WBEH
	Need procedures to follow up on complaints	3NPFC
Safety & Security	No sexual harassment	1NSH
	No stealing	2NS
	Less accident probability	3LAP
	No probability of injury or falling when passengers have to board and get down from running bus	4NPIPBGRB
Affordability	Occasional fare change	1OFC
	Cheap fare	2CF
	No extra fare	3EF

Besides, during the interview, as part of a solution to the problems specific to female road users, the respondents discussed three alternatives to improve bus services to make e buses more accessible to female passengers. These alternatives are:

a. Separate buses for male and female bus users,

b. Accommodate both genders on the same buses, or

c. Redesign the interior of buses to make the buses more accessible to female passengers.

The first alternative primarily suggests the necessity of providing separate buses for females to improve poor service quality issues such as reliability (unavailability of seats), comfort (uncomfortable rides), safety and security (sexual harassment), etc., for female travelers. Consequently, the second proposed alternative proposes focusing on improving service quality attributes of public buses without gender classified bus service. However, besides improving the facilities of the public buses, this option also requires changes in bus drivers', bus service providers', and bus passengers' attitudes and behaviors to ensure quality public bus service and passenger satisfaction for both genders.

Finally, the third and last alternative recommends significantly changing the existing interior design of the buses such as providing lower stair heights, handrails, and separate doors for the genders to board the bus, spacious seats, wider aisles, and so on. The society of Bangladesh is mostly segregated due to its religious belief and cultural background, and it demands separate places for men and women (Shefali, 2000). It is, therefore, uncomfortable and difficult for women in Bangladesh to compete with their male counterparts to board and alight from the same door of public buses, which are mostly overcrowded, especially in the rush hours in Dhaka (Shefali, 2000). So, it is important to provide separate doors for each gender in the buses of Dhaka. Additionally, the current interior design of the buses such as high stair height, one door system, absence of handrails to board buses, narrow seat space, narrow aisle space, etc. is some of the leading causes of discomfort and sexual harassment faced by female bus users in Dhaka city. As a result, the third alternative of redesigning the bus interior could improve its overall service quality attributes as well as serve as a

solution to the numerous safety, comfort, and accessibility issues mainly faced by the female passengers.

4.1.3 ANP model

The ANP model was built using the super decisions software for evaluating the perception and preference of public bus users based on gender. The dimension obtained from the proposed service quality model is used as the criteria, and the attributes related to the dimension are used as sub-criteria. These criteria, sub-criteria, and alternatives have generated the clusters of the system to build a network model structured around connections between the elements of clusters, and thus the ANP model was developed as illustrated in **Fig 4.2**. Two types of connections are evident in the model: the one-directional arrow representing one-way dependency and the bi-directional arrow representing a two-way dependency among the elements. The model is made up of six clusters and twenty nodes with inner and outer dependencies, and feedback networks. From these six clusters, the five groups of clusters were the major criteria which include: reliability, affordability, comfort, safety and security, and responsiveness and empathy. The final one is the alternatives cluster which includes three alternatives options to improve bus services to make the buses more accessible to female passengers and is to select the best option from among the alternatives or rank all the alternatives by their priority weight.

The pairwise comparisons for the criteria, sub-criteria, and alternatives were carried out through a survey questionnaire (**Appendix A)** by public bus users and finally, the judgments were put into the software. For example, in the questionnaire mode of software, a cluster comparison with respect to alternatives for female passengers is shown in **Fig 4.3**.

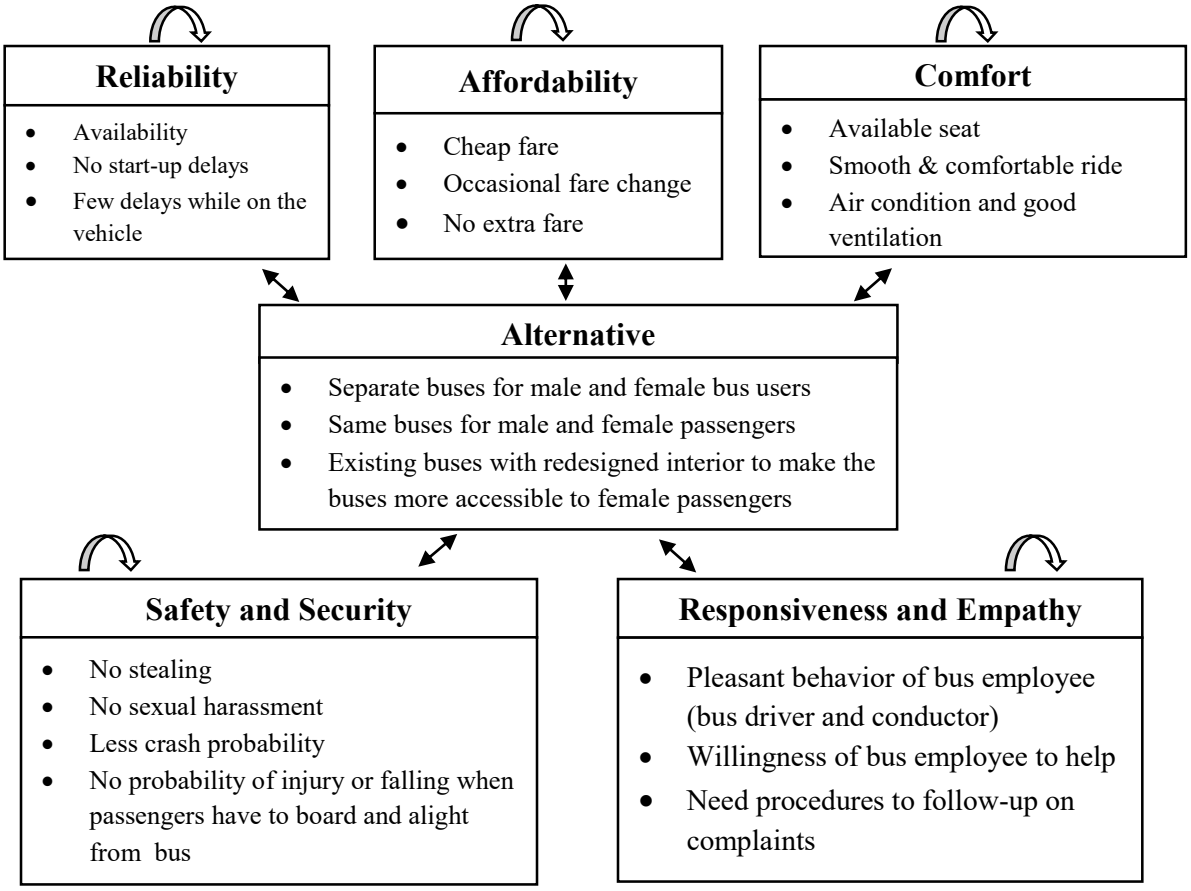


Fig 4.2: Network model among criteria, sub-criteria, and alternatives

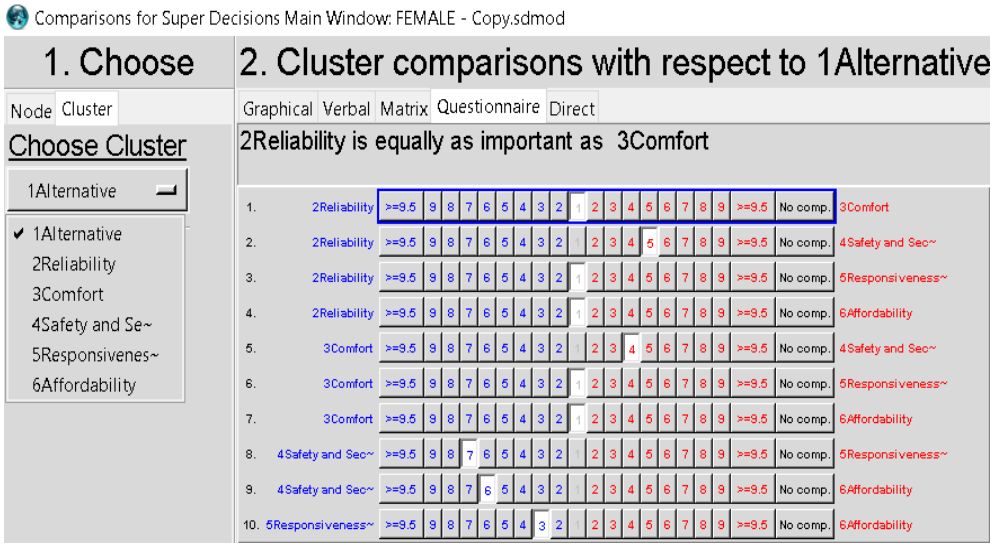


Fig 4.3: Cluster comparisons w.r.t. alternatives for female

For this study, data were analyzed separately for men and women. Hence, two separate ANP models were constructed, each containing responses from 100 pubic bus users. To run the ANP model, the geometric mean of each of the answers to

questions in the questionnaire, i.e., comparisons on a 1 to 9 scale, was calculated and then entered into the model as recommended in the literature (Saaty, 2001). The inconsistency ratio for every pairwise comparison for each question was calculated and found to be less than 0.10, which verifies the survey data to be consistent (Soma, 2003).

At first, the similarities and differences between the priority weightings for the various service quality criteria (dimension) as perceived by the two genders are discussed. Then, the discussion goes up to sub-criteria (attribute) level for each criterion. From the results of the analysis, gender-based preferences based on normalized values of priorities are explored for the three alternatives to see the similarities and differences between men and women. Lastly, the cluster and overall priority weightings for the sub-criteria are examined from the perspective of both genders.

4.1.3.1 Criteria preferences for service quality

The criteria for public bus service quality are “safety and security”, “responsiveness and empathy”, “comfort”, “reliability”, and “affordability”. The priorities for the criteria for both genders are sorted and illustrated in **Table 4.2**. It is observed that the “safety and security” criteria for both females (0.5696) and males (0.4054) are much higher than all other criteria with female bus users giving it a priority of nearly 57%. This is followed by “responsiveness and empathy” (0.1310), “comfort” (0.1103), “reliability” (0.1048), and “affordability” (0.0843) for females. For male passengers, however, “safety and security” (0.4054) are followed by “reliability” (0.2456), “affordability” (0.1351), “comfort” (0.1226), “responsiveness and empathy” (0.0913). Compared to male passengers, “safety and security” and “responsiveness and empathy” are more important to female passengers by 16.42% and 3.97% respectively.

Table 4.2 Priority list of criteria for female and male passengers

Female Priorities			Male Priorities		
Criteria	Normalized	Idealized	Criteria	Normalized	Idealized
Safety and Security	0.5696	1	Safety and Security	0.4054	1
Responsiveness and Empathy	0.1310	0.2301	Reliability	0.2456	0.6057
Comfort	0.1103	0.1937	Affordability	0.1351	0.3333
Reliability	0.1048	0.1840	Comfort	0.1226	0.3024
Affordability	0.0843	0.1481	Responsiveness and Empathy	0.0913	0.2252

On the other hand, in comparison to females, "reliability" and "affordability" are more preferred criteria for males. However, in the case of "comfort", both genders have almost similar preferences (Female: 0.1103~ Male: 0.1226). Graphical representations of normalized priorities of criteria are given in **Fig 4.4**.

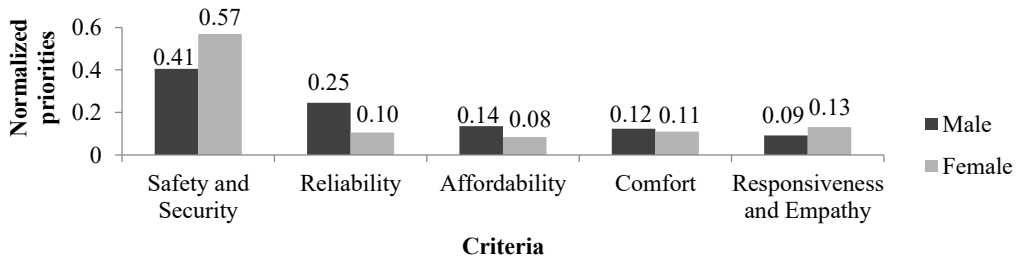


Fig 4.4: Normalized priorities of criteria

4.1.3.2 Constructing Un-weighted supermatrix of ANP for male and female

The results of all the pairwise comparisons are entered in the unweighted supermatrix which contains the local priorities derived from the pairwise comparison throughout the network as shown in **Apendix D** for females and males. For example, the priorities of the sub-criteria, “arriving on time/availability”, “no start-up delays”, “few delays while on the vehicle” concerning separate buses for male and female passengers are in order of 0.634, 0.287, and 0.077 derived from the unweighted supermatrix for females. On the other hand, these values are 0.674, 0.226, and 0.101 for the unweighted supermatrix for males.

4.1.3.3 Constructing weighted supermatrix of ANP for male and female

By multiplying all the elements in a component of the unweighted supermatrix by their corresponding cluster weight formed a weighted supermatrix from an unweighted supermatrix.

As an example, the results of cluster weight for reliability “criteria” is 0.1048 times the unweighted weight of sub criteria for females (“arriving on time/availability” (0.634), “no start-up delays” (0.287), “few delays while on the vehicle” (0.77)) results in 0.067, 0.03,0.008 respectively concerning separate buses for male and female passengers shown in **Appendix E**.

4.1.3.4 Constructing limit supermatrix of ANP for male and female

The weighted supermatrix is raised to power until it meets to yield, then the matrix multiplication process is halted. The limit supermatrix has been found when the relative values of the column are the same for every column and it signifies all possible interactions in the system. The limit supermatrix for females and males is shown in **Appendix F**. The unweighted supermatrix, weighted supermatrix, and limit matrix are calculated by the Super Decisions software.

4.1.3.5 Sub-criteria preferences for service quality

From the limit super-matrix, the priorities of sub-criteria are generated which are summarized in **Table 4.3** and ranked separately for male and female passengers. The ranking is first done within each criterion and then finally based on the values of the overall sub-criteria. Also, the rankings are sorted by priority in descending order. For each criterion cluster, the rankings of male and female passengers are very similar, but the weighted priorities are quite different. The following subsections discuss each of the criteria based on the rankings of the sub-criteria.

