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Implementation Document

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1. Introduction

Transportation within Wales is mostly accomplished by car, bus, and rail. The most popular form of transportation is the car, with nearly 80% of Wales citizens driving to their place of work (Welsh Government, 2020a). The high percentage of private vehicle usage has resulted in a great number of cars on Welsh roads, causing citizens to raise concerns about road quality, frequency of crashes, and increased overall traffic congestion (Summer, 2023a; Summer, 2023b). In an effort to alleviate these concerns and decrease the number of private vehicles on the roads, the Welsh government has attempted to increase the usage of rail and bus (Welsh Government, 2020b). However, the usage of both has decreased over time and has remained below pre-pandemic levels (Welsh Parliament, 2022). From rising ticket prices, inaccessible stations, and a lack of services in rural areas, public transportation does not appear to be an attractive alternative to driving for the Wales populace (Sustrans, 2022). Media coverage and survey data from Transport for Wales both suggest that satisfaction with the transportation system in Wales is low and can be improved amongst those who have use of a private vehicle, those who suffer from a long-term illness, and those who live in areas with low access to services.

2. Data Analysis

The objective of the exploratory data analysis undergone in this report is to identify the primary concerns citizens have regarding public transportation so that Transport for Wales can use this data in the future to improve the transportation systems within the country. The initial investigation allowed for a hypothesis that the low overall satisfaction

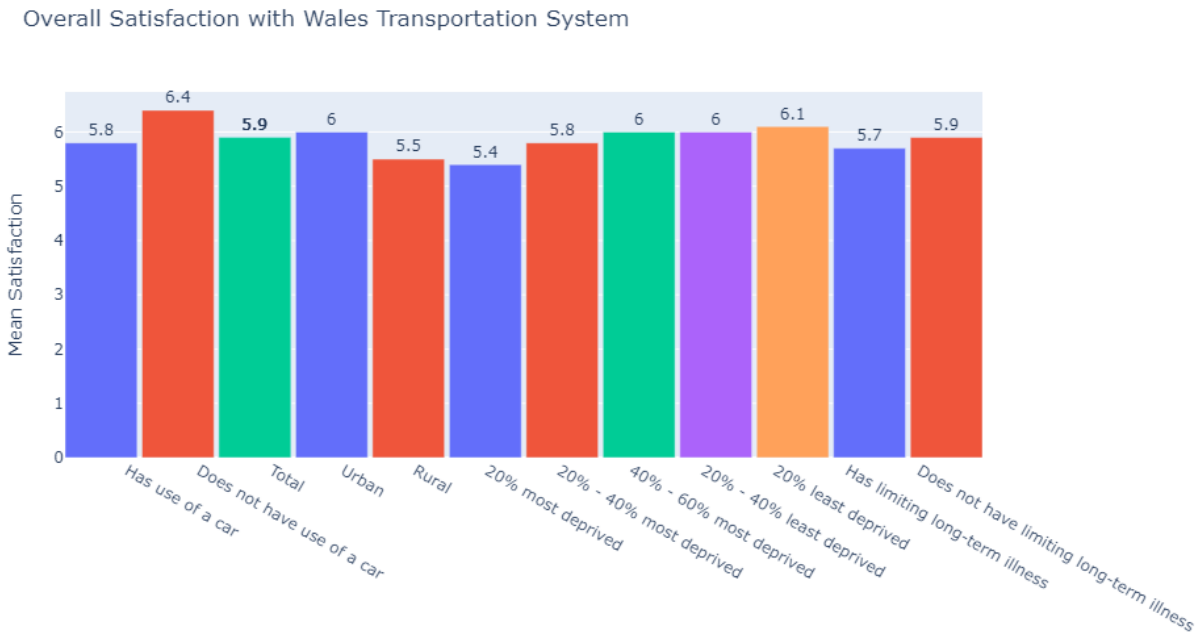
with the transportation system in Wales is related to increased car usage, decreased access to services, and poor accommodation for those with limiting long-term illness.

To properly test the hypothesis developed in the initial data analytics report, careful consideration of the dataset given by Transport for Wales was necessary. The survey dataset consists of 42 excel tables with values consisting of means, percentages, and confidence intervals. The data comes in the form of nominal and ordinal variables collected by telephone interviews and online questionnaires conducted on the general populace of Wales. The tables initially chosen in the data analytics report were tables 2, 4, 8, 12, 15, 18, 20, 22, 23, 25, 26, 31, 33, and 34. These tables are all related to hypothesized citizen concerns related to car usage, access to services, and accessibility issues for the sick and disabled. None of the tables have any missing data and all data within the tables is within an acceptable range.

