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*Research Article*

# The role of Public Transport in addressing Sustainable Mobility for the Elderly Population in Malta

**Deborah Mifsud**[1] **and Maria Attard**[1]
[1]Institute for Climate Change and Sustainable Development, University of Malta, Msida, Malta

**Abstract.** Over the past few years, several countries have continued experiencing a growth in their elderly population. Similarly, a number of towns and villages in Malta registered a high elderly population in the last census (NSO, 2012). The elderly people are one of the dominant 'transport disadvantaged' groups in the community. This research aims to analyse whether the current public transport system in Malta is providing effective and efficient mobility for elderly in the town of Luqa. In order to analyse this, the study analysed spatial accessibility, sought to identify barriers encountered by the elderly when using public transport and determine temporal accessibility to medical care. Data was collected using telephone surveys, travel time and bus frequency surveys. Statistical analysis was carried out using IBM SPSS 20 and Geographic Information Systems. The study showed that proximity to bus stops in Luqa does not affect public transport use amongst the elderly. The main barriers that elderly encounter when using public transport are mainly related to long waiting times, lack of comfort on bus stops and inaccessible travel information. Finally, temporal accessibility from Luqa to the State's general hospital, Mater Dei, still requires improvements as it does not meet the desired time budgets of elderly people. By identifying the main concerns this study seeks to encourage policy makers and planners to target future development in public transport taking into consideration the requirements of the growing elderly population.

**Keywords** Elderly population – Public transport – Spatial and temporal accessibility – Barriers in public transport – Luqa.

## 1 Introduction

A main goal of sustainable mobility is to meet the travel demands of present and future population. One major demographic group which has specific mobility needs is the elderly population. Globally there are 800 million people (11% of the global population) that are over 60 years, and this is set to increase to two billion by 2050, representing 22 per cent of the global population (Bloom et al., 2011). The Maltese Islands are following the same trend. In 2011 the number of elderly people over 65 years of age in Malta was 67,841, representing 16.3 per cent of the whole population, compared to 13.7 per cent in 2005 (NSO, 2012). Projections by the National Statistics Office (2011) reveal that the elderly population in the Maltese Islands will increase by 72 per cent in 2060 when compared to this segment of the population in 2010. Therefore, with such a continuous increase in the number of elderly people, analysing their mobility needs is fundamental because such growth will challenge the current transport and urban infrastructure. Different system requirements will be necessary to provide equal travel opportunities that support elderly mobility independence.

Sustainable mobility requires the need to promote travelling through an accessible and reliable public transport system (Gutiérrez et al., 2011). The elderly are one of the "transport disadvantaged groups" in society, that is people that use public transport because they have no other choice due to various factors, mainly age, disability, income and no access to private means of transport (Beimborn et al., 2003). Hence, one main contribution of public transport is to potentially

*Correspondence to*: D. Mifsud (deborah.mifsud@um.edu.mt)

minimize social exclusion and increase social justice for those in need (Farrington and Farrington, 2005). Lucas (2012) explains the interrelationship between transport disadvantage and other key issues that can lead to social exclusion (Fig.(1)). Being transport disadvantaged does not necessary mean being social disadvantaged. However these two aspects usually merge directly or indirectly and cause transport poverty. This subsequently results in inaccessibility to fundamental goods and services as well as exclusion from decision-making processes. As a result, social exclusion and further transport inequalities then follow.

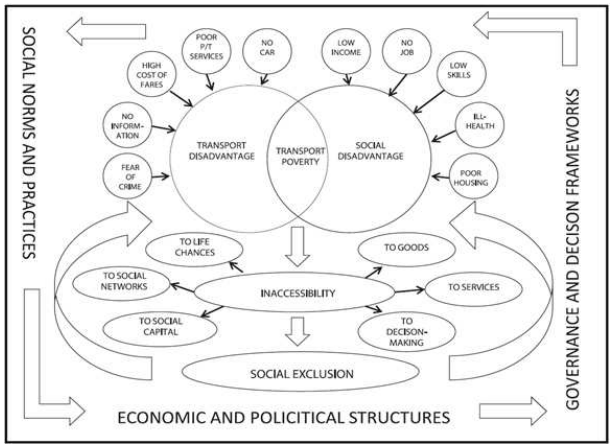


Figure 1: The relationship between transport disadvantage, social disadvantage and social exclusion. Source: Lucas (2012).

