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The resilience of public transport post-COVID: The case of Great Britain

Ffion Goodland, Dimitris Potoglou *

School of Geography and Planning, Cardiff University, CF10 3WA, Cardiff, UK

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ABSTRACT

A highly contagious disease, COVID-19, was formed at the end of 2019, and spread quickly from person-to-person around the globe. By the 23rd of March 2020, Great Britain had been launched into a national lockdown. This had profound negative effects on the public transport (PT) industry. Many people lost trust in PT systems as the virus spread through being in close contact with others and consequently, many nations saw a dramatic decrease in the number of trips made by PT.

This study provides an operator's perspective of the challenges the pandemic has brought to public transport systems and the interventions that have been used to mitigate these challenges. Twelve semi-structured online interviews were conducted with individuals who worked within the PT industry between July and August 2022. Thematic analysis showed that underinvestment and underfunding were identified as major issues both prior to and since the pandemic for smaller urban areas, however, this was not as problematic within larger urban areas. Bus driver shortages have also had important implications on overall regularity and reliability of PT systems both prior to and during COVID-19.

Additional funding has been identified as the best solution by interviewees to solve both their short- and long-term problems within their respective PT sector. Both national and local governments should therefore consider increasing the amount of funding provision provided to PT operators. Similar or comparative studies should be conducted in the future to determine the long-term resilience of PT systems against unplanned disruptions across countries.

1. Introduction

In 2019, a 'highly contagious respiratory syndrome', COVID-19, formed in humans in the city of Wuhan, Hubei province, China (Luan et al., 2021; p. 271). The disease quickly spread around the globe, with the first international case being identified in Thailand on the 13th of January 2020 (Anwari et al., 2021). By the middle of March many nations had implemented national lockdowns to try and reduce the spread (BBC, 2020). Great Britain (GB) was launched into a national lockdown on the 23rd of March 2020 whereby all residents in England, Scotland, and Wales were asked to 'stay at home' as much as possible and avoid any contact with anyone from outside their household (Scott, 2021). This meant that education, leisure, and retail facilities were forced to shut for an undefined amount of time, to try and limit the spread of the virus. Only those who could not work from home, such as healthcare-services staff, were allowed to travel to work (Scott, 2021).

People altered their daily routines to help alleviate the spread of the virus. Working from home is a prime example of this, with 80% of UK residents doing so during the pandemic compared to one in eight people doing so prior to this (Office for National Statistics, 2022a). This trend is expected to continue, with 84% of those that worked from home during the pandemic plan to continue to do so on a hybrid basis in the future (Office for National Statistics, 2022a). The pandemic has therefore hampered public transport systems' (PTSs) reputation not only in Great Britain but across the globe (see, Abdullah et al., 2021; Angell and Potoglou, 2022; Arimura et al., 2020; Bucsky, 2020; Eisenmann et al., 2021; Molloy et al., 2021; Shamshiripour et al., 2020). As PTSs are very complex systems, their recovery period from any form of disruption such as natural disasters, infrastructure failures, terrorist attacks, and reputation damage is far greater (Kattan et al., 2013; Sung and Monschauer, 2020; Zhou et al., 2019).

The concept of vulnerability has been studied extensively by academics, especially within the transport sector (Reggiani et al., 2015). Nevertheless, academics have struggled to agree on one definition (Reggiani et al., 2015). Haimes (2009) describes vulnerability in a general sense as '*the parts of a system that can be exploited by something or*

* Corresponding author at: School of Geography and Planning, Cardiff University, Cardiff CF10 3WA, Wales, UK.
E-mail addresses: ffiongoodland@gmail.com (F. Goodland), potogloud@cardiff.ac.uk (D. Potoglou).

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someone that can then cause overall damage to said system', while Berdica (2002) specifically defines vulnerability within the context of transport as *"a [systems] susceptibility to incidents that can result in considerable reductions in…serviceability."* Both definitions note, however, those incidents can lead to negative changes to the overall service of a system.

A similar term related to vulnerability is resilience. The word *'resilience'* is derived from the Latin word *'resiliere'*, which means *'to spring back'* (Zhou et al., 2019). Nevertheless, this is not a new concept, and academics have utilised it in other subject areas, such as ecology (Holling, 1973). For example, Holling (1973) studied resilience in relation to how ecological systems evolve over time and how stable each system is during this period. In the context of transport-systems research, resilience has been largely under researched in the past, however, there has been growing interest over the past decade (Hosseini et al., 2016). For example, Yossyafra et al. (2018) utilised the concept in relation to flood data to assess the resilience of urban PTSs to floods in the city of Padang, in West Sumatra, Indonesia. They concluded that whist Padang's PTSs were vulnerable to the negative effects of future flooding and demonstrated that flood simulations can provide governments with vital information that can help increase the resilience of their PTSs to such events (Yossyafra et al., 2018).

The study of the concept of resilience within the context of public transport (PT) is important as this could help PTSs implement strategies to ensure they can *'bounce back'* from unforeseen circumstances, such as COVID-19 and other small- or large-scale disruptions. Thus far, the published literature on PTSs' during COVID-19 has primarily focused on its impacts on the patronage levels rather than the wider organisational impacts (Farida, 2018), which is key to ensuring that the PT industry is equipped with the knowledge and evidence of how to tackle challenges within the industry. As such, this research provides an insight into the challenges faced by the PT industry through the eyes of PT experts across Great Britain.

