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Smart and sustainable: collecting urban transport and mobility innovation in the 2020s

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Abstract

How can museums collect transport objects to reflect the changes that we can see happening on the streets around us today? Much of what is changing relates to behaviour and integrated transport systems, both of which lack material 'objects' to collect. Some transport changes might be more easily acquired for the historic collection – the arrival of on-street hire bikes, for example – but much of what is different with the emerging systems is about attitudes, behaviour and the use of smart technology.

Scotland's cities are experiencing a revolution in smart, sustainable transport and active travel. City centre transformation schemes, already several years in the planning, have been radically accelerated by the response to Covid-19. During lockdown in 2020 cities prioritised pedestrians and cyclists over motor vehicles as part of the public health emergency. At the same time electric vehicles, cargo bike delivery collectives, bike and scooter hire schemes, extended tram network and hydrogen-powered public buses are all making an impact on how Scottish cities operate.

This article explores the changes we see today to vehicles, systems and infrastructure on the streets of Scotland's cities as a microcosm of the wider global transport revolution and provides two case studies of recent acquisitions made by National Museums Scotland to illustrate how museums might capture this moment. By considering the Lutz Pathfinder pod, a prototype fully autonomous vehicle, and items relating to Edinburgh's Cargo Bike Movement, this article brings together two ends of the sustainable transport technology spectrum: futuristic driverless cars and low-tech bicycle deliveries. Furthermore, this article suggests approaches to how museums might collect other areas of change in transport systems and infrastructure.

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Keywords

Sustainable transport, intelligent mobility, contemporary collecting, urbanism, Scotland, cycling, cargo bikes, connected autonomous vehicles, active travel

A smart and sustainable transport revolution

All areas of transport are being challenged and transformed by the development of intelligent transport systems and the transition to a low-carbon energy strategy. As transport becomes more user-centred and incorporates advances in online technologies, the aim is for systems, vehicles and infrastructure to become integrated, sustainable and seamless. The three strands of transport history – vehicles, systems (scheduling, ticketing, hailing, etc.) and infrastructure (points of departure, rails, charging points, signage, etc.) – are all reflecting increasingly fast changes in the way we travel. Energy production and consumption is at the heart of planned future changes to transport systems, whether by changing the fuel types used by vehicles, or encouraging active travel such as walking and cycling. As the majority of transport systems in Scotland have been devolved to the responsibility of the Scottish Government (with the exception of air transport, and some maritime and cross-border rail) this article takes a Scottish perspective on these issues and reflects on how they can be incorporated into the transport collections of National Museums Scotland.

While many studies have centred on the financial and environmental consequences of transport policies, new research is being undertaken into the gender and racial aspects of transport use such as barriers to women using public transport, bike-sharing schemes or autonomous vehicles, as well as the impacts of transport and travel on communities, as evidenced by Edinburgh Napier University's Transport Research Institute publications and the reports of the Scottish Transport Studies Group.[1] These social dimensions are an increasingly important area for government, transport and city planners. They demonstrate that public behaviour will also need to change in order to achieve Scotland's Energy Strategy low-carbon commitments in the Scottish government's ambition towards the United Nations Sustainable Development Goals as described in their 2020 progress review of 'Sustainable Cities and Communities' development goals, which 'prioritises walking, cycling and public and shared transport options in preference to single occupancy private car' (Scottish Government, 2020, p 14).

The Scottish Government has set ambitious targets (Ibid.):

- The equivalent of 50 per cent of Scotland's heat, transport and electricity consumption to be met from renewable sources by 2030
- Phase out petrol and diesel cars in Scotland's public-sector fleet by 2025
- Net Zero by 2045

In Scotland's Climate Assembly interim report of March 2021 on Public Transport, 93 per cent agreed that Scottish government should 'Implement an integrated, accessible and affordable public transport system, and improved local infrastructure, throughout Scotland that reduces the need for private cars and supports active travel' (Scotland's Climate Assembly, 2021, p 16). Low Emission Zones (Low Emission Zones Scotland, 2021) are being introduced across Scottish cities to restrict the most polluting vehicles from accessing city centres and encouraging the use of public transport and active travel. It is clear that substantial change is coming to our city streets. How do museums best react to this change and reflect it in collecting contemporary urban materiality?

These changes are very much part of the urban setting, with existing infrastructure and choices of transport for people to use, but rural transport needs are very different, and it will be difficult to replace the convenience and reliability of cars in many remote parts of Scotland. Talk of the '20-minute neighbourhood' (O'Gorman and Dillon-Robinson, 2021), where work, schools, health care and shops are all within a 20-minute walk or cycle ride from people's homes, is more realistic in the city and suburb than the shire. It is therefore in the context of urban materiality (Rotenberg and Wali, 2014) that museums can focus their attention.