Consequently, accessible and reliable public transport is essential to provide the necessary mobility for the transport disadvantaged elderly. Marsden et al. (2007) state that for older people, the journey itself and the feeling of freedom it gives them, are often more important than the actual destination. Consequently, lack of access to transport among older persons could result in social isolation, lower self-esteem, feelings of uselessness, loneliness, unhappiness, low levels of physical activity, reduced independence and depression, which contribute to further poorer health conditions and risks (Victor et al., 2005; Hess, 2009). Shergold and Parkhurst (2010) explain that public transport, in the form of buses, is a key measure to support social sustainability as it helps to avoid social exclusion.

However, public transport is not always a reasonable substitute for private transport for older people (Hess, 2009). The use of public transport by the elderly is negatively affected by several restrictions such as physical limitations, lack of accessibility (e.g. absence of low floor buses, dangerous busy roads and high curbs), fear of falling, safety, bus design, bus driver behaviour, and overall declining quality of public transport systems (Wixey et al., 2005; Marsden et al., 2007). Also, public transport is often oriented towards commuters travelling during peak hours and hardly ever for the off-peak hours when elderly travel the most.

Another important issue to consider when analysing barriers in public transport is travel time. It is an important indicator for both operators and users and significantly impacts transport costs and benefits, particularly in regions trying to foster a modal shift to public transport (Newman and Kenworthy, 1999). Tribby and Zandbergen (2012) explain how determining changes in travel times is one measure of assessing public transport's accessibility equity. This type of accessibility is sometimes more important to study in public transport because frequency and service hours can make some of the necessary, but not temporally fixed obligations unreachable by bus. In actual fact, a crucial obligation, with particular reference to elderly people, is the access to medical care. Although healthier than their European counterparts, in 40 years' time Malta's elderly population will reach the 108,000 mark, of which 20 per cent are expected to require hospitalisation (Times of Malta, 2012). Hence, good and equal access to health care services is crucial for the elderly (Department of Health, 2002).

## 2 Proposed Methodology

The methodology proposed in this work aimed to analyse the relationship between elderly people and public transport accessibility. This was tackled through the analysis of spatial and temporal accessibility together with the analysis of barriers that elderly encounter when using public transport. Spatial and temporal accessibility are two main factors that affect public transport usage (Murray and Wu, 2003) and which fit into the multi-dimensionality of accessibility as a means to measure equity (Tribby and Zandbergen, 2012). However, good accessibility is usually hindered by several barriers. For this reason, the research highlights these obstacles and provides suggestions to minimise their impact. The main data collection methods used were (i) 200 telephone surveys to a sample of elderly people residing in Luqa, (ii) a GPS to locate the elderly residences and, (iii) travel time and bus frequency surveys to analyse temporal accessibility to the State's general hospital in Malta, Mater Dei. The research was carried out throughout a period of one year and three months (November 2011 – February 2013) of which two months (May –June 2012) were utilised for the telephone surveys data collection and another one month (July 2012) for the travel time and bus frequency surveys.

Telephone surveys were chosen because as Conrad and Schober (2000) explain, conversational interviewing ensures a uniform interpretation of the intent of each question. Telephone surveys also have large scale accessibility, particularly for elderly. A high percentage of old

people do not have access to a computer or to the internet so the telephone is the best way of communication for them. Telephone surveys are also more 'safe' compared to a home visit which creates a sense of 'fear'.

Several studies concerning accessibility only dealt with spatial accessibility (proximity). However as emphasised by other researchers, including Cheng (2008), Mavoa et al. (2011) and Tribby and Zandbergen (2012), public transport accessibility should include the walking time to bus stop (spatial accessibility), waiting time, trip journey and walking time from the disembarking stop to destination. In this study, the Closest Facility Function within the Network Analyst Extension in ArcGIS 10 was used to determine the average walking time from the elderly residences to their nearest bus stop. Service frequency is another vital aspect of accessibility and like travel time it can vary markedly between peak and off-peak hours. Bus frequency was analysed by listing all the public transport trips (of different routes) arriving on the respective bus stops.