The aim of this study, in particular, is to provide an insight into past, present, and future challenges facing PTSs in Great Britain. The objective is to shed light, especially, on the challenges that have become more prominent since the COVID-19 outbreak, and these will be discussed through a series of interviews with PT experts. To address the aim of the study, the following research questions have been introduced: (a) What are the pre-, during and post-COVID19 challenges for public transport systems in Britain?; and (b) How have British cities tried to tackle these challenges and seize any opportunities?

The remainder of this paper is structured as follows. Section 2 provides a targeted and critical summary of the literature, which helps to justify why further research is required into the vulnerability and resilience of PTSs. Section 3 details the research design and data collection approach. Section 4 reports on the findings and provides a discussion of the interview data. The final section offers concluding remarks of the research study.

2. Public transport systems

2.1. Challenges for public transport systems

No transport system is perfect, so there is little surprise that PTSs have faced several challenges over the years. Farida (2018) highlights that PT can suffer from six main issues: safety, security, comfort, affordability, equality, and regularity, all of which can affect ridership levels. While their work focuses on developing nations, these problems apply to PTSs in developed countries like the UK, as problems surrounding, for example, bus irregularity are apparent throughout the nation for residents that do not reside in London (Kirby, 2019). Similarly, Bahreini et al. (2016) note that areas differ in their PT usage due to service quality, reliability, and travel information provided by PT modes, and the socio-demographics of the area.

The COVID-19 pandemic led to social and recreational activities being banned, and millions of people were forced to work from home the world's travel patterns changed dramatically overnight, especially in developed nations (European Parliament, 2020). The main challenge faced by PTSs in the case of COVID-19 pertained to passenger usage, as the virus spread through being in close contact (NHS, 2022). As such, many people lost trust in PTSs. For example, in a survey of 1200 residents across the Chicago metropolitan area, Shamshiripour et al. (2020) found that 93% of residents thought that 'travelling on PT was dangerous'. Consequently, many nations saw a dramatic decrease in the number of trips made by PT. For example, Hungary, where 45% of its population relies on PT, saw a 90% decrease in the number of weekly PT users. This meant that only 430,000 residents were using PT weekly, as opposed to 4,000,000 prior to the pandemic (Bucsky, 2020). Similarly, Switzerland saw a dramatic decrease in its PT usage, as average daily kilometres travelled on rail services decreased by 95% (Molloy et al., 2021).

These patterns in PT use can be linked to the 'avoidance phenomenon', which suggests that people would avoid an area or activity due to certain characteristics that have deemed it unsafe (Angell and Potoglou, 2022). Over time, the number of people using an area or service may increase back to its previous numbers (Angell and Potoglou, 2022). For instance, following the SARS outbreak in Taipei in 2003, the use of PT returned to its pre-epidemic levels 300 days after declaration (Wang, 2014). However, Angell and Potoglou (2022) noted that sometimes levels may not return to normal as people may have a new preferred mode of transportation.

Much like PT, car usage also decreased when governments implemented travel restrictions upon the population. For example, Switzerland saw a 60% reduction in the number of kilometres travelled during its COVID-19 lockdown (Molloy et al., 2021). Nevertheless, in contrast to PT, it is predicted that the use of private vehicles will increase around the globe in response to the pandemic. For example, Politis et al. (2021) noted that those who had access to a car during the pandemic used it more frequently due to the 'avoidance phenomenon' (Angell and Potoglou, 2022). This will be particularly challenging to overcome as private vehicles have been intertwined into the daily lives of people globally (Griffiths et al., 2021). The Welsh Government (2021a) and Molloy et al. (2021) highlighted this issue as they found that car usage bounced back far quicker than PT when travel restrictions eased.

Another challenge that comes with increased private vehicle use is increased greenhouse gas (GHG) emissions. Research conducted by the UK Department for Business (2019) highlighted the environmental benefits of travelling via PT in comparison to private vehicles. They found that bus users only produced 105 g of Carbon Dioxide (CO_2) per kilometre, whilst medium sized private vehicles produced between 171 and 192 g of CO_2 per kilometre (UK Department for Business, 2019). If the number of private vehicles on roads continues to increase, this will have negative implications upon people's health as vehicles emit local pollutants such as Nitrogen Oxide (NOx), and Carbon Monoxide (CO), and create secondary pollutants like ground-level Ozone (O3) through reactions between other gases in the atmosphere (Johnson, 2017). Health conditions such as bronchitis and asthma would become more common, especially for people living near busy roads (Buckeridge et al., 2002).

2.2. How have nations tried to tackle challenges?

The challenges discussed in the previous section were tackled via practical approaches and additional fiscal measures. Firstly, the pandemic highlighted that public safety is a key concern for PT users as they are at an increased risk of catching the virus (NHS, 2022). As such many nations in Europe and further afield imposed international travel restrictions (Wilson, 2020). For example, Australia banned overseas travel and only allowed some individuals, such as residents, to enter the country. Upon entering Australia, people were screened to ensure that they were healthy enough to enter the country. If this was not the case, then people were quarantined away from the main population until they

were healthy (Munawar et al., 2021).