Table 4.3 Priorities generated from limit super-matrix

Sub-criteria	Female				Male			
	Priorities in cluster	Rank in cluster	Overall Priorities	Overall rank	Priorities in cluster	Rank in cluster	Overall priorities	Overall rank
Reliability								
Availability	0.0399	1	0.0693	5	0.0999	1	0.1224	3
No start-up delays	0.0147	2	0.0256	13	0.0561	2	0.0688	6
Few delays while on the vehicle	0.0057	3	0.0099	17	0.0444	3	0.0544	9
Comfort								
Guaranteed seat	0.0295	1	0.0507	7	0.0296	1	0.0560	8
Smooth and comfortable ride	0.0157	2	0.0269	12	0.0147	2	0.0278	12
Air conditioning and good ventilation	0.0074	4	0.0127	15	0.0075	4	0.0142	17
Proper cleanliness	0.0117	3	0.0201	14	0.0130	3	0.0246	15

Responsiveness & empathy								
Pleasant behaviour of bus employee (bus driver and conductor)	0.0401	1	0.0613	6	0.0191	1	0.0400	11
Willingness of bus employee to help	0.0252	2	0.0386	9	0.0127	2	0.0265	13
Need procedures to follow up on complaints	0.0203	3	0.0310	11	0.0118	3	0.0248	14
Safety & security								
No sexual harassment	0.1693	1	0.3311	1	0.0688	1	0.1342	1
No stealing	0.0425	2	0.0831	2	0.0636	2	0.1240	2
Less accident probability	0.0405	3	0.0792	3	0.0423	3	0.0825	4
No probability of injury or falling when passengers have to board and get down from running bus	0.0389	4	0.0762	4	0.0331	4	0.06461	7
Affordability								
Cheap fare	0.0233	1	0.0396	8	0.0402	1	0.0722	5
No extra fare	0.0203	2	0.0345	10	0.0229	2	0.0412	10
Occasional fare change	0.0060	3	0.0102	16	0.0121	3	0.0218	16

Reliability

From the cluster of "reliability", the weights of "availability", "no start-up delays", and "few delays while on the vehicle" are 0.0399, 0.0147, 0.0057 for females, and 0.0999, 0.0561, and 0.0444 for male passengers. This indicates that for "reliability", male passengers prefer these sub-criteria more than female passengers during public bus transit. However, the ranks within the cluster are the same for both genders.

Comfort

From the "comfort" cluster, the weighted values for a "guaranteed seat" "air conditioning", and "good ventilation" are closely similar among male and female passengers. However, "smooth and comfortable rides" are more preferred by female passengers while male passengers prioritize "proper cleanliness" more than females. Also, the ranks for the sub-criteria within the cluster are similar for the genders starting with a "guaranteed seat", "smooth and comfortable ride", "proper cleanliness", "air conditioning", and "good ventilation".

Responsiveness and Empathy

The values of all the criteria of "responsiveness and empathy" are higher for females compared to males. In the case of "pleasant behavior of bus employees", ranked first for both genders, the weights of the priorities are 0.0401 for females compared to 0.0191 for males, indicating that females prefer more pleasant behavior than males.

Safety and security

In the case of "safety and security", for the "sexual harassment" sub-criterion, a vast difference between females (0.1693) and males (0.0688) is observed. This indicates that females consider "sexual harassment" as a much more evident criterion for "safety and security" compared to males. Also, this sub-criterion for females weighs the highest (0.3311) among all other sub-criteria. On the other hand, males give more priority to "no stealing" (0.0636) than females (0.0425). However, the preferences are almost identical for both males and females for less accident

probability and no probability of injury or falling when passengers have to board and get down from running a bus.

Affordability

In the cluster of "affordability", the weights of priorities for a "cheap fare", "no extra fare", and "occasional fare change" are higher for males. Nonetheless, the rankings of the sub-criteria are similar for both genders with "cheap fare" securing the first rank.

4.1.3.6 Alternative preferences for bus services

The first alternative to existing bus services primarily suggests providing separate buses for the two genders while also improving poor service quality issues such as "reliability" (unavailability of seats), "comfort" (uncomfortable rides), "safety and security" (sexual harassment), etc., particularly for female travelers. On the other hand, improving the service quality attributes of public buses without separating the genders is the second proposed alternative. This option requires changes in bus driving and riding attitudes as well as improvements in the public bus facilities. The third and last alternative recommends significantly changing the design of the interior of the buses such as providing separate doors for the genders, spacious seats, wider aisles, and so on. Such redesign of the interior is also expected to make buses more accessible to females.

The results of the priorities for the three discussed alternatives to improve bus service are summarized in **Table 4.4** in descending order. The idealized values in **Table 4.4** are obtained from the normalized values by dividing each value by the largest normalized value. Based on the normalized values, both male and female passengers prefer the first alternative of separating the genders to improve service quality. Females prioritize it more than their male counterparts by a normalized value of 4.91%, which suggests a keener interest in the alternative. Moreover, females prioritize the alternative of redesigning the interior of existing buses (0.4036) more than males (0.2926). Thus, from the perspective of females, separating the genders is the most preferred alternative (0.4489) followed by a redesign of existing buses (0.4036). For males, however, preference for the same buses (0.3076) is higher than

a redesign of buses (0.2926). On the other hand, females do not prefer the alternative of using the same buses (0.1475) compared to men (0.3076).

Table 4.4 Synthesized priority results of the alternatives

Female priorities				**Male priorities**			
Alternative	Ideals	Normals	Limits	Alternative	Ideals	Normals	Limits
1. Separate buses for male and female bus users	1	0.4489	0.2016	Separate buses for male and female bus users	1	0.3998	0.1632
2. Existing buses with a redesign of the interior to make the buses more accessible to female passengers	0.8992	0.4036	0.1813	Same buses for male and female passengers	0.7693	0.3076	0.1255
3. Same buses for male and female passengers	0.3286	0.1475	0.0662	Existing buses with the redesign of the interior to make the buses more accessible to female passengers	0.7317	0.2926	0.1194

4.1.3.7 Overall ranks

In the case of the overall ranking of priorities, “no sexual harassment”, “no stealing”, “less accident probability”, “no probability of injury or falling when passengers have to board and get down from running bus”, and “availability” are the top five sub-criteria for female passengers. On the other hand, “no sexual harassment”, “no stealing”, “availability”, “less accident probability”, and “cheap fares” are the top five preferences for males. Therefore, regardless of gender, “no sexual harassment” is the most concerning issue.

On the contrary, “few delays while on the vehicle”, “occasional fare change”, “air conditioning”, “good ventilation”, “proper cleanliness”, and “no start-up delays” are the last five rankings for females, whereas “air conditioning” and “good ventilation”, “occasional fare change”, “proper cleanliness”, “need a procedure to

follow-up on complaints", and "willingness of bus employee to help" are the least five overall sub-criteria for males. Hence, the least preferred sub-criterion for females is "few delays while on the vehicle" indicating more tolerance towards delays. In the case of males, the least important sub-criterion is "air conditioning" and "good ventilation". Moreover, these similarities and differences among overall priorities of sub-criterion between the genders are further illustrated in **Fig 4.5**.

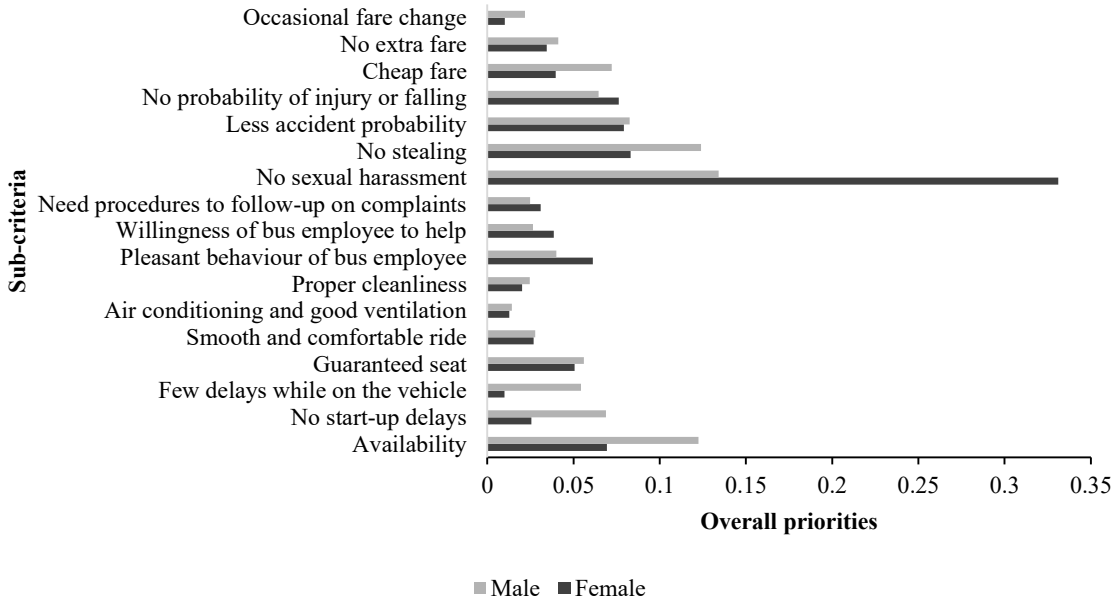


Fig 4.5: Overall priorities of sub-criteria of service quality

4.2 Redesign the interior of existing public buses

This section commences with summarizing the findings of the FGDs which laid the foundation of the AHP survey to identify the relative importance of various components of the interior of the existing bus services. Then, the results of the AHP study combined with the survey on preferences for each alternative revealed the overall inclination towards each of the alternative designs. Finally, combining these alternatives for different components of the interior of existing public buses, design recommendations were provided. For comparison, a typical picture of the interiors of the existing buses has also been presented along with the proposed interior design (**Table 4.8**, **Table 4.9**, and **Table 4.10**). The following subsections summarize the findings of the analysis.

4.2.1 Focus group discussions

Three FGDs were held based on a customized service quality model (SQM) to evaluate the perceptions of public bus users in Dhaka city and their preferences for the interiors of the public bus users. The customized SQM focused on 3 criteria, namely “comfort”, “safety and security”, and “responsiveness and empathy” which altogether consisted of 18 sub-criteria.

The discussed criteria, sub-criteria, existing features, and alternative interior design options summarized from the FGDs are presented in **Table 4.5**. While discussing the existing features of the interiors of public buses in Dhaka, at least one alternative option was proposed by the participants for each case. Out of the 18 sub-criteria, in the case of 5 subcriteria (“seat space”, “seat material”, and “standing facilities in the bus”, “seat plan”, and “ticket collection system”), an additional second alternative option was also discussed. In only one of these 5 cases (“seat plan”), a third alternative was proposed. This suggested that the participants were mostly divided in their expectation of the rearrangement of the seating plan of public buses compared to all other cases.

Table 4.5 List of criteria, sub-criteria, existing features, and alternative options for the redesign of public bus interiors

Sub-criteria	Existing features	Alternatives		
		Option 1	*Option 2*	*Option 3*
Criterion 1: Comfort				
1. Seat space	Narrow seat with no handle between two seats; narrow leg space	Large seat with more legroom	Large seat with handle and extended legroom	N/A
2. Seat material	Seats made of resin or covered with cloth (often in poor condition)	Solid plastic seat; commonly found in buses of Bangladesh Road Transport Corporation (BRTC)	Solid seat covered with clean, comfortable, and durable resin or cloth	N/A
3. Facilities for a disabled person	No "wheelchair lift" and seating space in a bus for the disabled	Available "wheelchair lift" and seating/wheelchair parking space in a bus for disabled	N/A	N/A
4. Standing facilities on the bus	Only longitudinal bars going from front to back; no handle to hold on to for standing passengers	Bar with fixed handle as standing facility	Low height, a flexible handle attached to the existing bar	N/A
5. Aisle space	Narrow	Wider	N/A	N/A
6. Fan position	Middle of the bus; hanging from the roof	A fan is placed above the window at an inclined position	N/A	N/A
7. Window system	The horizontal sliding glass window	Pull up and down windows with glass and ripped sheets; like those in train compartments	N/A	N/A
8. Sunroof system	No sunroof	Sunroof which can be opened during summer	N/A	N/A

Criterion 2: Safety & security				
1. Stair size	High deck height with high “rise and step” of the bus stairs	Low deck height with minimized “rise and step” of the bus stairs	N/A	N/A
2. Seat plan	Only 9 seats are allocated for females, children, and the disabled; others are general seats	No designated seats for female passengers	A portion of bus seats near the female entry door is designated for females and others as general seats	Same as option 2, but more space for standing and fewer seat facilities
3. Railing or handle system outside the door of the bus	No railing or handle system at the door of the bus	Railing or handle system at the door of the bus for passengers to get on and off	N/A	N/A
4. Door	One/two doors for passengers to get on and off with one male conductor	Two separate doors – one for females and the other for a general seating area with female and male conductors respectively	N/A	N/A
5. CCTV and GPS tracker	No CCTV and GPS tracker	Installed CCTV and GPS tracker	N/A	N/A
Criterion 3: Responsiveness & empathy				
1. Uniform system	No uniform or ID card system for bus employees	Bus employees with uniform and ID card	N/A	N/A
2. Ticket collection system	Bus fares are collected from the passenger by the conductor inside the bus without handing over the ticket (in general)	Ticket collected by a passenger from bus stand	The ticket is provided by the conductor inside the bus using the hand-held ticket machine	N/A
3. Emergency button near the seat	No emergency button is available to contact the conductor	The emergency button is available for passengers to contact the conductor (especially to get off the bus)	N/A	N/A
4. Speaker, microphone, and route information display board system	No speaker and microphone system for bus employees to contact the passengers	Installed speaker, microphone system, and route information display board within the bus	N/A	N/A

4.2.2 Criteria and sub-criteria preferences by genders

From **Table 4.5**, it can be observed that the customized SQM consisted of 3 criteria and 18 sub-criteria to meet the primary research objectives. This hierarchy was thus used for the AHP study design. The data collected (males = 10 and females = 10) from the AHP survey questionnaire shown in **Appendix B** was analyzed separately for each gender. The geometric mean of the 10 responses (of each gender) for each pairwise comparison question was entered into the AHP model and analyzed. An inconsistency test revealed that the inconsistency ratio for each of the pairwise comparison questions was below 0.10 confirming that the data could be reliably used for analysis (Saaty, 2008).