The Pearson Chi-Square Statistical Test was used to analyse the relationship between various variables and the Kruskal Wallis Statistical Test was used to statistically analyse the effect of proximity to bus stop on public transport use. IBM SPSS 20 was used for the statistical analysis. ESRI's ArcGIS 10 with Network Analyst was used to spatially analyse the geographic data and visualise the results. The Network Analyst extension was specifically used to create buffers around the actual road network and provide a clearer picture of the actual walking distances between the sampled households and the location of bus stops. The Service Area Tool within Network Analyst was used to illustrate the catchment area based on the distance impedance factor. This means that the amount of resistance required to traverse paths in the network to access the bus stop was measured through walking distance. Higher impedance values indicated more resistance to movement.

# 3 The case study – the town of Luqa

Luqa is a town situated in the southeast of Malta, 6.4 kilometres away from the capital city, Valletta (Guillaumier, 2002). Hospital and medical centres are identified as common destinations for elderly people (Fuchs, 1999). The State's general hospital, Mater Dei is located in Msida and was the targeted destination for analysing temporal accessibility to medical care (Fig.(2)).The elderly people in Luqa (60+) amount to 31.65 per cent of the entire locality population (NSO, 2007). Nonetheless it should be highlighted that this population figure, derived from the 2005 Census of Population and Housing, include persons residing in institutions. For this reason, a very important contribution for the high elderly population in Luqa is the state residential home of St Vincent de Paule (the largest elderly residential home in Malta established in 1862). It currently hosts approximately 1,000 residents. Therefore, excluding the number of elderly residing in St Vincent de Paule, the percentage of elderly people in Luqa is approximately 18.5 per cent. Luqa is also identified as one of the localities in Malta that is likely to have an increase in the number of elderly people in the future (MEPA, 2006).

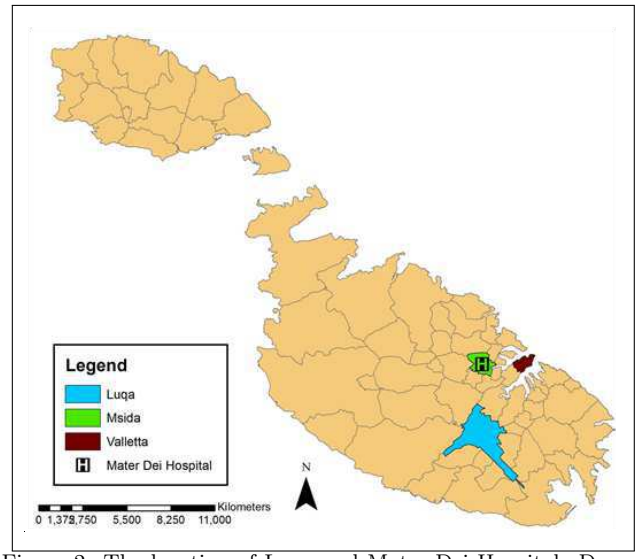


Figure 2: The location of Luqa and Mater Dei Hospital. Drawn by author.

Luqa is a residential town which still retains a traditional nucleated morphology. Its historical core is characterized by a narrow organic street pattern. The settlement's shape is organized in concentric streets radiating from the main parish church (MEPA, 2006). Luqa also has an expanding hamlet, Hal Farrug. It was therefore very interesting to analyse the patterns of residence of elderly people in relation to the public transport network (proximity). Despite being a traditional town, very important land uses and landmarks such as the Malta International Airport and St Vincent de Paule Elderly Residence are located in this town (Fig.(3)). These highly influence the transport network as well as the way public transport operates. No transport studies have ever been carried specifically focusing on this town therefore studying and analysing mobility demands of the older population(in particular trips to the general hospital) was essential, especially for future planning and investment in the public transport infrastructure.

# 4 Results and Discussions

The results of the surveys showed that only 35.5 per cent of the sampled elderly population in Luqa were in possession of a driving licence. In addition to this, 12.5 per cent of the males and 35 per cent of the females who held a valid driving licence did not own a car. Sixty-six per cent of the elderly were weekly-bus users. This confirmed what was discussed in Section 1 that the elderly highly depend on public transport for their mobility needs. Nonetheless, this study also showed high car availability because despite the fact that 85.5 per cent of thesample did not own a car, they claimed to have access to one. The main travel purposes identified through the questionnaire were shopping and medical care. The most common modes of transport were walking and by car. The bus was mainly used by the older old, particularly females, for medical purposes.