Once lockdown measures started to ease, many nations implemented methods to try and increase the number of people using PT, and research conducted by Labonté-LeMoyne et al. (2020) found that passengers of mass transit systems favoured seeing more frequent cleaning of facilities and mandatory hand washing over the use of health certificates as they lead to less discrimination. The most popular method however was the requirement to wear a face covering on PT (Chinn et al., 2020). Other examples, such as staggering ridership on PT services and creating online booking systems, were also proven to be beneficial in countries such as Israel, the Netherlands, Taiwan, and Denmark (Chinn et al., 2020; Subbarao and Kadali, 2021). Where this has not been possible, some regions, such as Catalonia, developed apps that notify those waiting for bus services about the capacity of the buses (Autocorb, 2020). Meanwhile, in Hamburg, they instead opted to increase bus services along busy routes, while reducing services along quieter ones (Covid Mobility Works, 2022).

To tackle PT issues surrounding the pandemic on a strategic level, many governments provided additional funding for PTSs and operators. As passenger numbers on PT fell dramatically globally, this meant that transport operators could not make profits but this funding was predominantly received in developed nations (Our Public Transport, 2020; European Parliament, 2020). For example, 33% of the emergency funding provided in Italy was utilised to increase the number of services on PT networks to ensure that social distancing measures could be followed (Our Public Transport, 2020) and the Metropolitan Transportation Authority in New York received a $6 billion grant to help recover from the pandemic (Hawkes, 2022).

2.3. Current literature limitations

As shown in Table 1, pre-COVID19 challenges regarding PTSs have been well-documented and researched in the literature. Meanwhile, a rapidly emerging body of knowledge was produced during the COVID-19 pandemic and identified that the main challenge highlighted was to ensure that people's trust in PTSs is not lost due to safety concerns. In the instance of the pandemic, this trust was lost (Shamshiripour et al., 2020) and many people had consequently chosen other means of transportation such as private vehicles and active travel (Politis et al., 2021). PT operators implemented measures to increase the number of PT users, such as mandatory masks and booking systems (Chinn et al., 2020; Subbarao and Kadali, 2021) (see, Table 1). However, the literature offers little evidence what PT operators would do in the long term to address the decline in passenger numbers, and how they are going to increase these figures beyond their pre-pandemic levels. This is a particularly important aspect to consider as social distancing and mask wearing are no longer mandatory in the UK (BBC, 2022) and the climate crisis is an ever-growing concern (Office for National Statistics, 2022b).

Table 1
Summary of pre- and during COVID-19 challenges for public transport systems.

Challenges for Public Transport Systems	Mitigation Measures	Relevant studies
Pre-COVID-19 Safety and security challenges Comfort Affordability Reliability Equity	Affordability – provide subsidies to lower the cost of travel. Equity – adopt a multimodal approach when designing transport systems	(Anwari et al., 2021; Bahreini et al., 2016; Balcombe et al., 2004; Campaign for Better Transport, 2018; Farida, 2018; Institute of Transport Economics, 2022; Litman, 2023; Mattsson and Jenelius, 2015; Pidd, 2019)
During COVID-19 Facilitating travel for marginalised segments of society Loss of market share to private vehicles and active travel	Mask wearing Staggering start times at education facilities Banning overseas travel Funding	(Chinn et al., 2020; Institute for Government, 2021; Our Public Transport, 2020; Subbarao and Kadali, 2021)

Investigating PT challenges and interventions to such challenges over several time frames from the perspective of PT workers and operators would help provide an insight on the current trends on PT patronage. Furthermore, as COVID-19 restrictions were removed in GB in May 2022 (BBC, 2022), this research offers evidence on the resilience of PT systems. As such, this study focuses on two emerging questions: (a) What are the pre-, during and post-COVID19 challenges for public transport systems in Britain?; and (b) How have British cities tried to tackle these challenges and seize any opportunities?

3. Method

3.1. Study area and background

Great Britain has been chosen as the overarching study area, which includes the countries of England, Scotland, and Wales. It has an estimated population of 65,185,724 people (Stats Wales, 2021). Great Britain's PTSs have been highlighted as unreliable in recent years in comparison to other nations such as Japan (BBC, 2017).

Great Britain has had long history of rail and bus transport, and COVID-19 was not the first event to challenge its PTSs. Between the 1840 and 1890 Great Britain saw the mass expansion of its railway network, and the industry has experienced periods of both privatisation and public ownership. With the exception of the two World War periods (1914–1918 and 1939–1945, respectively), the rail industry was originally privatised (Gunn, 2018). In 1947, however, the rail industry became government owned, primarily due to low demand (Golbuff and Aldred, 2012). The Railways Act introduced in 1993 led to the re-privatisation of the rail industry between 1994 and 1997 (Gunn, 2018), nevertheless, rail fares continue to be regulated by national governments to ensure that fares do not increase by exponential amounts annually (Rutherford, 2016).

The COVID-19 pandemic triggered national response in Wales and Scotland regarding ownership and operation of rail services. In 2021, the Welsh Government via Transport for Wales took ownership of the rail network and assumed direct responsibility for operating its Wales and Boarder rail network to "protect services, safeguard jobs and deliver infrastructure improvements in light of ongoing challenges of coronavirus" (Welsh Government, 2021b). Also, the Scottish Government decided not to award another franchise agreement and transferred rail services into public control and ownership in 2022 (Transport Scotland, 2022b). A selection of services in England that previously failed under private ownership are also under public ownership (We Own It, 2023).