To begin the data analysis in Jupyter notebook, all excel tables had to be transformed into csv files. Variables such as the upper and lower confidence intervals were discarded, as the mean values and overall percentages are easier to use in data visualization. Originally, the tables were to be concatenated by their major groupings as defined in the initial data analytics report and referenced. However, while the concatenation of the tables was not difficult to perform, the creation of bar graphs using concatenated tables resulted in less than satisfactory results. Instead, concatenating the figures of the individual tables themselves using the python library plotly resulted in more attractive and readable tables. The tables were still concatenated for the ease of direct comparison for the researcher – and they can be observed in the programming document – but they were not overtly used within the implementation document itself.

3. Results

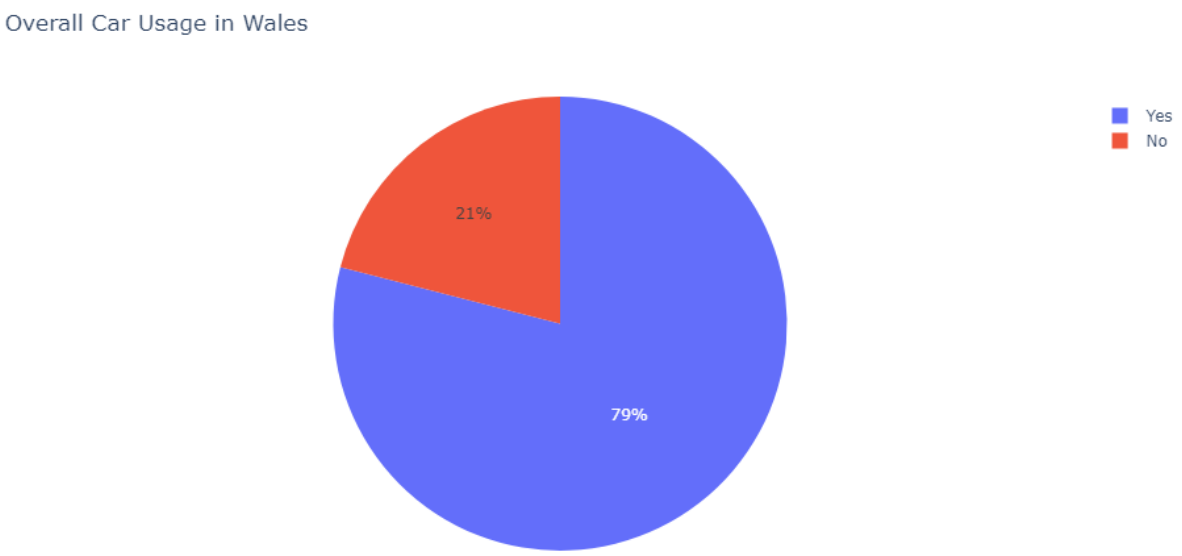
Figure 1. Overall Satisfaction with Wales Transportation System



The individuals with the lowest satisfaction with the Wales Transportation system are the individuals living in areas with a WIMD access to services score of 20% most deprived. The characteristics of individuals with a satisfaction rating lower than the Total mean overall satisfaction of 5.9 are: Has use of a car (5.8), Rural (5.5), 20% most deprived (5.4), 20-40% most deprived (5.8), and has limiting long-term illness (5.7). This is in line with the initial research done into the citizens' concerns with the public transportation system of Wales. However, the mean overall satisfaction ratings from individuals who have use of a car and/or suffer from a limiting long-term illness are not far from the mean overall satisfaction in total. This might indicate that having access to a car and accessibility to stations for limiting long-term illnesses is not as big of a concern as previously thought.