Museum collecting strategies have traditionally focused on the firsts and lasts of a type or system of transport (Divall and Scott, 2003, p 14). 'Acquisition at the point of obsolescence' is the 'distinguishing characteristic of transport collecting' (Divall and Scott, 2003, pp 46–47) and this is certainly borne out by an examination of the transport collections at National Museums

Scotland. The Museum includes examples such as one of the last Leyland 'Cub' buses to be built at Bathgate before the plant closed in 1985, or the last LNER D49 Shire Class steam locomotive *Morayshire,* which was rescued by an enthusiast when it was sold for scrap in 1962. This is a well-trodden path used by museums and industrial displays for over a century. Indeed, there are famous examples of railway vehicles collected and displayed this way, such as at the 1924 British Empire Exhibition at which LNER 'juxtaposed *Locomotion* with the then ultra-modern *Flying Scotsman* in a small exhibition called 'The First and Last' (Divall and Scott, 2003, p 14).

Figure 1

One of the last Leyland 'Cub' buses built at Bathgate

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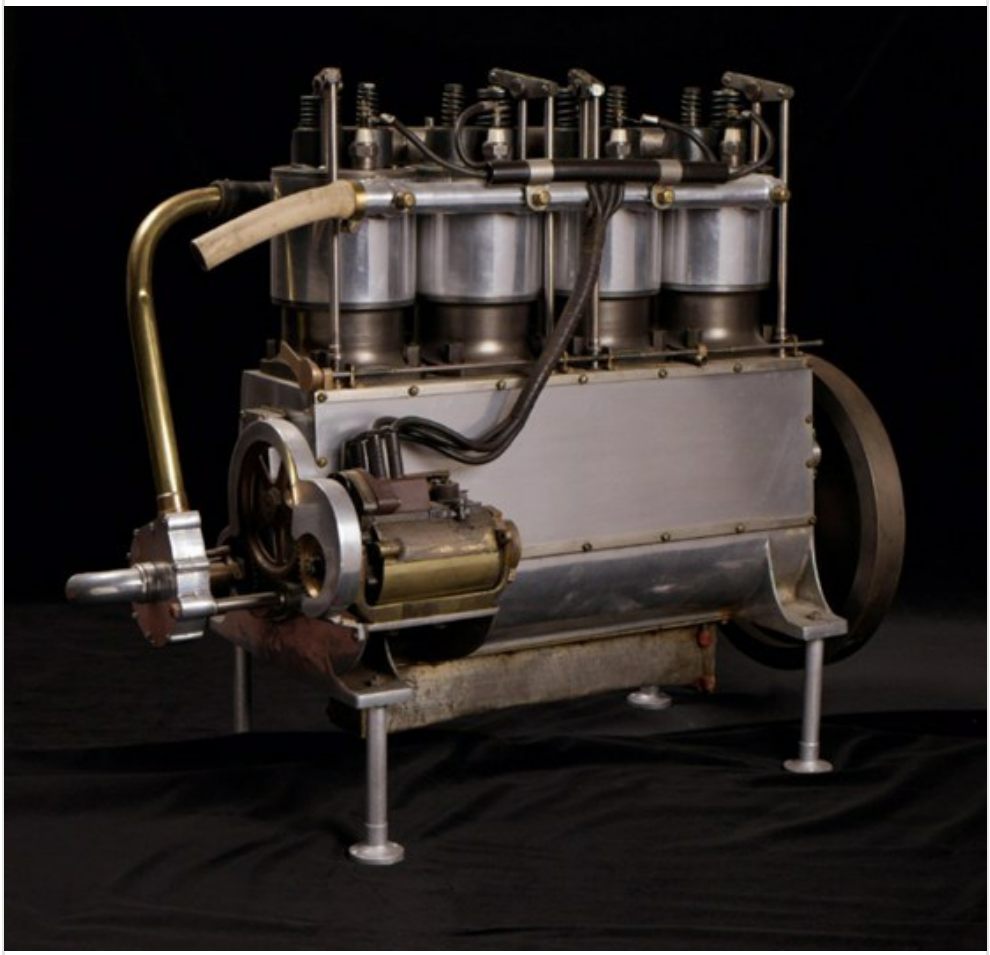
Museums also collect key moments in time, objects that represent a fleeting glimpse of the direction we thought the technology might take us. National Museums Scotland, for instance, displays *Concorde* at the National Museum of Flight, representing both the first and the last supersonic passenger aircraft. As Egerton points out, 'that we are nostalgic for twentieth-century technologies, as well as nineteenth-century ones, points to the importance of the disappearance of things which represented the future' (Edgerton, 2006, p 38).