In contrast to rail, the bus industry was originally publicly owned. By 1932, 100 local authorities operated bus services across the United Kingdom (Gunn, 2018). However, in 1984, the Buses White Paper outlined proposals to deregulate the bus industry except London, largely due to a substantial decrease in patronage levels across the UK in the years prior, along with rising costs (Department for Transport, 1984). This meant that local authorities would no longer be responsible for coordinating local PT, and bus firms had increased flexibility over their services and fare prices (Rutherford, 2016). As such, bus fares were no longer regulated throughout the majority of GB (Rutherford, 2016).

As shown in Fig. 1, the dominance of private vehicles on British roads is quite clear. Whilst the total kilometres travelled by private vehicles has been steadily increasing between 1960 and 2019, during the same period both rail and bus journeys remained below 100 billion passenger-kilometres on annual basis (Department for Transport, 2021).

The COVID-19 pandemic has also left negative marks on public transport services as a result of lockdown restrictions and government recommendations to 'stay at home' (see also,Jolly, 2020; Angell and Potoglou, 2022). During the first four weeks of the first national lockdown between March 23rd and April 20th, 2020, patronage levels declined on PT services by approximately 90% (Table 2) (DfT, 2022b).

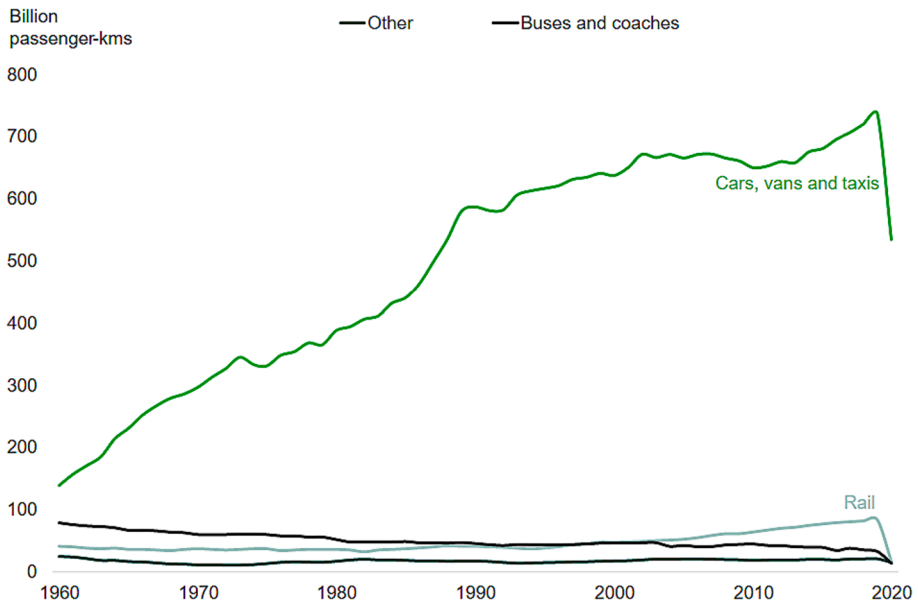

Fig. 1. Passenger kilometres travelled by mode in Great Britain between 1960 and 2020 (().
Source: Department for Transport, 2021

Table 2
Change of public transport ridership relative to pre-COVID-19 levels (DfT, 2022b; DfT, 2023).

Time frame	Bus (excl. London)	National Rail	Bus London only	Tube London only
23/03 – 20/04/2020	12.8%	7.4%	17.9*	5.3%
14/7—7/8/2022 Weekdays	66.8%	81.9%	82.9%	69.1%
14/7—7/8/2022 Weekends	84.8%	83.0%	90.6%	85.6%
30/7 – 7/8/2023	69% – 86%	81% – 103%	82% – 91%	71% – 86%

*No statistics were available for the 20th of April 2020 due to a change in boarding policy therefore London bus percentages have been calculated between the 20th of March and the 19th of April 2020.

Ridership levels remained at less than 20% for all modes of transport until the 10th of July 2020 (DfT, 2022b). This, however, was still 80% below pre-COVID levels, highlighting the long-term challenges of the PT industry (DfT, 2022b). Whilst motor traffic has returned to its pre-COVID levels as of July 2023, rail transport remains at around 96% and buses (outside London) remain at approximately 75% (Department for Transport, 2023). As such, these trends have raised concerns regarding the vulnerability and resilience of PT in Britain.

In 2022, the DfT (2022b) calculated that PT patronage levels had regained 75% of their pre-COVID levels on average during the week, and 86% on average at weekends (Table 2). The data in Table 2 shows the average percentage of patronage relative to pre-COVID levels.

3.2. *Interview protocol*

To address the research questions, this study collected data through semi-structured interviews, a qualitative approach. An overview of the means of verification in this study is shown in Fig. 2. A qualitative approach allowed to obtain an in-depth understanding of the issues around public transport systems, data which do not necessarily fit within answers of a quantitative survey questionnaire using close-ended questions (Longhurst, 2016; Minichiello, 1990; p. 5). Opting-in for an open-ended survey questionnaire would also pose significant and well-known challenges. This particularly significant when the aim of study is to recruit and survey participants who are busy professionals whom have a good understanding of public transport issues but the likelihood of them answering to an online questionnaire is relatively low (Krysan et al., 1994). Also, a semi-structure interview approach offers flexibility to obtain a wholistic view of the issues involved regarding public transport systems, prompt questions would also help recall previous and current experiences as well as link those with the outlook of PTSs (Merton et al., 1990; p. 21).