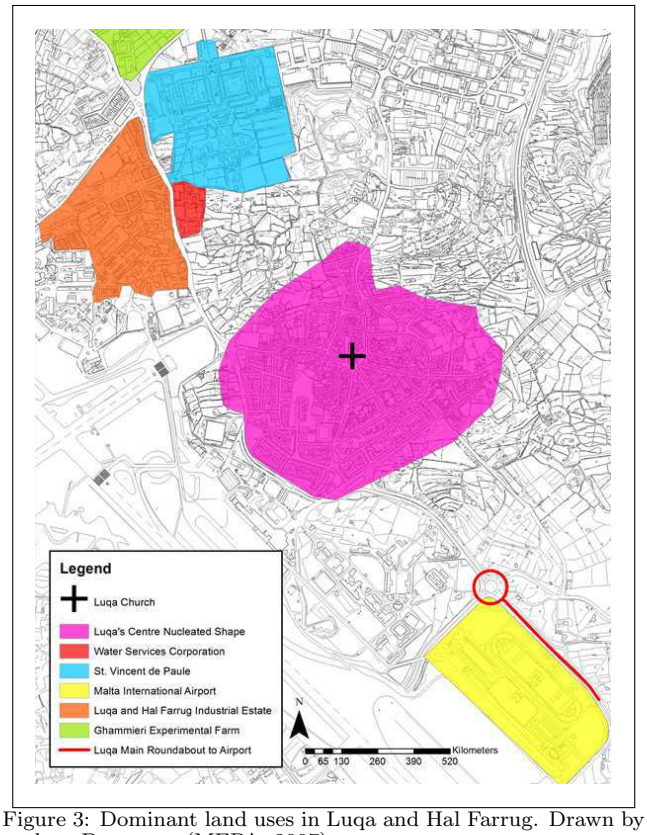



Figure 3: Dominant land uses in Luqa and Hal Farrug. Drawn by author; Base map (MEPA, 2007)

The surveys also revealed that age, health condition and car availability affect mostly public transport usage.It was also evident that health status, car availability and long waiting times at bus stops were the primary reasons for low public transport use amongst the sampled population.