Next, normalized priority value and ranking for each criterion (**Fig 4.6**) and sub-criterion (**Table 4.6**) were calculated and summarized to analyze the similarities and dissimilarities between the genders. The obtained AHP values for each gender were normalized by dividing them by the largest value. Comparisons were then based on the resulting idealized values as shown in **Fig 4.6**. Likewise, **Fig 4.7**, **Fig 4.8**, and **Fig 4.9** illustrate the idealized sub-criteria preference values of the genders for each of the three criteria – "comfort", "safety, and security", and "responsiveness and empathy" – respectively.

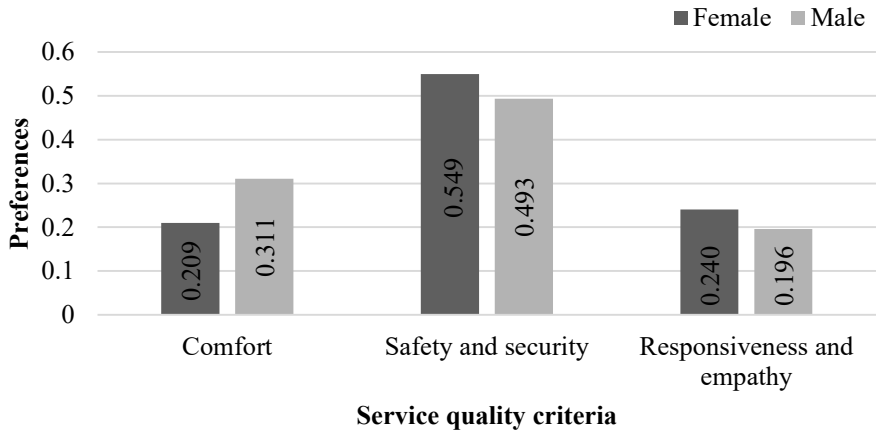


Fig 4.6: Criteria preferences of genders for service quality

Females ranked the criteria "safety and security" above all (0.549) followed by "responsiveness and empathy" (0.240), and "comfort" (0.209). Likewise, men also

put “safety and security” (0.493) above the other criteria. However, they preferred “comfort” (0.311) over “responsiveness and empathy” (0.196). This was consistent with the results of a previous study (Rouf et al., 2018) where many uncomfortable experiences related to “responsiveness and empathy” were discussed by female bus users of Dhaka city. The normalized priorities of females for “safety and security” and “responsiveness and empathy” were still 10% and 18% higher than men respectively.

On the other hand, men’s preference for “comfort” was 32% higher than females'. Also, men prioritized “comfort” above “responsiveness and empathy” by 37%. This suggests that men are less sensitive to the “responsiveness and empathy” of bus employees while women are more sensitive towards it; in contrast to “comfort”. Hence, the new findings suggest that both genders cared about “safety and security” first and foremost followed by contrasting preferences for “comfort” and “responsiveness, and empathy”.

The sub-criteria were then ranked in descending order based on their weighted values in the cluster for each gender (see **Table 4.6**). While the weighted priorities for the sub-criteria were different for the genders, the rankings within the cluster were more similar.

4.2.2.1 Comfort

Under the “comfort” criterion, the “seat space” sub-criterion weighted and ranked the highest for females followed by “facilities for the disabled”, “standing facilities in the bus”, “seat material”, and “aisle space” were sequentially ranked in weights and priorities followed by “fan position” and “window system”. The least priority weightings were for the “sunroof system” and “mobile charger port”. Men had a somewhat similar ranking with a few differences. Male ranked highest for “facilities for the disabled”, followed by “seat space”, “aisle space”, “Standing facilities in the bus”, “fan position”, “seat material”, “window system”, “sunroof system” and “mobile charger port”.

The AHP results reiterate the findings of the FGDs as women (0.225) and men (0.182) both preferred wider seats which was an indication of their discomfort with the existing narrow seats. Also, from the FGDs, it was evident that women didn’t like

sitting too close to their next passenger, especially if that person is not of the same gender, and men found the limited leg space uncomfortable. Both the genders strongly felt the need for “facilities for the disabled”- men (0.235) more than women (0.175).

Next, women prioritized “standing facilities in the bus” (0.131) more than men (0.125) which was easy to comprehend. It is expected that during peak hours’ passengers may need to utilize the standing capacity in the buses to satisfy the increased demand and in such situations, women will need better standing facilities that will reduce their probability of being harassed. Besides, women (0.121) were more sensitive to “seat material” than men (0.080). “Aisle space” was a greater issue for men (0.147) than women (0.117) as their average height, in general, is higher than female passengers. Moreover, women and men both exhibited quite similar priorities for “fan position”, “window system”, “sunroof system”, and “mobile charger port”. However, men’s exceeding priority weighting for “sunroof system” (0.053) compared to women’s (0.020) indicates their preference for better ventilation.

4.2.2.2 Safety and security

Under the “safety and security” criterion, the “stair height” sub-criterion weighted and ranked the highest for females followed by “seat plan”, “handle system on the door of the bus”, “door”, and “CCTV and GPS tracker” whereas males preferred and ranked highest for “stair height” followed by “handle system outside the bus door”, “seat plan”, “door” and “CCTV and GPS tracker”.

With regards to passengers safety and security in public bus, rankings of men and women were almost similar except for the higher ranking of “seat plan” in the case of women and “handle system on the door of the bus” for men. It was evident that women were more dissatisfied than men about the current seat plan in existing buses, which is only 9 seats are allocated for females, children, and the disabled. They preferred proper seat plan for their security issues. Males discovered the importance of a railing system on the bus's door over the seat plan after falling and injuring themselves when boarding and exiting the bus. However, men’s priority weightings for all sub-criterions exceeded women’s indicates their preference for better safety issues for redesign the interior of existing buses. Nonetheless, both the genders felt

strongly about “stair size” (female: 0.218 ~ male: 0.221), “seat plan” (female: 0.195~ male: 0.201), “handle system outside the bus door” (female: 0.178 ~ male: 0.214), and “door” (female: 0.162 ~ male: 0.184) for both safety and security reasons. Both genders put the least priority on “CCTV and GPS tracker” (female: 0.103 ~ male: 0.127) for public buses compared to other “safety and security” features.

4.2.2.3 Responsiveness and empathy

Women preferred "uniform and ID card" for "responsiveness and empathy", followed by "ticket collection system", "emergency button", and "speaker and route information display system". "Ticket collection system" was the top priority for men, followed by "emergency button" and "uniform and ID card”. Their least preferred subcriteria was the same as women's: "Speaker and route information display system".

Women’s weighted priority (0.337) for the “uniform system for the bus employees” was about twice as much as that of men’s (0.188). However, while the “uniform system” ranked first for women, it ranked third for men. According to the FGDs, women feel more comfortable if bus drivers, and other bus staff are uniformed and have an official ID card system so that they can be quickly identified and contacted when assistance is required. On the other hand, the “ticket collection system” was ranked first for men (0.422) with a priority weighting that was almost double that of women (0.273); it ranked second for women. Men’s general practice of often boarding heavily-crowded buses could be linked to this stronger preference for the alteration of the “ticket collection system”. Besides, both genders felt somewhat similarly about the “emergency button beside the seat”- men slightly more than females. “Speaker and route information display system” was ranked the least for both genders. Even so, priority weighting for it was higher in the case of females (0.126) than male participants (0.103). It may indicate that women care more about staying informed about the route than men as they are often lesser aware of their route for not traveling as much.

Table 4.6 Priorities generated from the AHP model

Sub-criteria	Female		Male	
	Priority in cluster	*Rank in cluster*	*Priority in cluster*	*Rank in cluster*
Criterion 1: Comfort				
Seat space	0.225	1	0.182	2
Facilities for disabled person	0.175	2	0.235	1
Standing facilities in bus	0.131	3	0.125	4
Seat material	0.121	4	0.080	6
Aisle space	0.117	5	0.147	3
Fan position	0.109	6	0.089	5
Window system	0.079	7	0.072	7
Sunroof system	0.020	8	0.053	8
Mobile charger port	0.019	9	0.017	9
Criterion 2: Safety & security				
Stair height	0.218	1	0.221	1
Seat plan	0.195	2	0.201	3
Railing or handle system at the door of the bus	0.178	3	0.214	2
Door	0.162	4	0.184	4
CCTV and GPS tracker	0.103	5	0.127	5
Criterion 3: Responsiveness & empathy				
Uniform and identity card	0.337	1	0.188	3
Ticket collection system	0.273	2	0.422	1
Emergency button near seat	0.263	3	0.288	2
Speaker, microphone, and route information display board system	0.126	4	0.103	4

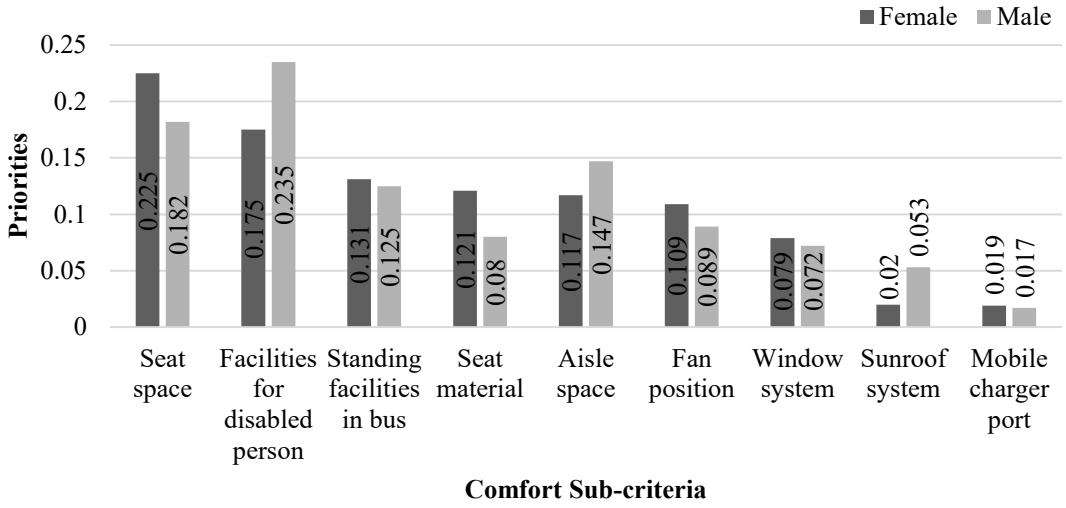


Fig 4.7: Sub-criteria priorities of genders for comfort criterion

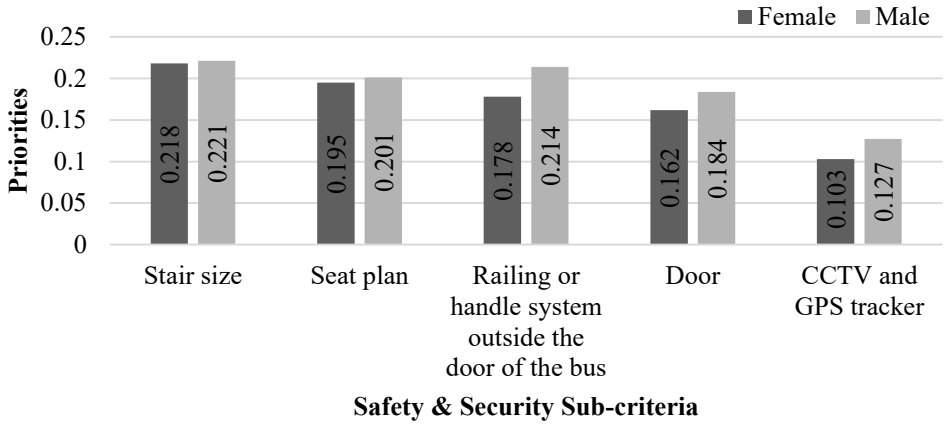


Fig 4.8: Sub-criteria priorities of genders for safety and security criterion

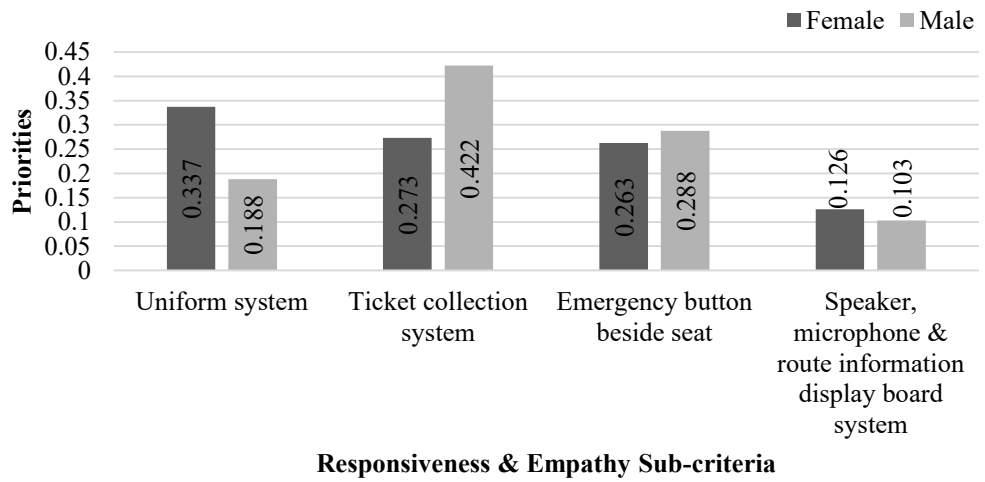


Fig 4.9: Sub-criteria priorities of genders for responsiveness and empathy criterion

4.2.3 Interior redesign option preferences gender

The results of the second survey questionnaire shown in **Appendix C,** asking participants (n=150) their preferred redesign alternatives for the existing bus interiors were analyzed and tabulated for females and males separately (see **Table 4.7**). The options with the highest percentile under each sub-criterion were listed along with their global weight (product of criterion weight, sub-criterion weight, and the percentile value). Based on the global weight of the options, the sub-criteria under each criterion were then ranked in descending order. The ranks of most of the sub-criteria found for males and females were comparable to that of **Table 4.6**. For instance, "fan position", "window system", "mobile charger port", and "sunroof system" for the highest percentile option are still ranked the least in **Table 4.7**. Likewise, the global weight of the highest percentile option for "CCTV and GPS tracker" and "speaker, microphone, and route information display board system" also ranked the least under the criteria "safety and security" and "responsiveness and empathy" respectively – suggesting that the respondents of the AHP study and the second questionnaire survey had similar preferences.