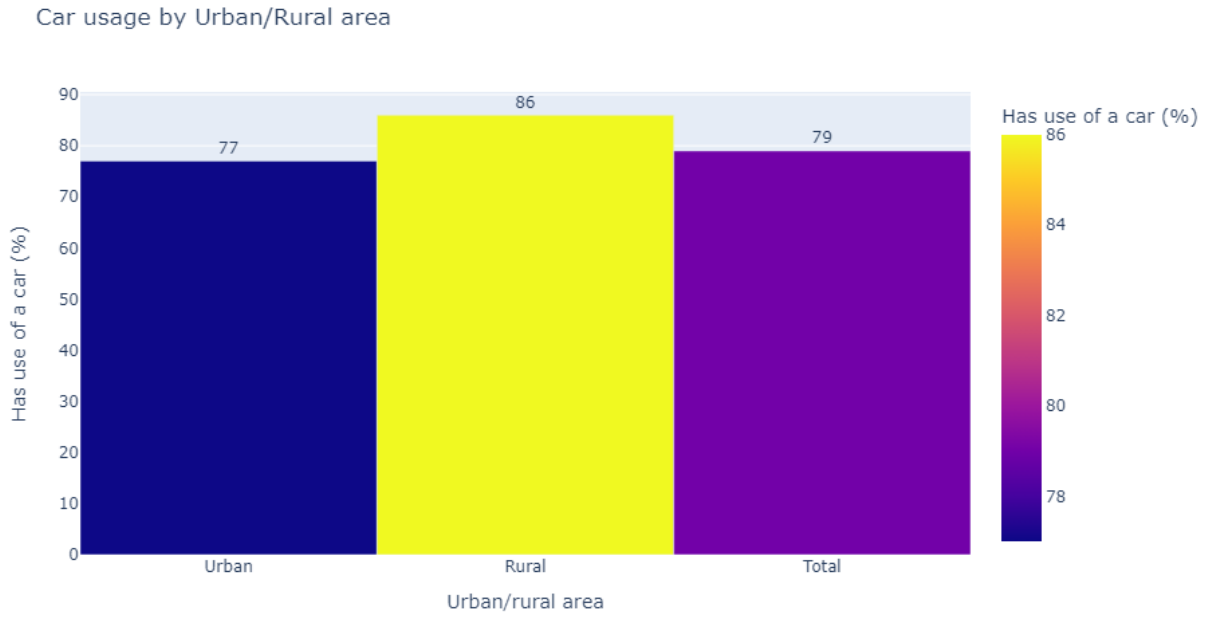
However, while the contrast between those who do (5.7) and do not (5.9) have limiting long-term illnesses is only 0.2 points, the contrast between having use of a car (5.8) and not having access to a car (6.4) cannot be ignored. Individuals who don't have access to a car are rating the transport system of Wales 0.6 points higher than those who do. Similarly, individuals who live in urban areas rate the transport system of Wales half a point higher than those who live in rural areas. These are both large discrepancies. But the largest is within the WIMD access to services score, with the most deprived rating the transport system at only 5.4, but the least deprived rating the transport system at 6.1. This is a 0.7-point difference. The next step is to focus on the largest discrepancies displayed in the above bar chart.

Figure 2. Overall Car Usage



Car usage in Wales is very popular, with 79% of respondents to the Transport for Wales survey stating that they have use of a car. As so many users have a car but have a lower satisfaction rate compared to those who do not (5.8 vs 6.4) there is clearly a need to improve the situation. Further investigation into the areas where car usage is high but satisfaction is low is needed.