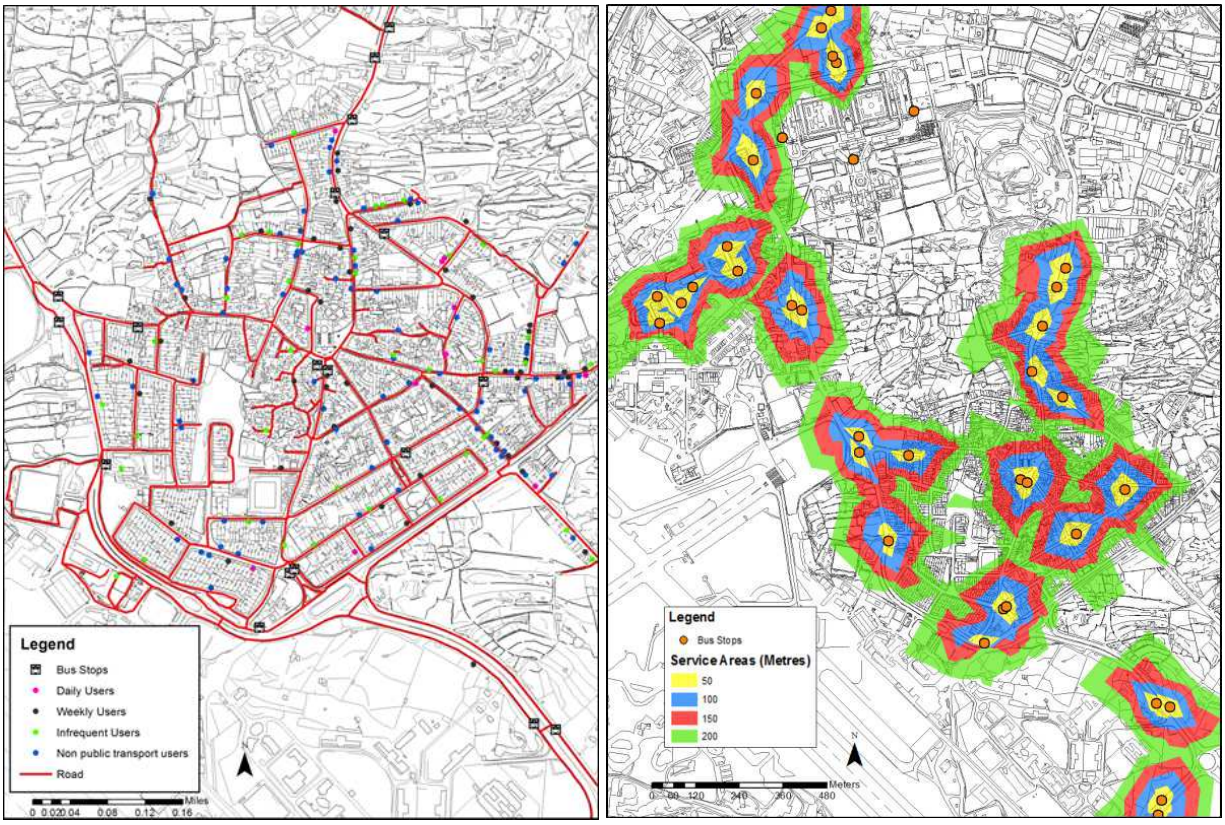
## 4.1 Spatial Accessibility

Spatial accessibility is one of the primary determinants of public transport use and only in the presence of such accessibility will a user consider other factors such as cost, comfort and security (Beimborn et al., 2003). It is nearly universally accepted that a 400 metres walking distance to the nearest bus stop is the maximum distance that people of all ages are willing to comfortably walk to access public transport (Murray and Davis, 2001; Zhao et al., 2003). However, these figures are not applicable to the local context due to the small size of the Maltese Islands. The average service area distance for Malta to access a bus stop is only 150 metres (MEPA, 2003). Obviously, this issue is more critical for the elderly population due to their age and related physical constraints. A Kruskal Wallis p-value of 0.239 indicated that the mean duration (in minutes) to reach the nearest bus stop did not vary much between the elderly people who use public transport daily, weekly, infrequently and never.

In order to analyse this issue spatially, the Network Analyst Extension in ArcGIS10 was used. The pedestrian network was created and eventually the sampled elderly residences (visualised according to public transport usage) and the bus stops were inputted. Their location was determined through the use of a GPS (Fig.(4a)). The impedance factor used in the study was 'metres' representing the distance that the elderly people have to walk through the network in order to reach their nearest bus stop. Ultimately, based on the inputted layers (Fig.(4a)) the creation of service areas determined whether elderly living closest to bus stops were frequent bus users or not (Fig.(4b)). The highest percentage of all elderly people fell within the 200 metres service area, meaning that for most of the sampled population, the 150 metres national threshold was exceeded. Moreover 66 per cent of the frequent bus users were also within the outer buffers which showed that proximity was not a crucial determinant for public transport use. The main conclusion of this analysis showed that proximity to bus stops was not a determinant factor affecting public transport use for sample population of elderly in Luqa.

## 4.2 Barriers encountered by elderly when using public transport

The research showed that 72 per cent of the sampled elderly people in Luqa encountered barriers when using public transport. The two most common barriers were long waiting times followed by a high criticism of the bus stops' infrastructure and comfort. These two issues are highly correlated to each other especially for older adults waiting in different weather conditions. The average walking speed for elderly people is of 1.3 metres




(a) Visualisation of the elderly addresses (divided according to public transport use), bus stops and road network in Luqa. Drawn by author.

(b) Formation of Service Areas (50, 100, 150, 200 metres) around the bus stops in Luqa and Hal Farrug, based on the road and bus stop layers. Drawn by author.

Figure 4

per second whilst that of younger adults is of 1.5 metres/second (Bohannon, 1997; Carey, 2005; Kang and Digwell, 2007). Therefore when dividing the average walking time to reach the nearest bus stop for a younger adult by that of an elderly there was an approximate difference of 86.7 per cent. This highlights the importance of good spatial accessibility for elderly. Although 150 metres are a relatively short distance, for most cases they were exceeded. When neighbourhood barriers were analysed, a considerable percentage (37 per cent) of the frequent users also complained that bus stops are not well distributed to cater for the needs of users from different zones and are also difficult to access due to traffic. This also leads to accumulative time wasted because pedestrians have to wait long to cross the main road. At times, this delays the bus on the stop resulting in more time wasted on route. The issues surrounding the distribution of bus stops and the current infrastructure highlights the need for a better design and location so that different needs of different demographic groups, particularly those of elderly people, could be met. The study also revealed that although proximity did not significantly affect public transport use, it was repeatedly mentioned as an important component of service quality for elderly mobility. Other barriers were related to

- the low frequency of particular services,
- the problems with punctuality which still plague the new bus service (Attard, 2013),
- the lack of accessibility,
- dated and inaccessible travel information,
- lack of safety,
- fear to travel alone and,
- inappropriate driver behaviour.