Interestingly, men and women mostly selected the same design alternative option under each sub-criterion except for only two cases, namely, "seat space" (under

"comfort") and "seat plan" (under "safety and security"). Out of the two listed alternative options for "seat space", more females (50.7%) preferred the second option (large seat with handle and more space in front of the seat), and more men (56.2%) preferred the first option (large seat with more legroom). Both genders wanted a larger seat with more leg space. The only difference is that females also wanted handles between seats which is expected to provide more support and privacy. In the case of a seating plan, none of the genders preferred the first option, i.e., no designated seats for females, suggesting that they were unequivocal about retaining the 'female-only' seats. Females mostly preferred (59.5%) the second option where a portion of bus seats near the female entry door would be designated for females and others would be general seats, and all males preferred (100%) the third option which was similar to the second option but with more space for standing and fewer seating facilities. This also meant that women did not prefer standing inside the bus and wanted more seats in the bus.

On the other hand, in the case of "seat material", "standing facilities in the bus", and "ticket collection system" both males and females preferred the same option out of the two alternative options, namely solid seat covered with clean and proper cloth, low height flexible handle with bar, and ticket provided by conductor inside the bus using hand-held ticket machine respectively. The majority of both genders (female: 71.6% ~ male: 74.3%) preferred solid seats covered with cloth to solid plastic seats (option 1) indicating that they found solid seats more comfortable than plastic seats. Likewise, more males (65.3%) and females (77.3%) chose the option of low height, flexible handle with a bar instead of just a bar with a handle as a standing facility which is often difficult to reach for people who are not tall enough. Moreover, they are more difficult to hold on to while the bus is passing over the bad quality pavement. However, the majority of the men (95.9%) and just above 50% of the females selected tickets provided by the conductor inside the bus using the hand-held ticket machine option and not the other alternative option of ticket collected by a passenger from the bus stand. Currently, bus fares are collected from passengers by a conductor inside the local bus without providing a ticket in return. Almost 100% of the females preferred the introduction of CCTV and GPS trackers inside the bus and uniform system for the bus staff; whereas, less than 50% of the males showed the

same preference. This again suggested that women felt more concerned about safety and security and responsiveness and empathy than men (see **Fig 4.6**).

Table 4.7 Highest percentile and priority results of the options in descending order

Female				**Male**			
Sub-criteria (weight)	*Option*	*Highest percentage of option in each sub-criterion (%)*	*Global weight of option*	*Sub-criteria (weight)*	*Option*	*The highest percentage of options in each sub-criterion (%)*	*Global weight of option*
Comfort (0.209)				**Comfort (0.311)**			
Facilities for disabled person (0.175)	1	97.3	0.036	Facilities for disabled person (0.235)	1	89.3	0.065
Aisle space (0.117)	1	98.6	0.024	Aisle space (0.147)	1	94.3	0.043
Seat space (0.225)	2	50.7	0.024	Seat space (0.182)	1	56.2	0.032
Standing facilities in bus (0.131)	2	77.3	0.021	Standing facilities in bus (0.125)	2	65.3	0.025
Seat material (0.121)	2	74.3	0.019	Seat material (0.080)	2	71.6	0.018
Fan position (0.109)	1	69.3	0.016	Fan position (0.089)	1	60.8	0.017
Window system (0.079)	1	63.0	0.011	Sunroof system (0.053)	1	52.7	0.013
Mobile charger port (0.019)	1	85.3	0.004	Window system (0.072)	1	78.7	0.012
Sunroof system (0.020)	1	72.0	0.003	Mobile charger port (0.017)	1	78.7	0.004

Safety and security (0.549)				**Safety and security (0.493)**			
Stair height (0.218)	1	90.7	0.109	Stair size (0.221)	1	98.7	0.108
Railing or handle system at the door of the bus (0.178)	1	98.7	0.100	Railing or handle system at the door of the bus (0.214)	1	100.0	0.105
Door (0.178)	1	98.7	0.089	Door (0.184)	1	97.3	0.089
Seat plan (0.195)	2	59.5	0.064	CCTV and GPS tracker (0.127)	1	37.8	0.063
CCTV and GPS tracker (0.103)	1	98.7	0.056	Seat plan (0.201)	3	100.0	0.038
Responsiveness and empathy (0.240)				**Responsiveness and empathy (0.196)**			
Uniform and identity card (0.337)	1	100.0	0.081	Emergency button near seat (0.288)	1	100.0	0.054
Emergency button near seat (0.263)	1	97.3	0.061	Ticket collection system (0.422)	2	95.9	0.040
Ticket collection system (0.273)	2	50.7	0.033	Uniform and identity card (0.188)	1	48.6	0.037
Speaker, microphone, and route information display board system (0.126)	1	98.7	0.030	Speaker, microphone, and route information display board system (0.103)	1	90.5	0.018

4.2.4 Existing features and proposed alternative design

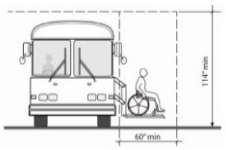
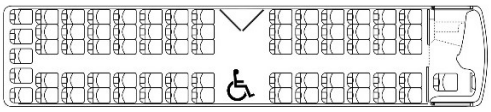
Since women were identified as the more vulnerable gender group in Dhaka city (Shefali, 2000; Rouf et al., 2018; Sultana et al., 2019), illustrations for the redesign of the existing buses were prepared based on the females' global ranking for the priority option under each sub-criterion and tabulated along with illustrations of the existing bus features for each criterion (see **Table 4.8, Table 4.9,** and **Table 4.10**). Hence, under each criterion, the most preferred modification for each sub-criterion is

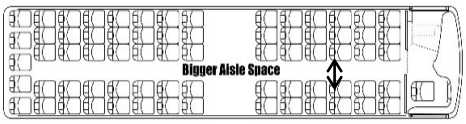
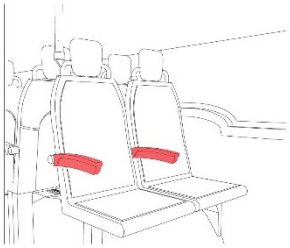
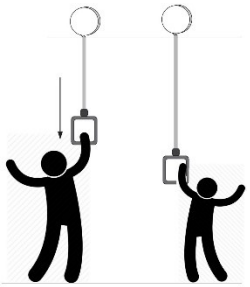
discussed in descending order. That is, the first proposed sub-criterion modification is more important to the female participants than the second, and so on.

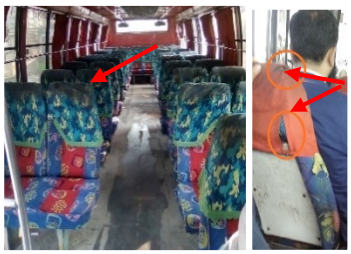
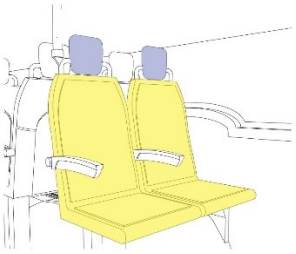
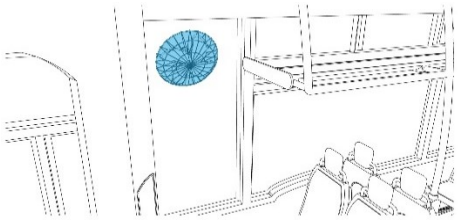
4.2.4.1 Addressing comfort

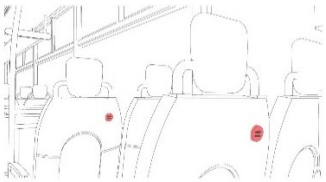
Currently, there exist no facilities for the disabled in the existing public buses except for a few reserved seats. In this study, the majority of both male and female participants (male: 89.3% ~ female: 97.3%) insisted on appropriate facilities to be included. As a result, illustrations showing a lifting facility and a designated seating area for disabled passengers are shown in **Table 4.8** (Item 1). Also, aisle space is quite narrow currently, so a sketch showing wider aisle space (preferred by around 96%) is included. Similarly, seat space is limited, leading to a desire for bus seats with handles and more space between them. Moreover, as a standing facility, only bars without handles exist which are often hard to reach and harder to hold on to in a moving bus. Both genders thus wanted low flexible handles attached to the bars. Seats in current buses are either made out of resin or covered with clothes that are often dirty and ripped. Thus, both genders wanted the seats to be made of solid materials which are covered with clean and proper cloth. Also, in existing buses, fans are located in the middle of the bus- hung from the roof. Results suggest passengers (male: 60.8% ~ female: 69.3%) would like them above the side window at an inclined position- providing better air circulation. Likewise, instead of the existing sliding glass window system, participants preferred (male: 52.7% ~ female: 63%) a window system with either single or double movable panels to ensure window access for all passengers. Lastly, around 78% of the participants suggested a USB charging port behind every seat and sunroof inside the bus for convenience and comfort respectively as sketched and shown in **Table 4.8.**

Table 4.8 Proposed redesign of the interiors based on female perspective and priority to address comfort issues

Comfort design features		
Sub-criteria	Features of existing bus	Priority options for redesign
1. Facilities for the disabled person	No facilities for the disabled 	Landing clearance for the lift for the disabled  114” min 60” min.  Reserved facilities for disabled person (Wheelchair to be faced rearwards with back against bulkhead and brakes on)

2. Aisle space	Narrow aisle space 	Wider aisle space inside the bus 
3. Seat space	Narrow seat space (between seats and narrow legroom) 	Seats with handles and more space between them and greater legroom 
4. Standing facilities on the bus	Only bar; no handle to hold 	Flexible handle attached with the bar 

5. Seat material	Seat made of resin or covered with cloth (often in poor condition) 	Solid seat covered with clean, comfortable, and durable resin or cloth 
6. Fan position	Middle of the bus; hanging from the roof 	A fan is placed above the window at an inclined position 
7. Window system	The horizontal sliding glass window 	Window with single/double retractable panels 

8. Mobile charger port	No mobile charger port is available	USB port for charging behind every seat 
9. Sunroof system	No sunroof system is available 	Sunroof provided inside the bus 

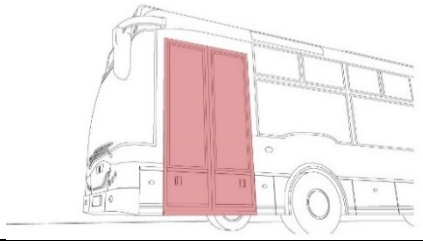
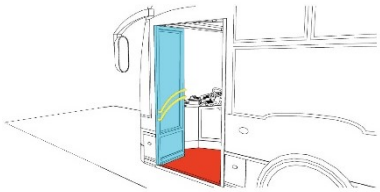
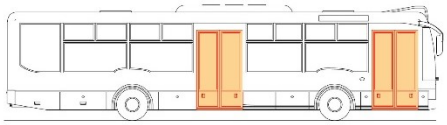
4.2.4.2 Addressing safety and security

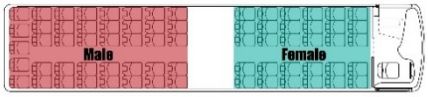
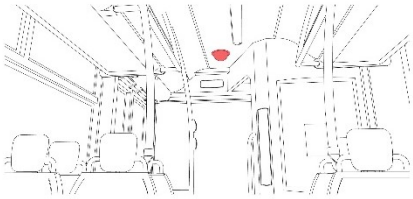
Above 90% of both genders wanted low height bus deck and short steps, railing with bus door, and separate doors for males and females to make boarding a bus safe and secure for all. The current high decks and steps of buses combined with the absence of railing on the bus doors cause great discomfort to passengers while boarding and alighting. Likewise, the presence of a single door for both genders puts the female passengers in a vulnerable situation where they have a higher probability to be sexually harassed (Rouf et al., 2018). Consequently, three design sketches are provided in **Table 4.9** to address these issues.

Additionally, as per the expressed concerns of both genders regarding the present seating plan with only 9 reserved seats for females, children, and the disabled, a design sketch showing separate male and female seating areas within the bus was prepared. Finally, an illustration showing CCTV inside the bus was added as it was a

highly desired redesign option for the female passengers (98.7%) under the "safety and security" criteria.

Table 4.9 Proposed redesign of the interiors based on female perspective and priority to address safety and security issues

Safety and security design features		
Sub-criteria	Features of existing bus	Priority options for redesign
1. Stair height	High rise and steps of the bus 	Low rise and steps of the bus with low height gate 
2. Railing or handle system at the door of the bus	No railing or handle at the door 	Railing provided with bus door 
3. Door	Only one door (often) for males and females 	Separate doors for males and females 

4. Seat plan	9 reserved seats for females, children, and the disabled; others are general seats 	Separate seat plan for males and females 
5. CCTV and GPS tracker	Not available	CCTV and GPS trackers available inside the bus 

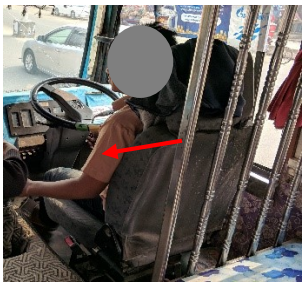
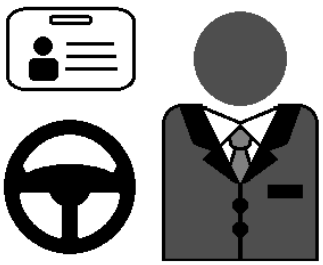
4.2.4.3 Addressing responsiveness and empathy

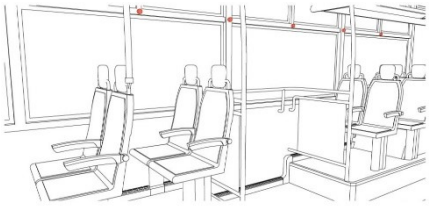
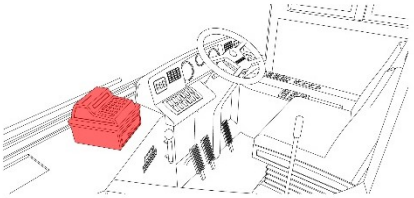
The majority of both genders chose the inclusion of emergency buttons inside the bus and speaker, microphone, and route information display board system (90.5%~100%). This indicates that they would like to be informed about the bus route and also be able to contact the bus employees in case of an emergency. Currently, all of these are done verbally in often over-crowded buses leading to communication gaps and other nuisances from both parties. Also, in general, public bus employees in Dhaka city do not wear the uniform or display staff ID- often creating confusion and mistrust among passengers. Hence, female participants strongly (100%) preferred the introduction of a uniform and ID system for bus staff.