Each interview explored eight topics for which responses were

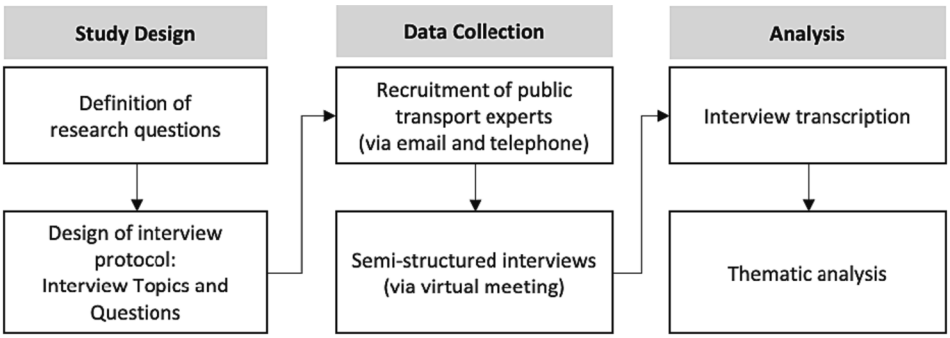

Fig. 2. Means of verification in the study.

sought via 10 interview questions (see, Table 3). The links across research questions, interview topics and interview questions are also shown in Table 3. It was important to initially obtain an understanding of the situation different PT operators were facing prior to, and since the pandemic. Only then could we discuss these challenges in more depth to ascertain what PTSs require to offer a sustainable transport mode for the future. The semi-structured interviews required participants to recall their past and present experiences of their respective PTSs. The purpose of this recall exercise was to gather information on the challenges PTSs have faced prior to, during, and since the COVID-19 pandemic, in addition to the strategies implemented to try and alleviate these challenges. Recall bias could potentially have had a negative effect on the data collected, however, as interviewees requested a copy of the interview questions prior to the interview, this ensured that issues surrounding recall bias were diminished as they had time to familiarise themselves with the topics at hand.

3.3. Implementation

GB has quite a few councils and PT operators due to them being deregulated in many areas (Pidd, 2019).As shown in Fig. 3, the cities and regions of Bridgend, Kent, London, Bristol, Manchester, Newcastle, Huddersfield, Glasgow, Edinburgh, and Dundee were chosen due to their importance within each respective nation and the availability of participants.

As also shown in Fig. 2, this study targeted professional experts in the public transport industry across Great Britain as they would be the most appropriate individuals to respond to the interview topics and help address the research questions in Table 3. Thus, PT operators and transport planners that had senior or junior roles within Great Britain were approached and interviewed. A convenience sampling method was utilised initially as the participants were known to the researcher and were easier to contact in comparison to unknown individuals who would also have similar valuable information (Albert et al., 2010; Bhattacherjee, 2012). Snowballing was also used in some instances to contact more participants than would have been approached otherwise, therefore ensuring that a reasonable number of participants with sufficient knowledge of the industry were recruited (Parker et al., 2019). The interviews were conducted online due to the time and cost savings provided by online video services (Clark et al., 2021).

Table 3
Interview topics, questions and their links to research questions.

Research Question	Interview Topics	Interview Questions
(a) What are the pre-, during and post-COVID19 challenges for public transport systems in Britain?	1. PTSs challenges prior to COVID-19 in their respective regions.	[1] "What are some of the main issues your transport sector has suffered in recent years prior to COVID-19?"
	2. Challenges PTSs have suffered since the outbreak of the COVID-19 pandemic.	[2] "What are some of the main challenges you've seen to your transport network since COVID-19 began?"
		[3] "Have ridership levels returned to their pre-COVID levels?"
(b) How have British cities tried to tackle these challenges and seize any opportunities?	3. Reasons for why these challenges occurred.	[4] "Why do you think that these issues arose?"
	4. How they tried to overcome these challenges and whether they were successful in doing so.	[5] "How did you try and overcome these issues?"
		[6] "Have these implementations been successful?"
	5. Their opinion on the largest challenge(s) for their region and why.	[7] "What do you think is the issue that had the largest impact on ridership levels prior to COVID-19?
	6. Ideas they had to try and alleviate the issues but couldn't implement.	[8] "Did you want to try and implement some things but couldn't?"
	7. The future of PT	[9] "How do you see the future of public transport in light of COVID and inflation?"
	8. The viability and resilience of PT in GB in the short-, medium- and long-term.	[10] "What would be needed to ensure that these PT systems are viable and resilient in the short-, medium- and long-term?"

Fig. 3. Participating towns, cities, and regions ().
adapted from: https://geoportal.statistics.gov.uk/

3.4. Analytical approach

All interviews were transcribed within seven days of the day of the interview to ensure that the discussions were accurately recorded (Dey,

1993). These transcriptions were then annotated using written notes from the interview. This ensured that context was brought into the information provided by participants (Kitchin and Tate, 2000). As shown in Fig. 3, a thematic analysis was utilised, and data was classified according to key themes that emerged during the primary data collection process (Kitchin and Tate, 2000). This approach helped analyse the interview data while preventing 'own perceptions bias' and was in line with Nikitas et al. (2019) analysis on parental perceptions of walking buses as a travel mode school. Data was first classified in relation to their respective interview question and then coded further in relation to the themes that emerged from discussing the interview questions with participants. These classifications helped observe how each classification interacted with each other. Nevertheless, one must note that classifying data means that some data may be oversimplified in the process, thus all original statements were referred to when interpreting the data, to ensure that true meanings were not lost (Kitchin and Tate, 2000).