Informal discussions held with elderly on Luqa bus stops during fieldwork showed that for the majority of cases the elderly were not accurately informed about the correct time schedules and expected bus arrival. This lack of information might compound the amount of time the elderly spent waiting on the bus stop and the overall length of trip. This indicates that although there were actual delays in the public transport system (making the system unreliable) a crucial problem was the elderly population's lack of appropriate knowledge and information about the services.

The surveys also provided for some suggestions to improve the bus service and meet the demands of the el-

derly. These related to better infrastructure (including accessible walkways) and a better distribution of bus stops to minimise the walking distances. Other suggestions included the need for higher service frequency, better route coverage, improved reliability of service, better accessibility, increased safety inside the buses and more accessible travel information.

### 4.3 Temporal accessibility to Mater Dei Hospital

Temporal accessibility is highly interrelated with spatial studies. This work confirmed what was discussed in Polzin et al. (2002): the frequency of the bus service and for how long the users are willing to wait, are indispensable considerations to attract people to use public transport. The research studied temporal accessibility by bus from Luqa to Mater Dei Hospital (which covers a distance of approximately eight kilometres). This was an important issue to consider because as already discussed, medical trips together with shopping were the two most common purposes why elderly people in Luqa travel. Sixty-four per cent of the sampled population stipulated a desired time budget of 20 to 30 minutes. However, all the routes from Luqa to Mater Dei Hospital exceeded this time budget. The shortest route (Route 117) took an average travel time of 36.7 minutes in the peak hours and 35.3 minutes in the off-peak hours. This was followed by Route 118 and 135. The direct routes to hospital provided a shorter travel time than those which involved an interchange. The longest route was route X4/210 (involving the need to change bus at the Marsa Park and Ride Interchange) which exceeded the one hour travel time. Subsequently, when travel time was analysed cumulatively for the X4/210 service, the highest amount of time spent, was waiting on the bus stop particularly at the Marsa Park and Ride Interchange (Fig.(5)). The main reason for long waiting times at this interchange was not just caused by delay, but the lack of coordination between the schedules of the connecting routes arriving and departing from the interchange.

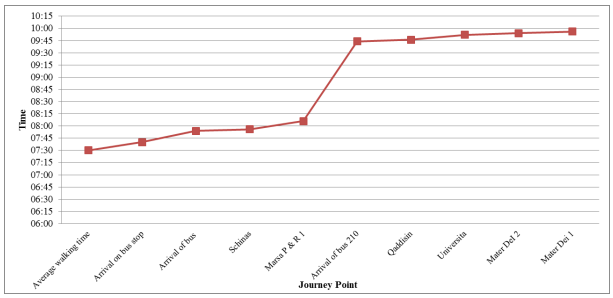



Figure 5: Cumulative travel time graph showing the very long waiting time spent at Marsa Park and Ride Interchange

The bus frequency surveys showed that only few routes operated according to the published time tables (mainly Route 117). Most routes, particularly Route X4 arrived early, delayed or failed to arrive (Fig.(6)). All this indicates that several improvements are required in the services from Luqa to Mater Dei, in an attempt to also improve temporal accessibility of elderly to medical care.