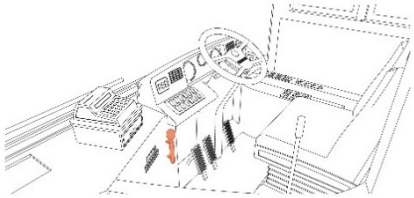
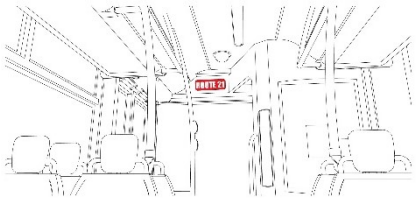
Lastly, the present ticket collection system was considered problematic by both genders, especially males (95.9%). Hence, out of the two alternative options, they opted for the option in which the bus conductor would take bus fares from passengers inside the bus (also done currently) and also provide tickets using a handheld ticketing machine (not currently practiced). Passengers were less inclined to choose the option in which they would collect tickets from the bus stands. This could be attributed to the fact that passengers preferred availing themselves of a bus before

paying since its arrival or arrival time is often uncertain. In many cases, the passenger will take the bus from another company or choose a different mode to complete the trip if the intended bus is not on time. In general, the ticket counters do not return the money if the bus is late. Therefore, they prefer buying the ticket once they are on board as sketched and shown in **Table 4.10**. Also, during the FGDs, participants had complained about conductors often charging higher fares leading to arguments inside the bus. Hence, both genders agreed that fares collected with a ticketing machine would create a more transparent and smooth transaction between the parties.

Table 4.10 Proposed redesign of the interiors based on female perspective and priority to address responsiveness and empathy issues

Responsiveness and empathy design features		
Sub-criteria	Features of existing bus	Priority options for redesign
1. Uniform and identity card	No uniform or identity cards for bus employees 	A uniformed bus driver and staff having identity cards 

2. Emergency button near the seat	Not available	Emergency buttons are available inside the bus 
3. Ticket collection system	Fares collected by conductor inside the bus without providing ticket 	Fares are collected by the conductor inside the bus with a ticketing machine 

4. Speaker, microphone, and route information display board system	Not available 	Microphone and speaker system available inside the bus  Route map displayed inside the bus 

4.3 Conclusion

The results suggest that female public bus users expect more 'women only' buses to be introduced. At the same time, the existing buses, want their interiors to be redesigned to ensure that female passengers can access, egress, and complete their trip with minimal physical interaction with male passengers. It was also found that female passengers are more sensitive toward safety, security, human behavior, and comfort and less sensitive to the reliability of the service and its affordability as compared to their male counterparts.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter summarizes the major findings of this research, which included assessing service quality (objective 1), identifying and categorizing the preferences of female and male public bus users (objective 2), as well as policy implications (objective 3) drawn by various researchers in their pieces of literature, and finally, recommendations for interior design improvements to public buses (objective 4). The proposals may assist governments, policymakers, stakeholders, city planners, and public transit operators in developing public transportation that is gender equitable and introducing new interior design preferences for male and female public bus users in Dhaka. Finally, the chapter highlights the limitations and future research goals.

5.2 Major finding

This section summarizes the primary findings from this study in order to meet the requirements of the study's first two objectives, as defined in Error! Reference source not found. According to the major findings, it was suggested that there is a difference in preference between men and women regarding various criteria and sub-criteria of service quality of public buses. Combining those, redesign recommendations have been compiled.

5.2.1 Service quality assessment

The study's first objective was "To develop a qualitative framework to assess the service quality of public buses in Dhaka city accommodating the needs of female passengers". The standard service quality model (SERVQUAL and RESCA) failed to build a qualitative framework for service quality of public buses in Dhaka, especially for female passengers. Due to this, to fulfill the objective, a newly proposed service quality assessment (SQA) model was developed. This proposed service quality

analysis model was developed encompassing the views of both genders by the outcome of text mining of relevant literature and focus group discussions in order to meet the better service quality requirements of public bus passengers. The findings from this objective are as follows:

a. The proposed service quality model is introduced five criteria: “Reliability”, “Comfort”, “Responsiveness & empathy”, “Safety & security”, and “Affordability”.
b. The service quality assessment (SQA) model is developed by grouping seventeen different service quality and passenger satisfaction subcriteria under five criteria. These subcriteria are: "Availability", "No start-up delays", "Few delays while on the vehicle", "Cheap fare", "Occasional fare change", "No extra fare", "Available seat", "Smooth & comfortable ride", "Air condition and good ventilation", “Proper cleanliness”, "No stealing", "No sexual harassment", "Less crash probability", "No probability of injury or falling when passengers have to board and alight from bus", "Pleasant behavior of bus employee", "Willingness of bus employee to help", and "Need procedures to follow-up on complaints".
c. Three alternatives generated as a part of solutions are: providing separate buses for male and female bus users, accommodating both genders in the same buses, or redesigning the interior of buses to make the buses more accessible to female passengers.

5.2.2 Identifying and prioritizing the preferences

The findings present the gender-based order of service quality preferences using the framework that meets objective-2 of this study, which is “to identify and put in order the preferences of both female and male public bus users to ensure equal opportunity for female bus trips users in Dhaka city”. To fulfill this objective, one of the popular decision-making models, ANP is used for modeling and making comparisons. The criteria, sub-criteria, and alternatives for the ANP models – were separately constructed for males and females. The following outcome have been drawn from this study:

a. Both genders prefer separate buses. In contrast to their male peers, females place greater emphasis on this preference.
b. If it is not possible to provide separate buses, female passengers feel that the existing buses should be redesigned to accommodate their needs. Males, on the other hand, prefer that buses remain the same rather than be redesigned. This result indicated that public transportation was built for male passengers (Hamilton et al., 2005), creating significant challenges for female passengers (Shefali, 2000; Zohir, 2003).
c. It has been revealed that the priority of the "safety and security" criteria for both males and females is significantly higher than any other criteria.
d. Female passengers put the highest priority for "safety and security", "responsiveness and empathy" and "comfort" whereas their male counterparts prioritize "safety and security", followed by "reliability" and "affordability".
e. "Affordability" is at the lowest on females priority list, while "responsiveness and empathy" are the least prioritized issues for males.
f. "No sexual harassment" is at the top of everyone's priority list, regardless of gender, and females prioritize it more as expected. As it was documented, over 80% of women have been sexually harassed and avoid public transportation (The World Bank, 2018).
g. Passengers of both the genders prioritize an environment where sexual harassment and stealing does not take place, however, female passengers are more cautious regarding road crashes whereas their male counterparts are concerned about fare.
h. Female passengers are less concerened about the delay, waithing time inside the bus with cleanliness and good ventilation. Males, on the other side, are less concerened about the well behavior of bus employees and proper cleanliness issues.

5.3 Policy implication

The third objective's outcomes are described in this section as policy implications. By discussing policy recommendations a strategy can provide for female trip makers to make sure equal opportunities to use the public bus. This chapter is combined into two parts: perception and preferences of service quality and redesigning the interior.

5.3.1 Perception and preferences of service quality

By integrating passengers' preferences into the decision-making process, the ANP method used in this research can assist policymakers in creating public transport that is favorable to both genders. Likewise, the suggested alternatives for the improvement of public buses by separating the genders, improving the service quality and not separating the genders, or modifying the design of the interior of the buses might have a potentially positive impact on the public bus users' experiences in Dhaka city.

a. For public bus

- Based on the alternative highly preferred by both genders, 'providing separate buses for the genders', policymakers and transportation planners might evaluate the feasibility of introducing separate buses to improve the overall quality of the public bus system within the context of a developing nation. The alternative prioritized in this finding by both genders could be an effective solution to the negative issues of current public transport facilities as identified by the sample and the literature that suggested that public transport had been primarily designed for male passengers (Hamilton et al., 2005), and consequently, it has created many obstacles for female passengers (Shefali, 2000; Zohir, 2003). Duchene (2011) also suggested providing separate buses for the genders for developing countries and ensuring women's safety in public transport for developed countries a lack of which could make them avoid using it.

- Proper time schedules and fares should be fixed by the government to avoid nuisances and harassment inside buses.
- Based on the result of this research, policymakers need to take some appropriate actions to improve the critical service quality criteria of public buses as identified by the genders such as safety and security for females and reliability and cleanliness for males. Moreover, based on the weighted priorities expressed by the genders, policymakers must particularly improve the reliability, affordability, and comfort of public buses for females as their priority weightings mostly exceeded their male counterparts.

b. For policy makers

- Information found in these studies could inform decision-makers and stakeholders about opportunities for improvements in current and future public transport services and infrastructures.
- Rules, fines, and punishments must be strictly implemented. The 2017 Act stipulates that a person on a public bus barring a woman from occupying the reserved seats for women would be punished with a one-month jail time and/or a fine of a maximum of 5000 takas (Ministry of Law, Justice and Parliamentary Affairs, 2017).
- Proper security measures must be undertaken to ensure incidents such as verbal or sexual harassment, stealing, and other unexpected activities do not go unnoticed.
- Need to increase women's employment in transportation sector. Literature suggests that men who mostly travel by car have been predominantly working in the transport sector creating policies that favor private vehicles over public transport (Duchene, 2011).
- Hence, measures such as women’s participation in planning and decision-making processes in transport policies could also benefit the current situation. Evident that existing policies and public transport facilities had not taken into

account the distinctive characteristics of women's mobility needs and troubles (Duchene, 2011; Shefali, 2000).

c. For bus employee

- Bus employees (driver and conductor) must have a minimum education level and should be trained accordingly, so they may display proper behavior and helping attitudes toward the passengers, especially the female bus users. The more recent Road Transportation Act 2017 of Bangladesh ordains that an occupational driver needs to be at least 21 years old and an 8th-grade graduate (Ministry of Law, Justice and Parliamentary Affairs, 2017).
- Both service providers and passengers should be aware of transportation laws.
- Consequently, to make sure that the bus employees are indeed qualified, proper vetting, uniform, and official ID cards need to be mandated by the employers.

5.3.2 Redesign the interior of public bus

Interior features of public transport in Dhaka city such as one door system, narrow aisle, and seat space, seat plan, stair size, etc. have led to numerous boarding, standing, seating, traveling, and verbal or sexual harassment issues for female passengers (Turner and Fouracre, 1995; Shefali, 2000; Smith, 2008; Duchene, 2011; Rouf et al., 2018). The redesign of the interior features of the existing buses proposed by the respondents in this study has been laid out in **Table 4.8**, **Table 4.9**, and **Table 4.10**. Most of the recommendations can already be seen implemented by the public transit service providers in many developed countries such as Singapore, China, Germany, etc. However, the need for some major customizations is required for Dhaka city. Eventually, stakeholders, policymakers, government agencies, and transport companies need to further explore and formulate implementation strategies.

a. For Public Bus

- **Facilities for disabled person**

  The respondents of both genders have heavily emphasized the issue of equal opportunity for people with disabilities. The Rights and Protection of Persons with Disabilities Act 2013 of Bangladesh was prepared in line with the principles of the United Nations Convention on the Rights of Persons with Disabilities (CRPD) mandates that the design of services must be usable by persons with disabilities where needed (UNCRPD, 2008; Ministry of Law, Justice and Parliamentary Affairs, 2013). Also, under Section 32 of the same 2013 Act, buses must reserve 5% of seats for people with disabilities. According to the suggestion of respondents, government and policy makers should introduce a provision for landing clearance to facilitate access through wheelchairs, which can be placed inside the bus facing rearwards with back against the bulkhead having breaks on.

- **Seat space and seat material**

  Respondents recommended solid hard surface seats covered with good quality resin or cloth which will not get damaged too soon. The seats are suggested to be wider and they expect seats to have retractable handles that they can use to create separation from the person sitting next to them. Policymakers and transportation planners might reconsider the potential of introducing wider seats constructed of the suggested materials.

- **Aisle space and standing facilities**

  The participants recommended greater legroom. For the standing passengers, the ride comfort can be enhanced by increasing aisle space and equipping the existing longitudinal bars overhead with flexible handles. Aisle space should be increased to assist in increasing standing capacity during peak hours, and the reduction of the number of seats can be compensate by the increased standing capacity.

- **Fan position, window system and sunroof system**

  Most of the proposed redesign suggestions to improve comfort are related to enhanced air circulation within the bus, are suitable for tropical areas having hot summers and prolonged rainy seasons. The respondents felt that mounting the fans, which are at present located at the center of the bus just at the zenith of the aisles, to the sides just over the windows and tilting them towards the aisles, and placing retractable sunroofs at the ceiling will substantially improve the ventilation and thereby address the increased temperature related issues. The retractable sunroofs can be kept open during summertime but closed when it rains. Also, the bus users identified that the existing windows slide open horizontally, leaving half of the windows closed all the time. This can be changed by replacing them with vertically retractable windows.

- **Mobile charger port**

  The passengers expressed that an accessible mobile charging port from the seats will be highly appreciated. This is understandable as due to congestion, the passengers assume the journey time to be often quite long, and having mobile charging ports will help them in using cell phones while traveling and remaining occupied.