4. Results and discussion

The study successfully recruited 12 participants, and interviews took place between the 13th of July and the 5th of August 2022. Nine interviewees had senior roles within their respective PT industry. Seven participants provided responses relating to the bus sector, while two participants provided answers relating to the rail sector. Three respondents were in position to provide information on both the bus and rail sectors (see, Table 4).

Although the number of participants appears relatively low, a good level of saturation – i.e., no new information was being discussed through conducting further interviews (Guest et al., 2006) – was achieved during the interview process. Obtaining a good level of saturation when conducting qualitative interviews helps improve the reliability of the collected data (Morse, 1994). As shown later in the paper, the participants provided valuable information and good quality data against the interview topics (Saunders et al., 2018).

The thematic analysis of the interview data pointed towards five challenges surrounding the public transport industry post-COVID19: underinvestment, transport culture, public perception, patronage levels, and bus driver shortages. These challenges were in contrast with the pre-COVID19 challenges identified in the literature review and included safety and security, comfort, affordability, reliability, and equity. Table 5 provides a summary of these challenges and the main points raised by participants. These points are discussed in detail in the subsections that follow.

4.1. Pre-COVID challenges

Underinvestment was highlighted as the main challenge for bus operators in GB prior to the pandemic. Local authority (LA) funding has decreased substantially over the years, and in 2019 Bridgend County Council, for example, cut all PT funding, which has led to the scrapping of all uncommercially viable routes (Participant H). Similar challenges were identified by Participant B in Kent, as the county faced £2.2 million in budget cuts in 2022. A third of interviewees noted that this was particularly an issue prior to COVID-19, and Participant K pointed out that funding issues had a negative impact on "un-metropolitan areas", in particular.

Table 4
Interviewee region and role within the public transport sector.

Participant	City or Region	Role	Public Transport Sector
A	Kent	Senior	Bus
B	Kent	Junior	Bus
C	Dundee	Senior	Bus
D	Newcastle	Senior	Rail
E	London	Junior	Rail
F	Glasgow	Senior	Bus
G	Bridgend	Junior	Bus
H	Bridgend	Senior	Bus
J	Manchester	Senior	Bus and Rail
K	Huddersfield	Senior	Bus and Rail
L	Edinburgh	Senior	Bus and Rail
M	Bristol	Senior	Bus

Table 5
Key themes and main points raised by participants.

Challenges	Main Points	Participants
Underinvestment	This was and continues to be the main challenge for PTSs. More of an issue in less densely populated areas. PT funding during the pandemic was less of an issue, however since lockdown measures have eased, it has become even more problematic.	H, B, K A, K, D
Transport Culture	Dominance of the car is the main reason why many people moved away from using PTSs to travel prior to COVID-19. Since the pandemic more people work from home, leading to fewer vehicle journeys and subsequently fewer people using PTSs.	K, F, A, D, E, H
Public Perception	Was negative prior to the pandemic, and worsened once lockdown measures were implemented.	F, A, B
Patronage Levels	The pandemic drastically reduced the number of people using PTSs. Levels have not returned to their pre-COVID figures in many areas, especially in relation to commuter travel. Leisure travel has recovered far better than commuter travel in many areas.	J, E, D, A, B, M A, D
Bus driver shortages	The pandemic led to many bus drivers changing career	A, B, M, K, D, F

The challenges experienced by Participants B, H and K corresponds with research conducted by Campaign for Better Transport (2018). Local funding budgets for PT have been reduced in recent years, which has led to the decline in uncommercial bus services in non-metropolitan areas of England and Wales. This is because many services, especially in rural areas, are not commercially viable, and therefore heavily rely on financial support through LA funding (Campaign for Better Transport, 2018).

In contrast, politics played a relatively small part in interviewees' responses, where only Participants E, M and H noted challenges regarding this scheme. Participant E stated that Brexit has led to fewer foreign nationals searching for work in GB. As such, this has led to challenges in urban areas such as London as it is now harder to run already overstretched services (Participant E). Between 2016 and 2020, the UK saw a 58% decline in the net migration of EU nationals, with only a 118,900 net increase in migration in 2020 compared to a 282,400 net increase in 2016 (Sumption and Kierans, 2020) (Sumption and William Walsh, 2022).

Both Participants K and F spoke about "the love of people for their cars" (Participant K) and how it was particularly "fab" for "ordinary families" as it allowed people to take their luggage to their doors (Participant F). Notwithstanding, Participant M noted that Bristol was in a relatively good position regarding car culture prior to COVID. They mentioned that this is because the city had "implemented residence parking schemes…in 2011" which in turn "pushed more people onto buses". This is in line with the information provided on Bristol City Council (2022), which states that the aim of the scheme is to 'nudge residents towards using smaller, more environmentally friendly vehicles, and towards increasing PT patronage'.