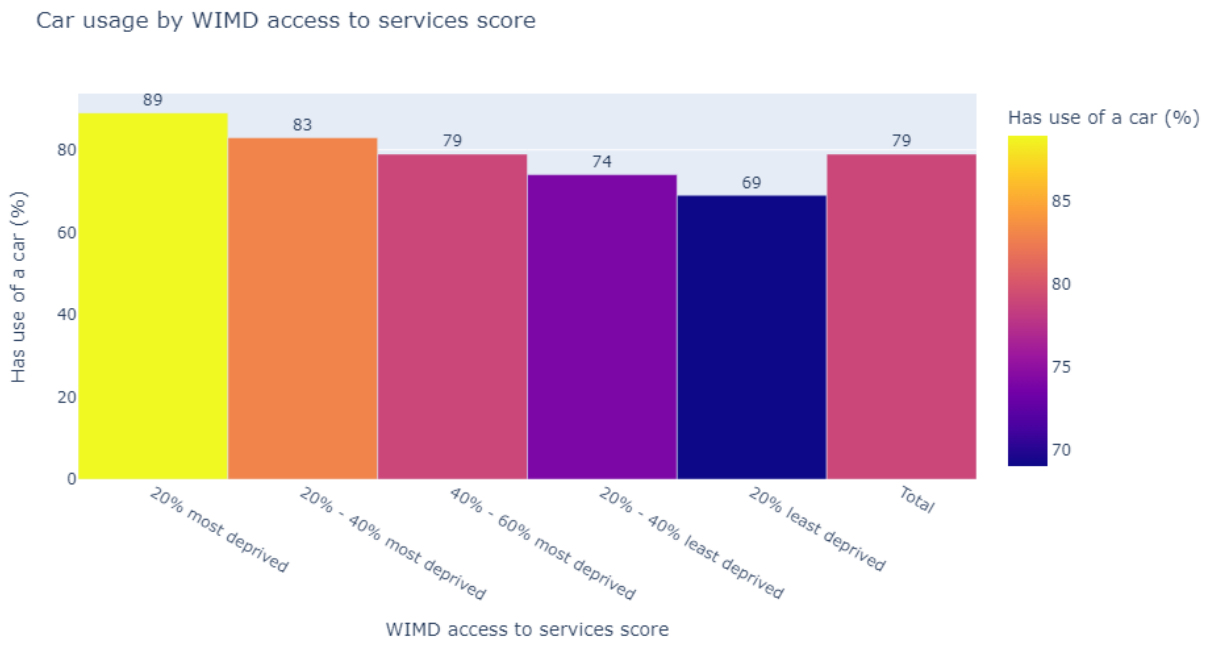
Figure 3. Car usage by Urban/Rural area



Individuals who live in rural areas are 9% more likely than those who live in urban areas to have use of a car, likely due to a lack of public transportation infrastructure and the need to travel longer distances to reach necessary services. Individuals who live in rural areas rated the transport system of Wales at just 5.5 out of 10, which was the second lowest rating in figure 1. The low rating reflects the initial research done in the initial data analysis report, as it was hypothesized that the lack of infrastructure and access to public transportation forces rural individuals to use cars. The increase in distance to

services also results in more time spent suffering on the road, suffering through the concerns that citizens' raised in media such as congestion, potholes, and crashes. Individuals in urban areas likely have less of a need for a car due to greater access to buses and rail, and they are more satisfied with the public transportation system as they spend less time travelling overall.

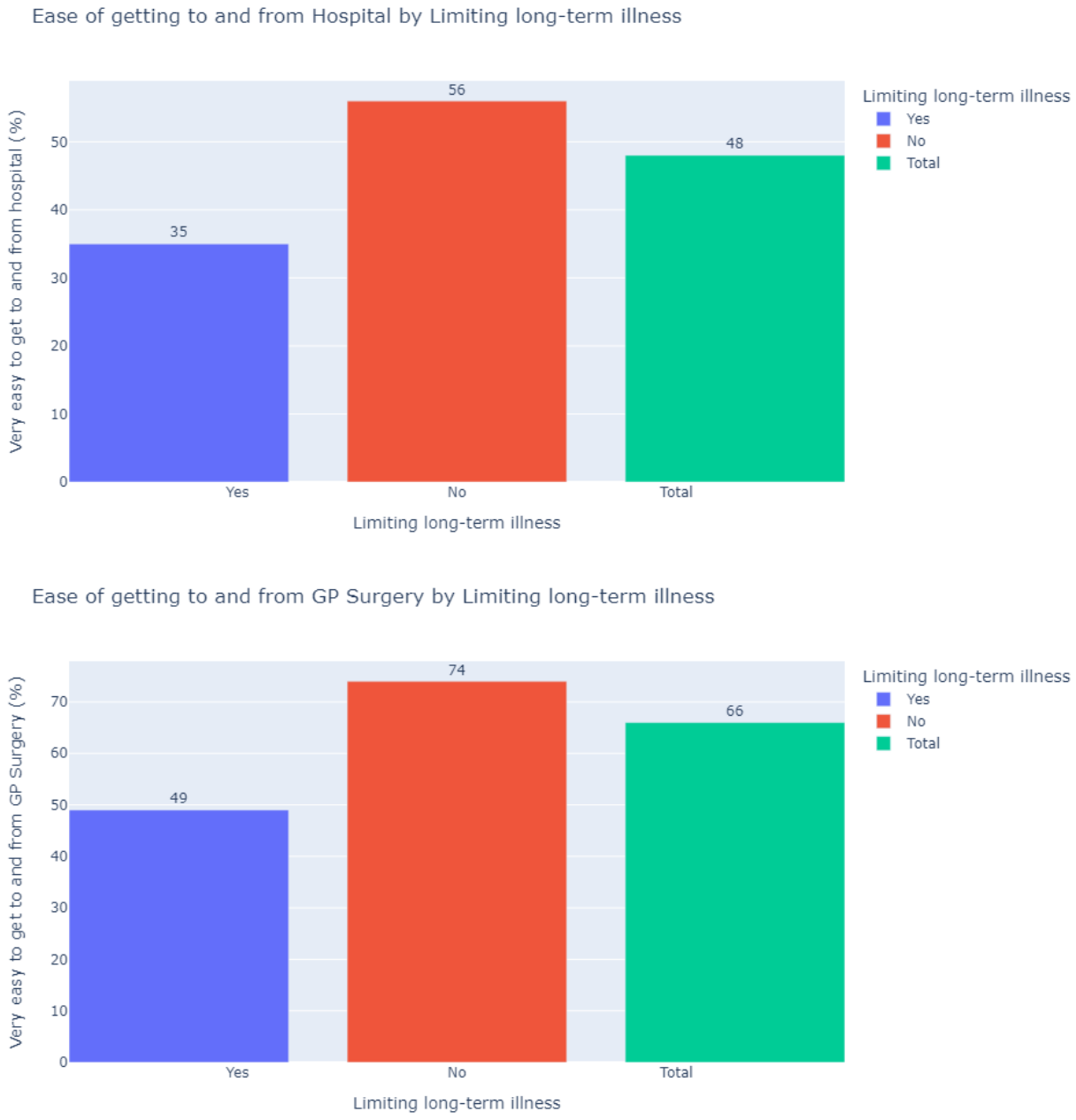
Figure 4. Car usage by WIMD access to services score