- **Seat plan**

  The public bus users opined that the seating areas should be demarcated based on gender – a female-only area and a general area where passengers of both genders can sit/stand. The number of seats allocated for these two divisions can be kept demand-responsive, e.g., by installing temporary covers on the headrest (having different colors). At the same time, provide wider aisle area will assist in increasing the standing capacity for female passengers as they feel safer and more secure than standing in a more crowded area.

- **Door**

  Even, the respondents recommended having separate doors for these two seating areas. Female bus users particularly remain vulnerable to sexual abuse and theft during the boarding and alighting time (Rouf et al., 2018), and having separate doors for the female and the general seating area is expected to substantially reduce this risk. Additionally, access to public transport for females who may carry children and packages needs to be improved as well by removing steps and providing wider doors for them (Duchene, 2011).

- **Stair size and railing or handle system outside the door of the bus**

  The respondents complained about the high deck and step heights of the existing buses. Deck height can be lowered for both gates following international standards. In the case of step size design, studies can be conducted to determine the appropriate step height for the gates of female and general passengers.

- **CCT and GPS tracker**

  Both male and female bus users recommended incorporating proper handles and railings to ensure safe boarding and alighting. Lastly, the passengers emphasized the importance of GPS tracker-enabled buses equipped with CCTV cameras. In recent times, several incidents surfaced through the print and electronic media where passengers became victims of organized crime in less crowded buses during the off-peak hours or at night time. Often, the bus will be driven to an isolated location, outside the designated route, to facilitate the crime to take place. GPS trackers and CCTV cameras should act as a deterrent to such crimes.

- **Emergency button beside seat**

  The passengers expect that the buses will be equipped with emergency buttons within the vicinity of the seats (and the standing areas) so that they can easily attract the attention of the conductor when they need something such as a certain emergency patient exit or harassment issue.

- **Speaker, microphone, and route information display board system**

  Buses equipped with display boards identifying the routes and the stops will be substantially helpful as often these are the most frequently asked questions by passengers. An automated system can also announce the information regarding the route, destination, approaching bus stops, and available interchanges.

- **Uniform and ID card system**

  Although not generally directly related to the redesign of the bus, the respondents opined that the driver, conductor, and staff at the bus stops should be in their uniforms and carry identity cards all the time so that they can be easily identified and approached when needed.

- **Ticket collection system**

  Passengers prefer the fare to be collected inside the bus and a receipt mentioning the fare to be provided to the passengers at the time the fare is being collected. This can be because often the arrival time of buses is highly unpredictable and in such cases, the passengers have options to shift to another bus operated by another company or another bus plying on a different route. Also, they can even shift to other available modes. Additionally, having the fare printed on the receipt will ensure that the passengers are not being charged an extra amount for their trip.

b. For policy maker and bus employee

- As a pilot study, a few buses can be introduced to accommodate the requested redesigns.
- Apart from these tangible changes, it is imperative to create awareness through education and special programs.
- Also, both the service providers and the public bus users should have aware of transport-related laws.
- A change of attitude towards female passengers along with coherent policy change is expected to yield a better outcome.
- It is also important that transport companies and their employees respect transportation laws that protect the rights of all passengers – especially female and disabled passengers so that people can experience an overall decent public transport service in Dhaka city.
- Also, government agencies need to safeguard that the laws are not neglected or abused. In case of violation, proper fines and punishment need to be strictly administered

Last but not the least, it should be understood that redesigning existing buses will provide means to improve the service quality of the public buses. However, it does not provide a one-stop solution to all the problems encompassing the existing bus services in Dhaka city.

5.4 Redesign recommendation

The fourth objective of the study was “recommend design improvements to existing bus interiors to improve the accessibility of female passengers to public buses”. For redesigning the interior of the existing public bus, passengers prioritize the following criteria under the top three subcriteria (in order of importance):

a. Females placed the highest priority on “safety and security” (“stair height”, “seat plan”, and “handle system outside the bus door”), as well as males (“stair height”, “railing or handle system”, “seat plan”). Female's normalized priorities for “safety and security” were 10% higher than men. It indicated that the current bus decks and steps, combined with the lack of railing on the bus doors, cause great discomfort to passengers especially female one (Rouf et al., 2018). Both genders have expressed their dissatisfaction with the current seating arrangement, which includes only 9 reserved seats for women, children, and the disabled.
b. For the criteria of “responsiveness and empathy” females ranked second (“uniform and identification card”, “ticket collection system”, and “emergency button near the seat”), while males ranked third (“ticket collection system”, “emergency button near seat”, “uniform and identity card”). Females normalized priorities for “responsiveness and empathy” were 18% higher than men This was supported by the findings of a previous study (Rouf et al., 2018), in which female bus users in Dhaka city reported a variety of uncomfortable situations connected to responsiveness and empathy.
c. Females were given the least priority in terms of “comfort” criteria (“seat space”, “facilities for disabled persons”, “standing facilities in bus”), while males were given the second-highest priority (“facilities for the disabled person”, “seat space”, “aisle space”). Men’s preference for “comfort” was 32% higher than females. This suggests that men are more sensitive to the comfort of the bus while women are less sensitive to it.

To fulfill this objective this study presented some sketches of the most popular redesign alternatives according to female priority options for the redesign of public buses illustrated in **Table 4.8**, **Table 4.9**, and **Table 4.10**. The findings from this objective are as follows:

a. In the redesigned bus, disabled people on their wheelchairs will be able to board and alight easily by landing clearance for the lift. Also, reserved facilities will be available.

b. The passengers would like to have separate seating areas for female and general passengers within the bus which can be accessed through two different doors.
c. The floor deck of the bus should be lowered and the step heights should be shorter.
d. Passengers should be able to board and alight safely by holding on to the railing and handle placed with the gate.
e. Within the seating area, the seats should be a bit wider; they should have retractable handles to increase privacy, and they should be made out of solid hard surfaces and covered with durable but soft materials.
f. The aisle space should be increased ensuring more standing capacity and ease of boarding and alighting.
g. To increase safety and comfort, the horizontal bars mounted above which the standing passengers currently hold on should have attached flexible handles.
h. Considering that summer in Dhaka can get quite hot, the respondents had several recommendations, such as relocating fans, installing sunroofs, and changing the window opening system.
i. Passengers expect all the drivers and supporting staff to be in uniform and carry ID cards.
j. Recommendation of display boards in the bus with enumerated routes and stops and announcements regarding stops will make the journey more convenient.
k. Passengers expect some modern facilities, such as mobile charging points, emergency buttons, GPS trackers, and CCTV cameras to be integral parts of modern buses in Dhaka city.
l. Passengers would like to introduce a ticketing machine for collecting fares by conductor inside the bus.
m. Apart from the respondents to the focus group discussion, it is noted that other distinct systems for safety, such as fire extinguisher, are already in place on Dhaka city's public buses. Also fire alarm, fire exit sign should be provided inside the bus.

5.5 Limitation and future scope

Seeking a better service quality and interior design of buses from the viewpoint of users can be an important practical solution for gender issues in transport services, which deserves more exploration. This study successfully shows several useful practical suggestions to improve the interior design of the public bus. Despite all the variables considered in the proposed framework for improving service quality and redesigning the interior of the public bus, there are still many opportunities for expanding the study and for validating the results. This research focuses on young educated female students and working women. This thesis only looks at the problem from the lens of the passengers. It would be more important to understand the viewpoint of service providers such as the public bus operators, transport authorities, and staff involved in service providing. Finally, a business model must be developed to ensure sustainable use of public transport. Moreover, this research can be expanded to other public transport modes in Dhaka city.

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APPENDICES

Appendix A

Questionnaire from service quality perception & preference for public bus users in Dhaka city: Through the lens of gender

In Dhaka, the traffic situation is deteriorating day by day. Sustainable city development requires reducing the use of private cars by improving the quality of public transport services. The obstacles that female passengers face in Dhaka city while taking public transit – especially buses, populate the electronic and print media on regular basis. This is forcing women to rely on other modes due to their different roles and travel pattern with comparing to men.

This is a survey questionnaire from which we are collecting valuable feedback from passengers both male and female by the method of the Analytic Network Process (ANP) to evaluate the perception and preference of service quality for using the public bus in Dhaka city. The identity of the respondents will be kept secret and information derived from the data will be presented only in aggregated form. The survey is expected to take around 20 minutes. Thank you for your cooperation in taking part in the survey.

Questionnaire

General Information:
Email ID/Phone:
Gender: (put a tick)

- ❑ **Male**
- ❑ **Female**

Profession:
Car ownership:
Age: <20 / 20-30 / 31-40 / >40

You are requested to compare the relative importance of two factors on a scale of 1 to 9 using Saaty's 1-9 scale (Saaty, 1996).

Saaty's 1-9 scale for Analytical Network Process (ANP) preference

Intensity of importance	Definition	Explanation
1	Equal importance	Two items contribute equally to the objective
3	Moderate importance	Experience suggests that one be slightly favored over the other
5	Strong importance	Experience suggests that one be strongly favored over the other
7	Very strong importance	Item strongly favored and its dominance demonstrated in practice
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values	Used to represent a compromise between priorities listed above

For example, in Part 1 choose the relative importance of reliability over comfort in evaluating the Bus service. If comfort should be strongly prioritized then assign a value of 5, which stands for strong importance in Saaty's scale, by encircling the number or placing a tick mark on it.

Reliability	9 8 7 6 5 4 3 2 1 2 3 4 (5) 6 7 8 9	Comfort

Some important terminologies:
Reliability: The quality of being trustworthy or of performing consistently well.
Responsiveness and Empathy: The capacity to understand what another person is experiencing and react quickly.
Alternatives: Needed new bus services over existing services.

Goal: Public Bus service based on passenger's perceptions and preference

Part-1

Compare relative Importance for each criterion

Sample question for comparing the first two factors (Reliability versus Comfort): In terms of evaluating "Public Bus service based on passenger's perception and preference". What should be the relative importance of Reliability consideration over Comfort?

Reliability	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Comfort
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Safety and security
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Responsiveness and Empathy
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Affordability
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Alternatives

Comfort	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Safety and security
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Responsiveness and Empathy
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Affordability
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Alternatives

Safety and security	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Responsiveness and Empathy
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Affordability
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Alternatives

Responsiveness and Empathy	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Affordability
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Alternatives

Affordability	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Alternatives

Part-2

Compare relative Importance for each sub- criteria

Criteria 1: Reliability

Sample question for comparing the first two sub criteria for reliability criteria (Availability of public bus versus Delays of the public bus): What is the relative service preference of Availability when compared to Startup Delays?

Availability	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No startup Delays
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Few delays while on the vehicle

No startup Delays	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Few delays while on the vehicle

Criteria 2: Comfort

Guaranteed/ Available seat	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Smooth and Comfortable ride
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Air Condition and good ventilation with curtain above window
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Proper Cleanliness

Smooth and Comfortable ride	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Air Condition and good ventilation with a curtain above the window
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Proper Cleanliness

Air Condition and good ventilation with curtain above window	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Proper Cleanliness

Criteria 3: Safety and Security

No mugging/ stealing/ pick pocketing	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No sexual harassment /assault/eve-teasing
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Less accident probability
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No probability of injuring or falling when passengers have to board and get down from running bus

No sexual harassment /assault /eveteasing	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Less accident probability
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No probability of injuring or falling when passengers have to board and get down from running bus

Less accident probability	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No probability of injuring or falling when passengers have to board and get down from running bus

Criteria 4: Responsiveness and Empathy

Pleasant behavior of bus employee (Bus driver and conductor)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	The willingness of bus employees to help
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Need procedure for follow-up on complaints

The willingness of bus employees to help	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Need procedure for follow-up on complaints

Criteria 5: Affordability

Cheap fares	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Occasionally fare change
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No Extra fare

Occasionally fare change	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No Extra fare

Part-3

Evaluation of alternative

Three alternative options for the sustainable Public Bus service are presented here for Dhaka city based on passengers' perceptions and preferences. The first one is, introducing separate buses for male and female bus users. The second one is, the same buses for male and female passengers and the last one is existing buses with redesigned interiors to make the buses more accessible to female passengers.

Sub Criteria 1: Availability

Sample question for comparing the first two alternatives for Availability sub criteria (separate buses for male and female bus users versus accommodating both of them in the same buses): What is the relative service preference of separate buses when compared to the same buses?

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 2: No Startup Delays

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 3: Few delays while on the vehicle

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 4: Guaranteed/ Available seat

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 5: Smooth and Comfortable ride

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior

Sub Criteria 6: Air Condition and good ventilation with a curtain above the window

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 7: Proper Cleanliness

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 8: No mugging/stealing/pickpocketing

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 9: No sexual harassment /assault/eve-teasing

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 10: Less accident probability

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to the female passenger

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria11: No probability of injuring or falling when passengers have to board and get down from running bus

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 12: pleasant behavior of bus employee (Bus driver and conductor)

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 13: Willingness of bus employees to help

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 14: Need procedure for follow-up on complaints

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 15: Cheap fares

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 16: Occasionally fare change

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Sub Criteria 17: No Extra fare

Separate buses for male and female bus users	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Same buses for male and female passengers
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Same buses For male and female passengers	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Existing buses with redesign the interior to make the buses more accessible to female passengers

Part-4

Alternative 1: Separate buses for male and female bus users

Sample question for comparing the sub criteria under "Reliability" for Separate buses for male and female bus users. In terms of evaluating Separate buses for male and female bus users, what should be the relative importance of Availability consideration over the No Startup Delays?