Nevertheless, interviewees highlighted that the overall public perception of PTSs was negative leading up to the COVID-19 pandemic. For example, Participant F noted that a "*snobbery*" exists towards bus transport within the UK, and they argue that this is due to poor accessibility to non or infrequent users. The cleanliness and safety of PTSs are

additional factors affecting perceptions. Participant F stated that safety issues are more problematic within the "*operating environment*" of buses, rather than on the services themselves. This is largely due to bus operators having little say on where street lighting is positioned along roads, as this is decided by local authorities (UK Government, 2022). This leaves them in a difficult position as to where to locate their services.

4.2. Challenges since the COVID-19 pandemic

Many interviewees from across England highlighted that the Government's messaging during the pandemic was particularly harmful to the PT industry. The UK Government encouraged people to "*avoid public transport*" unless necessary to "*save lives*" (Barrett, 2020). Participant J of Manchester explained that this messaging has "*…undone years and years of attempts to get more people to use public transport*", which demonstrates people's loss of confidence in GB's PTSs since the pandemic.

Interviewees thought this had negatively affected demographic groups disproportionately. Participant A argued that concessionary bus users were influenced by the Governments' PT messaging most as their ridership levels have been far lower than the overall figures themselves. Participant B expanded on this belief by stating that "*[…] only 60–65% of the elderly have returned to use the bus network in Kent*", which suggests that the perception of PTSs for some demographics has worsened since the pandemic began.

Patronage levels have improved since lockdown periods; however, interviewees emphasised that patronage levels have not reached their pre-pandemic levels. Interviewees representing larger urban areas mentioned that their respective PT services have regained around 80% of their pre-pandemic patronage levels (Participants J, E and D), while interviewees representing regional areas expressed that their patronage levels have only reached between 60 and 75% of pre-COVID levels (Participants A, B, and M).

Notwithstanding, many participants said that leisure travel has recovered far better than commuter travel. Rail services in Kent have seen patronage levels reach 120% of their pre-COVID levels on a Saturday, while bus patronage remains at around 70% in the region (Participant A). Similarly, Participant D mentions that rail patronage in Newcastle has also surpassed its pre-COVID levels for leisure and retail purposes and emphasises that these travel pattern changes can be explained by firms adopting working-from-home measures during the pandemic. This also agrees with Table 2 in Section 3.1 of the paper as fewer people are utilising PT services during the week in comparison to the weekend.

This was also supported by Participant A of Kent, who explained that the pandemic has led to parents staying at home to work, which has meant that they can now take their children to school. This has had a negative effect on the bus sector as children are no longer using their services to travel to school. Similarly, Participant D was unaware of anyone who has returned to work in the office full-time since the pandemic struck. Nevertheless, the workforce in Tyne and Wyre is an anomaly as the city has a large percentage of non-remote jobs, such as retail and healthcare. In areas such as London and Bridgend, Participant E mentioned that PT was quieter during 'peak times', while Participant H referred to the outcomes of working from home as "…a double-edged sword" as not only did the lockdown measures reduce car usage in the county, but it also negatively affected PT.

Interviewees noted that one reason behind the decrease in patronage levels was due to the bus driver shortages. Participant A explained that in Kent "*[the bus drivers] quite enjoyed not being out in the evenings and going up early in the morning and working weekends.*" Furthermore, Participant B highlighted that when "*more job opportunities in other industries became available, [they] started to lose drivers to other industries*" (Participant B, Kent). This has led to many bus services either being cancelled or operating on a reduced service (Participant M). As such, many bus users have had no other choice but to look for other means of travel (Participant K) as they "*just can't trust it*" anymore (Participant M).

The bus driver shortages also affected rail services. In Newcastle, Participant D explained that the shortage of bus drivers has had a knock-on effect on rail passengers in the city during rail maintenance work because the rail sector usually uses buses when this occurs. Similarly, Participant F in Glasgow described how bus operators no longer have a surplus of drivers that can be used at short notice, which explains why operators have had no other option than to cancel many of their services or only run at a minimum capacity. Low wages, along with long working hours and poor working conditions were the main reasons for bus driver shortages since the pandemic, according to 79% of 500 people questioned by Unite the Union (2021) at the end of 2021.

Table 5 highlighted that funding was an issue for the bus sector prior to COVID-19. During the pandemic itself, however, interviewees emphasised that funding was less of an issue as national governments provided sufficient funding to cover the gap in revenue lost (Participant A). The long-term viability of bus operators has become a challenge post-pandemic as the funding that was available pre-pandemic no longer ensures the financial viability of services.

> "If [councils] had to give one [form of financial aid] prior to COVID, now you have to give two or three times this support." (Participant K, Huddersfield)

Participant A noted that their Kent firm experienced "*whopping loss [es]*" because of the reduction in funding. For example, during the pandemic, Transport Scotland (2022a) provided £191 million to support Scottish buses between 2020 and 2021, whilst Transport for London was awarded over £4 billion in funding by the UK Government between May 2020 and December 2021 (UK Parliament, 2021). In contrast, Participant D explained that the rail industry in Newcastle has faced fewer issues surrounding funding as their rail services did not rely heavily on these pandemic grants, but they do acknowledge that their respective bus sector in the city is experiencing similar challenges.

4.3. The way Forward: The Experts' perspective

Regarding the future and viability of transport systems (see, topics seven and eight in Table 3, in the short-term, interviewees commented that integrated ticketing is vital to ensure that PT ridership levels increase (Participants J and L). This should encourage more people to use more than one mode of transport, which is currently what people do not do according to Participant L.