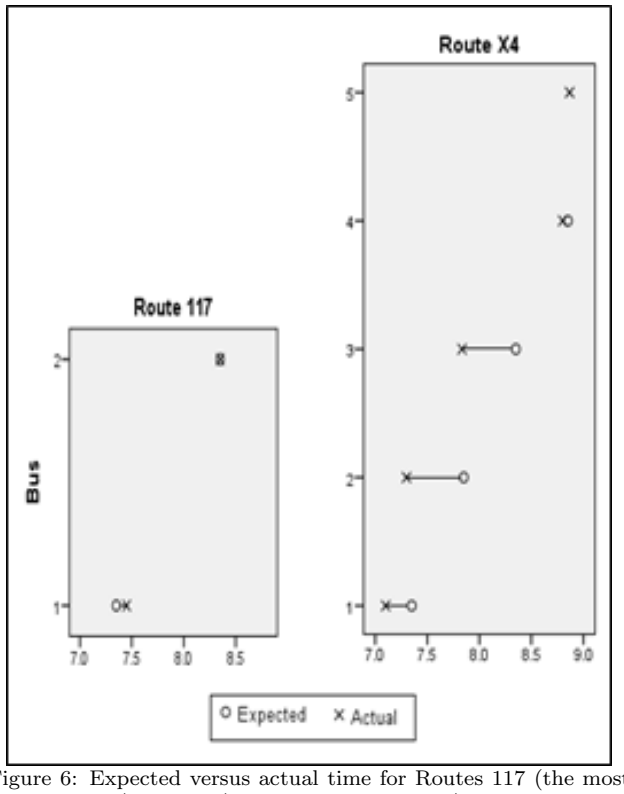



Figure 6: Expected versus actual time for Routes 117 (the most efficient route) and X4 (the least efficient route).

## 5 Relevance and limitations of the study

The chosen field of study has a significant relevance to the islands' socio-economic development and health status of the population. It highlights the importance of an accessible transport system and other indicators that can affect elderly mobility and quality of life. This study was a first to tackle elderly accessibility in public transport in Malta. It is fundamental for policy makers and planners to target future development in public transport, taking into consideration the needs of the elderly. This work also hopes to inform public transport operators to better understand the needs of their clients. Understanding how users perceive the public transport system is a critical issue in delivering accessible transport and subsequently ensuring sustainable mobility.

This research could serve as an incentive for further studies on a local level, that act as a guidance for the development of national policies or programmes target-

ing the mobility needs of an ageing society. The needs of the elderly are not so different from those of the rest of the population. They just become more critical with age. Hence helping old people to meet their needs makes travelling for all sectors ofthe society much easier.

The results could be highly transferable to other demographic groups and other areas in Malta. Particularly, they could be transferable to other 'transport disadvantaged' groups such as disabled people or women with young children. Since in Malta we just have one public transport operator, some of the results could also be easily transferable to other locations. Although the methods used for data collection and analysis (particularly the creation of service areas) were already used by other researchers, they were modified and adapted in a way to give a simple but effective representation of the situation in Luqa. Based on the findings, this study also gives several recommendations for improvements such as the need to improve bus stop design, increase comfort and accessibility, minimise the barriers that elderly encounter and improve the travel information. If elderly are furnished with easier and more understandable information (particularly on the media) they would be more knowledgeable and hence feel safer and more secure when travelling with public transport.

One limitation of the study was that it was based on one case study (Luqa) and not on a national scale. This means that the research results cannot be all transposed to the whole Maltese Islands. Nonetheless this could act as a motivation for future studies focusing on the whole of Malta. Another issue hindering the extension of the study to other areas in the island is the lack of geographic information related to the main and local road network. This study used Geographic Information Systems to analyse spatial and temporal accessibility. Without the reference data set about the road network, the extension of the study to the whole of the islands is not possible. Moreover, the fact that the study was carried out just one year after the public transport reform (started in 3rd July, 2011) could have affected in some manner the perception of the elderly towards the new public transport system.

# 6 Concluding Remarks

This research confirmed that elderly people in Luqa, a town with a high projection of elderly people in the future, has a high percentage of non-drivers. Despite this, it showed a relatively high car availability and high private mobility amongst its elderly. In most of the cases where elderly did not travel, the main reasons were related to age and health conditions and not due to infrastructure provision. The largest percentage of elderly travelled for shopping and medical purposes. This study disagreed with the literature with respect to the relationship between use of public transport and proximity. It is evident from the sampled population in Luqa that mobility by public transport is not affected by proximity to bus stop. In spite of this, as explained in detail in Sections 4.1 and 4.2, an analysis of walking distances to bus stops showed that most elderly lived beyond the national threshold of 150 metres from a bus stop, and informal discussions with elderly using public transport showed that distance impacted their use of the bus. The other barriers that were identified as contributing to difficulties in using public transport were mainly related to waiting times, lack of travel information and uncomfortable bus stop infrastructure. Hence, these barriers show that with reference to Luqa, the current public transport system in Malta is still not providing an efficient and fully accessible public transport service to the elderly. This was particularly the case when the study looked at the accessibility of the main hospital. The study found that average travel time by bus was not within the desired time budget. An efficient public transport system is seen as an important contributor to sustainable mobility. This study has shown that for elderly, a growing population segment in many cities worldwide, public transport systems still suffers weaknesses and offers challenges for their independent mobility.

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