Availability	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No Startup Delays
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Few delays while on the vehicle

No Startup Delays	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Few delays while on the vehicle

Sample question for comparing the sub criteria under "comfort" for Separate buses for male and female bus users

Guaranteed/ Available seat	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Smooth and Comfortable ride
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Air Condition and good ventilation with curtain above window
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Proper Cleanliness

Smooth and Comfortable ride	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Air Condition and good ventilation with a curtain above the window
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Proper Cleanliness

Air Condition and good ventilation with curtain above window	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Proper Cleanliness

Sample question for comparing the sub criteria under “safety and security” for Separate buses for male and female bus users

No mugging/ stealing/ pick pocketing	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No sexual harassment /assault/eve-teasing
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Less accident probability
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No probability of injuring or falling when passengers have to board and get down from running bus

No sexual harassment /assault/eve-teasing	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Less accident probability
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No probability of injuring or falling when passengers have to board and get down from running bus

Less accident probability	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No probability of injuring or falling when passengers have to board and get down from running bus

Sample question for comparing the sub criteria under "Responsiveness and Empathy" for Separate buses for male and female bus user

pleasant behavior of bus employees (Bus driver and conductor)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Willingness of bus employee to help
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Need procedure for follow-up on complaints

The willingness of bus employees to help	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Need procedure for follow-up on complaints

Sample question for comparing the sub criteria under "Affordability" for Separate buses for male and female bus users

Cheap fares	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Occasionally fare change
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No Extra fare

Occasionally fare change	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No Extra fare

Alternative 2: Same buses for male and female passengers

Sample question for comparing the sub criteria under "Reliability" for same buses for male and female bus users

Availability	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No Startup Delays
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Few delays while on the vehicle

No Startup Delays	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Few delays while on the vehicle

Sample question for comparing the sub criteria under "comfort" for Same buses for male and female bus users

Guaranteed/ Available seat	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Smooth and Comfortable ride
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Air Condition and good ventilation with curtain above window
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Proper Cleanliness

Smooth and Comfortable ride	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Air Condition and good ventilation with a curtain above the window
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Proper Cleanliness

Air Condition and good ventilation with curtain above window	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Proper Cleanliness

Sample question for comparing the sub criteria under “safety and security” for same buses for male and female bus users

No mugging/ stealing/ pick pocketing	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No sexual harassment /assault/eve-teasing
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Less accident probability
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No probability of injuring or falling when passengers have to board and get down from running bus

No sexual harassment /assault/eve-teasing	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Less accident probability
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No probability of injuring or falling when passengers have to board and get down from running bus

Less accident probability	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No probability of injuring or falling when passengers have to board and get down from running bus

Sample question for comparing the sub criteria under “Responsiveness and Empathy” for same buses for male and female bus user

pleasant behavior of bus employees (Bus driver and conductor)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Willingness of bus employee to help
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Need procedure for follow-up on complaints

The willingness of bus employees to help	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Need procedure for follow-up on complaints

Sample question for comparing the sub criteria under “Affordability” for same buses for male and female bus user

Cheap fares	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Occasionally fare change
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No Extra fare

Occasionally fare change	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No Extra fare

Alternative 3: Existing buses with redesign the interior to make the buses more accessible to female passengers

Sample question for comparing the sub criteria under “Reliability” for existing buses with redesigning the interior to make the buses more accessible to female passengers

Availability	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Startup Delays
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Few delays while on the vehicle

Startup Delays	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Few delays while on the vehicle

Sample question for comparing the sub criteria under “Comfort” for existing buses with redesigning the interior to make the buses more accessible to female passengers

Guaranteed/ Available seat	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Smooth and Comfortable ride
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Air Condition and good ventilation with curtain above window
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Proper Cleanliness

Smooth and Comfortable ride	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Air Condition and good ventilation with a curtain above the window
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Proper Cleanliness

Air Condition and good ventilation with curtain above window	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Proper Cleanliness

Sample question for comparing the sub criteria under “Safety and security” for existing buses with redesigning the interior to make the buses more accessible to female passengers .

No mugging/stealing/ pick pocketing	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No sexual harassment /assault/eve-teasing
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Less accident probability
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No probability of injuring or falling when passengers have to board and get down from running bus

No sexual harassment /assault/eve-teasing	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Less accident probability
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No probability of injuring or falling when passengers have to board and get down from running bus

Less accident probability	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No probability of injuring or falling when passengers have to board and get down from running bus

Sample question for comparing the sub criteria under "Responsiveness and Empathy" for existing buses with redesigning the interior to make the buses more accessible to female passengers

Pleasant behavior of bus employee (Bus driver and conductor)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Willingness of bus employee to help
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Need procedure for follow-up on complaints

The willingness of bus employees to help	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Need procedure for follow-up on complaints

Sample question for comparing the sub criteria under "Affordability" for existing buses with redesigning the interior to make the buses more accessible to female passengers

Cheap fares	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Occasionally fare change
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No Extra fare

Occasionally fare change	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	No Extra fare

Reference:

Saaty, T.L. (1996). Decision Making with Dependence and Feedback: The Analytic Network Process, RWS Publications, Pittsburgh.

Appendix B

Questionnaire for Redesign the interior of public bus based on passenger's perception and preference

Nowadays female passengers face numerous problems traveling by bus in Dhaka city due to the current interior design of public buses which makes less attraction to use public transport and forces them to rely on walking or more expensive, private and paratransit modes. Redesigning the interior of the public bus can make the buses more accessible to female passengers and increase their mobility.

This is a survey questionnaire from which we are collecting valuable feedback from passengers both male and female to evaluate the perception and preference for the redesign of a public bus in Dhaka city. The identity of the respondents will be kept secret and information derived from the data will be presented only in aggregated form. The survey is expected to take around 10 minutes. Thank you for your cooperation in taking part in the survey.

Questionnaire

General Information:
Email ID/Phone:
Gender: (put a tick)

- ❑ **Male**
- ❑ **Female**

Profession:
Car ownership:
Age: <20 / 20-30 / 31-40 / >40

You are requested to compare the relative importance of two factors on a scale of 1 to 9 using Saaty's 1-9 scale (Saaty, 1996).

Saaty's 1-9 scale for Analytical Analytic Hierarchy Process (AHP) preference

Intensity of importance	Definition	Explanation
1	Equal importance	Two items contribute equally to the objective
3	Moderate importance	Experience suggests that one be slightly favored over the other
5	Strong importance	Experience suggests that one be strongly favored over the other
7	Very strong importance	Item strongly favored and its dominance demonstrated in practice
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values	Used to represent a compromise between priorities listed above

For example, Part 1 chooses the relative importance of comfort over Safety and security evaluating the redesign of public bus service to make the buses more accessible to female passengers. If Safety and security should be strongly prioritized then assign a value of 5, which stands for strong importance in Saaty's scale, by encircling the number or placing a tick mark on it.

Comfort	9 8 7 6 5 4 3 2 1 2 3 4 (5) 6 7 8 9	Safety and security

Some important terminologies:

Responsiveness and Empathy: The capacity to understand what another person is experiencing and react quickly.

Goal: Redesign the interior of public buses based on passenger's perceptions and preference

Part-1

Compare relative Importance for each criterion

Sample question for comparing the first two factors (Comfort versus Safety and security): In terms of evaluating “redesign the interior of public bus based on passenger's perception and preference”. What should be the relative importance of consideration of Comfort over Safety and security?

Comfort	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Safety and security
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Responsiveness and Empathy

Safety and security	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Responsiveness and Empathy

Part-2

Compare relative Importance for each sub- criteria

Criteria 1: Comfort

Sample question for comparing the first two sub criteria for Comfort criteria (Seat material versus Seat Space): What is the relative redesign preference of Seat material when compared to Seat Space?

Seat material	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Seat Space
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Aisle space
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Facilities for Disable person
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Standing facilities into bus
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Fan position
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Window system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Sunroof system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Mobile charger port

Seat Space	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Aisle space
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Facilities for Disable person
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Standing facilities into bus
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Fan position
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Window system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Sunroof system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Mobile charger port

Aisle space	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Facilities for Disable person
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Standing facilities into bus
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Fan position
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Window system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Sunroof system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Mobile charger port

Facilities for Disable person	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Standing facilities into bus
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Fan position
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Window system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Sunroof system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Mobile charger port

Standing facilities into bus Fan position	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Fan position
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Window system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Sunroof system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Mobile charger port

Fan position	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Window system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Sunroof system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Mobile charger port

Window system	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Sunroof system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Mobile charger port

Sunroof system	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Mobile charger port

Criteria 2: Safety and Security

Railing or handle system outside the door of the bus	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Stair size
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Door
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Seat plan
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	CCTV and GPS tracker
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Bus Information:

Stair size	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Door
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Seat plan
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	CCTV and GPS tracker
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Bus Information:

Door	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Seat plan
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	CCTV and GPS tracker
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Bus Information:

Seat plan	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	CCTV and GPS tracker
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Bus Information

CCTV and GPS tracker	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Bus Information

Criteria 3: Responsiveness and Empathy

Uniform system	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Emergency button beside seat
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Speaker, Microphone and route information display board system
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Ticket collection system

The emergency button beside the seat	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Speaker and Microphone system:
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Ticket collection system

Speaker and Microphone system	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Ticket collection system

Appendix C

Redesign the interior of a public bus to make the buses more accessible to female passengers

Nowadays female passengers face numerous problems traveling by bus in Dhaka city due to the current interior design of public buses which makes less attraction to use public transport and forces them to rely on walking or more expensive, private and paratransit modes. Redesigning the interior of the public bus can make the buses more accessible to female passengers and increase their mobility.

This is a survey questionnaire from which we are collecting valuable feedback from passengers both male and female to evaluate the perception and preference for the redesign of a public bus in Dhaka city. The identity of the respondents will be kept secret and information derived from the data will be presented only in aggregated form. The survey is expected to take around 10 minutes. Thank you for your cooperation in taking part in the survey.

Questionnaire

General Information:
Email ID/Phone:
Gender: (put a tick)
❑Male
❑Female
Age: <20 / 20-30 / 31-40 / >40

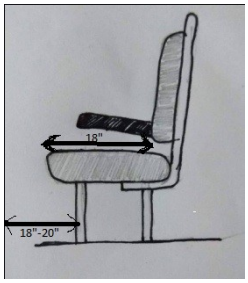
Put a tick in the circle that prefers by you most

Criteria 1: Comfort

Seat material

○ Existing bus	○ Option 1	○ Option 2
The seat is made of resin and cloth and there is a gap in the lower backside 	Solid plastic seat, like a BRTC bus seat 	Solid seat with no gap in the lower back made with resin or cloth 

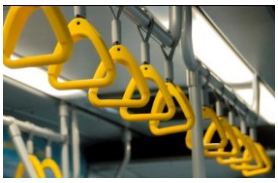
Seat Space

○ Existing bus	○ Option 1	○ Option 2
Narrow seat without handle between two seats with narrow space in front of the seat 	Large seat with more space in front of the seat 	Large seat with handle and more space in front of the seat 

Aisle space

○ **Existing bus**	○ **Option 1**
Narrow space 	Wide and more space 

Standing facilities on the bus

○ **Existing bus**	○ **Option 1**	○ **Option 2**
Only bar, no handle to hold for standing facility 	Bar with handle for standing facilities 	Low height, flexible handle with bar 

Facilities for Disable person

○ **Existing bus**	○ **Option 1**
NO "wheelchair lift" and sitting space in the bus for disable	Available "wheelchair lift" and sitting space in the bus for disable  

Fan position

○ **Existing bus**	○ **Option 1**
Middle of the bus hanging from the roof 	A fan is placed on top of the window in an inclined position 

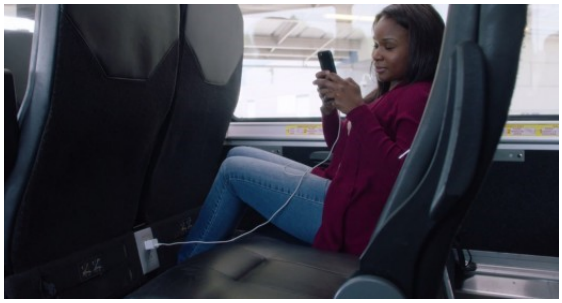
Window system

○ **Existing bus**	○ **Option 1**
Sliding glass window 	Pull up and down window with glass and ripped sheet-like train 

Sunroof system

○ **Existing bus**	○ **Option 1**
No sunroof 	Sunroof system 

Mobile charger port

○ **Existing bus**	○ **Option 1**
No mobile charger port is available	Mobile charger port beside every seat 

Criteria 2: Safety and security

Railing or handle system outside the door of the bus

○ **Existing bus**	○ **Option 1**
No railing or handle system outside the door of the bus 	Railing or handle system outside the door of the bus for passenger ups and downs 

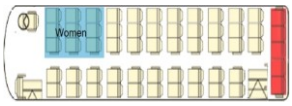
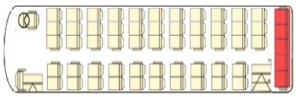
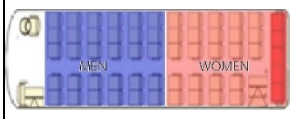
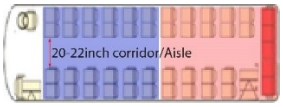
Stair size

○ Existing bus	○ Option 1
Bus height and stair size are the same as now 	The low height of the bus minimized the “rise and step” of the stairs of the bus 

Door

○ Existing bus	○ Option 1
Only one door with one male conductor for getting up and down for passengers 	Two separate doors and conductor for male and female passengers’ perspectives. 