The 20% most deprived individuals according to the WIMD access to services score are 20% more likely to have use of a car than the 20% least deprived. When taking into consideration the mean satisfaction ratings in figure 1, an inverse relationship is revealed. The 20% most deprived individuals have both the highest usage of cars and the lowest mean satisfaction rating of the Wales transportation system. As individuals are more deprived of services, they are more likely to use cars, and are less likely to be

satisfied with the public transportation system in Wales. There is likely to be some overlap between individuals who have a low WIMD access to services score and individuals who live in rural areas.

Figure 5. Ease of getting to and from Hospital and GP Surgery by Limiting long-term illness



Limiting long-term illness does not seem to affect satisfaction much, as seen in figure 1, where there was only a 0.2-point difference in overall satisfaction between those who do and don't suffer from a limiting long-term illness. Having a car does make it much easier to get to the hospital and the GP however, and while the overall satisfaction of citizens is important to consider when planning future improvements to the Wales transportation system, the safety and health of the general populace must also be considered. Making stations that are more accessible to individuals struggling from limiting long-term illnesses, and/or decreasing the cost of public transportation for individuals who may be unable to drive due to their long-term illness or disability could result in increased satisfaction but would almost certainly result in a healthier population. All things must be considered when improving the infrastructure of public systems.

From the analysis it appears that the area of greatest concern when it comes to overall satisfaction is within rural areas with a lack of access to services. This can be somewhat attributed to an increase in car usage and more time spent on roads. Individuals who live in rural areas and places with a low WIMD access to services score are unable to make the switch to taking the bus/coach/train due to lack of infrastructure, forcing them to use cars. This likely increases their dissatisfaction with the public transportation system of Wales. A solution to this issue would be to increase the amount of bus vehicles running in rural areas around Wales and increase public transportation infrastructure in rural areas and areas with low access to services. However, this cannot be implemented quickly and would result in very high costs that might not be offset, as the number of individuals that would begin using public transportation from rural and low access to services areas is likely to be very low. Increasing ticket prices could be a

solution to the high cost of implementing this solution, however it may result in lower satisfaction in other groups, such as those who are unemployed or have a low income and rely on public transportation to go about their daily lives.

A positive secondary effect of introducing a greater number of buses would be a decrease in public vehicles, resulting in less traffic on roads, less potholes, and less crashes. However, rather than just hope for a secondary effect from introducing a greater number of buses, coach, and rail, another solution would be to directly target these issues and work on implementing strategies to decrease congestion, increase the quality of the roads, and decrease the number of crashes experienced throughout the year. An example of a recent regulation from the Welsh government which aims to decrease the number of crashes is the introduction of 20mph speed limits on specific roads (Welsh Government, 2023). More regulations focused on how the Welsh populace use roads could help increase satisfaction with Transport for Wales. However, people do not enjoy change and are likely to resist new legislation, even if they understand why it is being pushed. No solution is perfect, but with this data analysis, future improvements of the transportation system of Wales can be directed to the areas that need it the most.

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