Additional funding was highlighted as the most common requirement to ensure the viability of PTSs in the short-, medium- and long-term. Participant A made the point that authorities need to improve their communication skills between themselves and bus operators as currently "*they're cutting funding within 30 days and then [bus operators] end up with a bus that isn't being used*". Instead, they suggest that if authorities provided a definite timeframe for the duration of funding, it would allow bus operators to "*invest in it knowing that [they've] got that time to…pay that money back*". Consequently, they could make necessary improvements to their services, which could help increase ridership levels.

Others, such as Participants M of Bristol and G of Bridgend, argued that without an increase in funding, it will be very difficult for bus operators to solve other challenges that lie within their respective services. Many of these challenges were highlighted as separate issues when discussing other interview questions, such as the cost of using PT, however, it appears that they were related to funding.

4.4. The resilience of public transport systems

When asked whether interviewees thought their respective PTS was resilient, responses were mixed (see, Table 6). Participants B of Kent and E of London explained that their answer would depend on the context. For example, Participant E stated that on the one hand similar historical

Table 6
Level of agreement regarding participants' views on whether PT is resilient to shocks such as COVID-19.

Response	Number of interviewees	City or Region
Yes	4	Dundee, Edinburgh, Newcastle, Bridgend
No	4	Kent, Bristol, Manchester, Bridgend
Don't know	1	Huddersfield
Depends on the context	2	Kent, London
Didn't answer the question	1	Glasgow

events have had similar impacts on PT patronage levels in the past, such as the 7/7 bombings in 2005, however PT services have managed to regain their patronage levels. Therefore, in this instance he views London's rail network as resilient. However, he also explained that the current cost-of-living crisis is not aiding the situation in regaining passengers, so patronage levels may take longer to 'bounce back'.

Interestingly, only Participant L of Edinburgh disputed the definition of resilience, as *"…sometimes things always have to evolve and change, and you can't mark progress just on return to its original state. So sometimes disruption like COVID can bring innovation and can bring change… So, in a way resilience is not about changing to your original returning to an original state, it's about taking a shock and adapting to it and producing something that's just as sustainable, if not better, in future."* Consequently, their answer is based on their own definition.

Furthermore, the discussion highlighted that incentives are required to increase not only the number of people using PTSs, but also those that operate said systems in Great Britain. This challenge will not be resolved overnight; therefore, we have identified three potential solutions that can be used in conjunction with each other to help improve these challenges.

In the short-term, improving the attractiveness of PTSs is key, and one way this can be done is through implementing integrated ticketing systems. Integrated ticketing would allow passengers to use the same ticket on different modes of transport, regardless of whether the operators or regions vary from place to place (Welsh Government, 2022). This should encourage more people to use more than one mode of transport, and therefore reduce the reliance on using private vehicles.

Improvements should also be made to the attractiveness of jobs within the public transport sector, and additional long-term funding could ensure this. This funding however should not only be directed at increasing workers' salaries., but also to be used to improve the work-life balance of the industry. This is particularly important for the bus sector as cash incentives to across GB in the aftermath of COVID-19 has not led to an increase in bus driver numbers Forbes (2021). Finally, it should be stressed that not all PTSs are the same in any given area. As such, it is key that public transport operators engage with their communities so that local PTSs cater to their needs. Only then will more people consider using PT to travel to their destinations.

5. Conclusion

This study explored the resilience of PTSs from the operators' perspective and in light of the COVID-19 pandemic and the challenges posted on these systems prior, during and post this pandemic. While these systems have been well-researched from a travellers' demand and perception perspectives (e.g. Bucsky, 2020; Eisenmann et al., 2021), the evidence from an operators' viewpoint is sparse in the literature. Thus, the aim of this study has been to provide an insight into past, present, and future challenges facing PTSs with the geographic focus on analysis being Great Britain, which presents a mixed picture of private and public ownership, especially in the rail sector. To address this aim, the study sought the insight of 12 experts across England, Wales and Scotland using online semi-structured interviews.

Despite input was sought from only 12 interviewees, a good level of saturation was achieved. Also, the group of respondents recruited had a good geographic spread as the study obtained views from a across England, Scotland and Wales and included evidence from 10 cities in Great Britain. The data collection took place during the summer period and as a result some professionals were on leave or unavailable due to increased workload. Having said that, the study did manage to recruit enough experts with many of them holding senior positions in the sector. Travel, time and budget constraints presented an additional challenge in this study; for example, it was not possible to conduct interviews face-to-face, however, virtual interviews worked well, and the data collection process did not present significant issues as people are now accustomed in using video conferencing software to participate in meetings.

The findings of this study revealed both similarities and differences against the challenges experienced by PT operators prior to and since the COVID-19 pandemic. Underinvestment and unreliable services were highlighted as particular challenges that existed both prior to and since COVID-19. On other hand, a change in people's habits was only brought on by the pandemic itself, which has led to many secondary challenges for PTSs as a result. Increasing funding for PT provision and implementing integrated ticketing systems across all PT modes were highlighted as being key to ensuring the long-term viability of PTSs in Great Britain.

CRediT authorship contribution statement

Ffion Goodland: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Visualization, Writing – original draft, Writing – review & editing. **Dimitris Potoglou:** Conceptualization, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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