Seat plan

○ Existing bus	○ Option 1	○ Option 2	○ Option3
9 seats are available for females and others are general 	No designated seat for female 	One portion seat of the bus near the female entry door should be designated for females and others are general seats. 	Same as option 2 but more space for standing position with fewer seat facilities 

Bus Information:

○ Existing bus	○ Option 1
No bus information is attached with the seat 	Bus information like bus number, route name, route map, barcode, is attached or printed with the bus seat 

CCTV and GPS tracker

○ **Existing bus**	○ **Option 1**
No CCTV and GPS tracker	Available CCTV and GPS tracker  

Criteria 3: Responsiveness and empathy:

Uniform system

○ **Existing bus**	○ **Option 1**
No uniform or id system for bus employees	Bus employee have their own uniform with an id card 

Ticket collection system

○ **Existing bus**	○ **Option 1**	○ **Option 2**
Ticket collected by conductor into the bus from passengers 	Ticket collected from bus stand 	Tickets are collected by a conductor with a ticket machine into the bus 

The emergency button beside the seat

○ **Existing bus**	○ **Option 1**
No emergency button available to contract with the conductor	Emergency button available to contract with conductor for passengers ups and downs 

Speaker and Microphone system:

○ **Existing bus**	○ **Option 1**
No Speaker and Microphone system for bus employees to contract with passengers	Speaker and Microphone system and also route information display board is available for bus employee to contract with passengers  

Appendix D

Unweighted supermatrix for female

Cluster Labels	Node	Alternative			Reliability			Comfort				Safety & security				Responsiveness & empathy			Affordability		
		Separate buses	Same buses	Existing buses with the redesign of the interior	1A	2NSD	3FDWV	1GS	2SCR	3ACGV	4PC	2NS	1NSH	3LAP	4NPIPBGRB	1PBBE	2WBEH	3NPFC	2CF	1OFC	3NEF
Alternative	Separate buses	0	0	0	0.319	0.474	0.387	0.387	0.428	0.457	0.428	0.428	0.527	0.443	0.332	0.428	0.4	0.428	0.428	0.443	0.376
	Same buses	0	0	0	0.122	0.149	0.169	0.169	0.142	0.126	0.142	0.142	0.139	0.169	0.139	0.142	0.2	0.142	0.142	0.169	0.149
	Existing buses with redesign of the interior	0	0	0	0.558	0.376	0.443	0.443	0.428	0.416	0.428	0.428	0.332	0.387	0.527	0.428	0.4	0.428	0.428	0.387	0.474
Reliability	1A	0.634	0.673	0.708	0.627	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2NSD	0.287	0.225	0.178	0.279	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3FDWV	0.077	0.100	0.112	0.093	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comfort	1GS	0.418	0.469	0.480	0	0	0	0.487	0	0	0	0	0	0	0	0	0	0	0	0	0
	2SCR	0.249	0.239	0.254	0	0	0	0.223	0	0	0	0	0	0	0	0	0	0	0	0	0
	3ACGV	0.109	0.110	0.112	0	0	0	0.126	0	0	0	0	0	0	0	0	0	0	0	0	0
	4PC	0.222	0.180	0.152	0	0	0	0.162	0	0	0	0	0	0	0	0	0	0	0	0	0

Safety & security	2NS	0.176	0.132	0.112	0	0	0	0	0	0	0	0.158	0	0	0	0	0	0	0	0	0
	1NSH	0.551	0.622	0.611	0	0	0	0	0	0	0	0.548	0	0	0	0	0	0	0	0	0
	3LAP	0.136	0.119	0.146	0	0	0	0	0	0	0	0.146	0	0	0	0	0	0	0	0	0
	4NPIPBGRB	0.136	0.125	0.129	0	0	0	0	0	0	0	0.146	0	0	0	0	0	0	0	0	0
Responsiveness & empathy	1PBBE	0.493	0.493	0.493	0	0	0	0	0	0	0	0	0	0	0	0.412	0	0	0	0	0
	2WBEH	0.310	0.310	0.310	0	0	0	0	0	0	0	0	0	0	0	0.259	0	0	0	0	0
	3NPFC	0.195	0.195	0.195	0	0	0	0	0	0	0	0	0	0	0	0.327	0	0	0	0	0
Affordability	2CF	0.466	0.474	0.474	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.466	0	0
	1OFC	0.100	0.149	0.149	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.10	0	0
	3NEF	0.433	0.376	0.376	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.433	0	0

Unweighted supermatrix for male

Cluster Node Labels		Alternative			Reliability			Comfort				Safety & security				Responsiveness & empathy			Affordability		
		Separate buses	Same buses	Existing buses with the redesign of the interior	1A	2NSD	3FDWV	1GS	2SCR	3ACGV	4PC	2NS	1NSH	3LAP	4NPIPBGRB	1PBBE	2WBEH	3NPFC	2CF	1OFC	3NEF
Alternative	Separate buses	0	0	0	0.413	0.413	0.4	0.413	0.333	0.327	0.333	0.493	0.55	0.333	0.413	0.319	0.333	0.327	0.327	0.327	0.24
	Same buses	0	0	0	0.26	0.26	0.2	0.26	0.333	0.413	0.333	0.311	0.21	0.333	0.26	0.46	0.333	0.413	0.413	0.413	0.55
	Existing buses with redesign of the interior	0	0	0	0.327	0.327	0.4	0.327	0.333	0.26	0.333	0.196	0.24	0.333	0.327	0.221	0.333	0.26	0.26	0.26	0.21
Reliability	1A	0.674	0.634	0.691	0.327	0.333	0.333	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2NSD	0.226	0.174	0.149	0.413	0.333	0.333	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3FDWV	0.101	0.192	0.16	0.26	0.333	0.333	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comfort	1GS	0.466	0.338	0.483	0	0	0	0.541	0	0	0	0	0	0	0	0	0	0	0	0	0
	2SCR	0.254	0.27	0.183	0	0	0	0.189	0	0	0	0	0	0	0	0	0	0	0	0	0
	3ACGV	0.089	0.154	0.105	0	0	0	0.124	0	0	0	0	0	0	0	0	0	0	0	0	0
	4PC	0.191	0.237	0.229	0	0	0	0.147	0	0	0	0	0	0	0	0	0	0	0	0	0

Safety & security	2NS	0.354	0.237	0.243	0	0	0	0	0	0	0	0.386	0	0	0	0	0	0	0	0	0
	1NSH	0.354	0.365	0.343	0	0	0	0	0	0	0	0.242	0	0	0	0	0	0	0	0	0
	3LAP	0.131	0.26	0.243	0	0	0	0	0	0	0	0.204	0	0	0	0	0	0	0	0	0
	4NPIPBGRB	0.161	0.139	0.172	0	0	0	0	0	0	0	0.168	0	0	0	0	0	0	0	0	0
Responsiveness & empathy	1PBBE	0.413	0.333	0.493	0	0	0	0	0	0	0	0	0	0	0	0.594	0	0	0	0	0
	2WBEH	0.26	0.333	0.311	0	0	0	0	0	0	0	0	0	0	0	0.249	0	0	0	0	0
	3NPFC	0.327	0.333	0.196	0	0	0	0	0	0	0	0	0	0	0	0.157	0	0	0	0	0
Affordability	2CF	0.474	0.474	0.584	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.61	0	0
	1OFC	0.149	0.149	0.184	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.166	0	0
	3NEF	0.376	0.376	0.232	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.225	0	0

Appendix E

Weighted supermatrix for female

Cluster	Node Labels	Alternative			Reliability			Comfort				Safety & security				Responsiveness & empathy			Affordability		
		Separate buses	Same buses	Existing buses with the redesign of the interior	1A	2NSD	3FDWV	1GS	2SCR	3ACGV	4PC	2NS	1NSH	3LAP	4NPIPBGRB	1PBBE	2WBEH	3NPFC	2CF	1OFC	3NEF
Alternative	Separate buses	0	0	0	0.213	0.474	0.387	0.194	0.429	0.458	0.429	0.071	0.528	0.443	0.333	0.143	0.4	0.429	0.214	0.443	0.376
	Same buses	0	0	0	0.081	0.149	0.169	0.085	0.143	0.126	0.143	0.024	0.14	0.169	0.14	0.048	0.2	0.143	0.071	0.169	0.149
	Existing buses with redesign of the interior	0	0	0	0.372	0.376	0.443	0.222	0.429	0.416	0.429	0.071	0.333	0.387	0.528	0.143	0.4	0.429	0.214	0.387	0.474
Reliability	1A	0.067	0.071	0.074	0.209	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2NSD	0.03	0.024	0.019	0.093	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3FDWV	0.008	0.011	0.012	0.031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Comfort	1GS	0.046	0.052	0.053	0	0	0	0.244	0	0	0	0	0	0	0	0	0	0	0	0	0
	2SCR	0.028	0.026	0.028	0	0	0	0.112	0	0	0	0	0	0	0	0	0	0	0	0	0
	3ACGV	0.012	0.012	0.012	0	0	0	0.063	0	0	0	0	0	0	0	0	0	0	0	0	0
	4PC	0.025	0.02	0.017	0	0	0	0.081	0	0	0	0	0	0	0	0	0	0	0	0	0
Safety & security	2NS	0.1	0.076	0.064	0	0	0	0	0	0	0	0.132	0	0	0	0	0	0	0	0	0
	1NSH	0.314	0.354	0.348	0	0	0	0	0	0	0	0.457	0	0	0	0	0	0	0	0	0
	3LAP	0.077	0.068	0.083	0	0	0	0	0	0	0	0.122	0	0	0	0	0	0	0	0	0
	4NPIPBGRB	0.077	0.071	0.074	0	0	0	0	0	0	0	0.122	0	0	0	0	0	0	0	0	0
Responsiveness & empathy	1PBBE	0.065	0.065	0.065	0	0	0	0	0	0	0	0	0	0	0	0.275	0	0	0	0	0
	2WBEH	0.041	0.041	0.041	0	0	0	0	0	0	0	0	0	0	0	0.173	0	0	0	0	0
	3NPFC	0.026	0.026	0.026	0	0	0	0	0	0	0	0	0	0	0	0.218	0	0	0	0	0
Affordability	2CF	0.039	0.04	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.233	0	0
	1OFC	0.008	0.013	0.013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.05	0	0
	3NEF	0.037	0.032	0.032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.217	0	0

Weighted supermatrix for male

Cluster Labels	Node	Alternative			Reliability			Comfort				Safety & security				Responsiveness & empathy			Affordability		
		Separate buses	Same buses	Existing buses with the redesign of the interior	1A	2NSD	3FDWV	1GS	2SCR	3ACGV	4PC	2NS	1NSH	3LAP	4NPIPBGRB	1PBBE	2WBEH	3NPFC	2CF	1OFC	3NEF
Altemative	Separate buses	0	0	0	0.206	0.206	0.2	0.206	0.333	0.327	0.333	0.164	0.55	0.333	0.413	0.213	0.333	0.327	0.164	0.327	0.24
	Same buses	0	0	0	0.13	0.13	0.1	0.13	0.333	0.413	0.333	0.104	0.21	0.333	0.26	0.307	0.333	0.413	0.206	0.413	0.55
	Existing buses with redesign of the interior	0	0	0	0.164	0.164	0.2	0.164	0.333	0.26	0.333	0.065	0.24	0.333	0.327	0.147	0.333	0.26	0.13	0.26	0.21
Reliability	1A	0.165	0.156	0.17	0.164	0.167	0.167	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2NSD	0.055	0.043	0.037	0.206	0.167	0.167	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3FDWV	0.025	0.047	0.039	0.13	0.167	0.167	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comfort	1GS	0.057	0.041	0.059	0	0	0	0.27	0	0	0	0	0	0	0	0	0	0	0	0	0
	2SCR	0.031	0.033	0.022	0	0	0	0.094	0	0	0	0	0	0	0	0	0	0	0	0	0
	3ACGV	0.011	0.019	0.013	0	0	0	0.062	0	0	0	0	0	0	0	0	0	0	0	0	0
	4PC	0.023	0.029	0.028	0	0	0	0.073	0	0	0	0	0	0	0	0	0	0	0	0	0

Safety & security	2NS	0.144	0.096	0.098	0	0	0	0	0	0	0	0.257	0	0	0	0	0	0	0	0	0
	1NSH	0.144	0.148	0.139	0	0	0	0	0	0	0	0.161	0	0	0	0	0	0	0	0	0
	3LAP	0.053	0.105	0.098	0	0	0	0	0	0	0	0.136	0	0	0	0	0	0	0	0	0
	4NPIPBGRB	0.065	0.056	0.07	0	0	0	0	0	0	0	0.112	0	0	0	0	0	0	0	0	0
Responsiveness & empathy	1PBBE	0.038	0.03	0.045	0	0	0	0	0	0	0	0	0	0	0	0.198	0	0	0	0	0
	2WBEH	0.024	0.03	0.028	0	0	0	0	0	0	0	0	0	0	0	0.083	0	0	0	0	0
	3NPFC	0.03	0.03	0.018	0	0	0	0	0	0	0	0	0	0	0	0.052	0	0	0	0	0
Affordability	2CF	0.064	0.064	0.079	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.305	0	0
	1OFC	0.02	0.02	0.025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.083	0	0
	3NEF	0.051	0.051	0.031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.112	0	0

Appendix F

Limit supermatrix for female

Cluster Node Labels		Alternative			Reliability			Comfort				Safety & security				Responsiveness & empathy			Affordability		
		Separate buses	Same buses	Existing buses with the redesign of the interior	1A	2NSD	3FDWV	1GS	2SCR	3ACGV	4PC	2NS	1NSH	3LAP	4NPIPBGRB	1PBBE	2WBEH	3NPFC	2CF	1OFC	3NEF
Alternative	Separate buses	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202
	Same buses	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066
	Existing buses with redesign of the interior	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181	0.181
Reliability	1A	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	2NSD	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
	3FDWV	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006

Comfort	1GS	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	2SCR	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
	3ACGV	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
	4PC	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
Safety & security	2NS	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
	1NSH	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
	3LAP	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	4NPIPBGRB	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
Responsiveness & empathy	1PBBE	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	2WBEH	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
	3NPFC	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Affordability	2CF	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
	1OFC	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
	3NEF	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Limit supermatrix for male

Cluster Node Labels		Alternative			Reliability			Comfort				Safety & security				Responsiveness & empathy			Affordability		
		Separate buses	Same buses	Existing buses with the redesign of the interior	1A	2NSD	3FDWV	1GS	2SCR	3ACGV	4PC	2NS	1NSH	3LAP	4NPIPBGRB	1PBBE	2WBEH	3NPFC	2CF	1OFC	3NEF
Alternative	Separate buses	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163
	Same buses	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126	0.126
	Existing buses with redesign of the interior	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119
Reliability	1A	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	2NSD	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056
	3FDWV	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044
Comfort	1GS	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	2SCR	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
	3ACGV	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
	4PC	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013

Safety & security	2NS	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064
	1NSH	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069
	3LAP	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
	4NPIPBGRB	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
Responsiveness & empathy	1PBBE	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	2WBEH	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
	3NPFC	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
Affordability	2CF	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	1OFC	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
	3NEF	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023