'Science and technology museums want, and do, tell a story of novelties, firsts and of the future' (Edgerton, 2006, p 29). These 'firsts' have also been a consistently popular area for collecting, such as John Boyd Dunlop's first pneumatic tyre from 1888, which was gifted to the National Museum of Scotland by Dunlop himself in 1910. The Museum has a tradition of reaching out to the inventors of the modern world, and indeed Orville Wright sent a four-cylinder Wright aeroplane engine, built in 1910 and previously installed in a Wright Model B aircraft, to the Museum following correspondence in 1927, by which time fixed-wing flying was a well-established form of transport.[2] These firsts were only collected once the technology was proven and their significance for the history of transport had been established. It is harder to spot the emerging technology that has the potential to have an impact on our lives at the prototype stage, and museums risk missing opportunities to collect crucial developments or may collect an example that does not achieve its projected potential.

Figure 2



Four-cylinder Wright aeroplane engine built in 1910 (T.1927.26) and gifted by Orville Wright to National Museums Scotland in 1927

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Previous abortive attempts at new technologies do make for interesting collections, with examples of what-might-have-been such as the beautiful Citroen DS19 car (ref.1973-377) in the Science Museum collection, modified by the Road Research Laboratory in 1960 to test automatic steering via a high-frequency signal from an electric cable buried in the road. The track tests, although successful, were not replicated on public highways and the reports recognised 'that it was human factors, not technology, that would limit motor car automation' (Rooney, 2009).

Figure 3

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Citroen type DS19 automatically guided motor car, 1960

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These dead ends and diversions in the development of technologies are interesting in themselves as they demonstrate the lack of linear progression in technological developments (Bijker, 1995). However, the 'technological firsts' approach to museum collecting also risks missing out on the 'extraordinary life stories' (Edgerton, 2006) that objects accrue and that provide a more accurate historical context.

These big stories are easier to spot with hindsight, but it is simpler to collect the first and lasts that are happening now when one looks at the broader context, in this case the imperative to tackle the climate crisis. The transport responses to this issue are areas for collecting; the first hydrogen-fuelled trains and ships already being trialled in Bo'ness and Orkney, the first fully autonomous buses soon to be used in a public trial across the Forth Road Bridge, and so on. Changes in societal behaviour are

more difficult for museums to collect in a tangible way, such as the move to smart apps for hailing and ticketing, the rise in online shopping and working from home. Museums need to be responsive to subtle changes that mark bigger trends; for example, changes in road usage to prioritise active travel reflected by changing street furniture, the increase in delivery drivers and riders, or the end of paper tickets and travelcards on public transport.

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Vehicles

Vehicles are the most striking and, in many ways, straightforward transport objects for museums to collect, albeit with occasional issues of size and cost creating barriers. Representing 'firsts' for museums are the new types of vehicles and new developments in fuels to collect. These include items reflecting micro-mobility such as on-street hire bicycles and e-scooters, which have appeared in cities in the last ten years and provide a low-cost, convenient alternative to bike ownership. In public transport, hydrogen-powered buses in Aberdeen have completed a five-year trial and included the installation of the UK's first hydrogen production and bus refuelling station in 2015. The world's first generation of double-decker hydrogen buses came into operation in Aberdeen later in 2020. Whilst the cycle hire scheme bikes have smart technology built into their design, and the hydrogen buses have gas tanks, fuel cells and high voltage batteries replacing the usual six-cylinder diesel engine, changes to the vehicles themselves appear minimal from the outside. The experience of riding or driving in a hydrogen or other electric vehicle will be significantly different – smoother and quieter – but the look, function and capacity of the vehicles will be the same. Capturing this change in the experience of transport will be the challenge for transport museums and we should look to work done over recent decades by ethnographic museums to collect intangible experiences that forefront the stories of people using the objects, and allow for a 'shift in attention from objects to ideas, community stories, and narratives' that bridge 'the divide between material and living culture, then, fortifies the relationship between objects and peoples' (Alivizatou, 2012, p 191). This is where the research into gender and racial aspects of transport use can help to guide museums, directing their collecting attention through observing and talking to transport users and gauging changes in behaviour.

Connected Autonomous Vehicles (CAV) have the potential to challenge road-usership and car ownership and to redefine public spaces. A trial project to run autonomous buses across the Forth Road Bridge was due to be undertaken in 2020 ahead of COP26 (Transport Scotland, 2021). On the rails hydrogen-fuelled trains are being trialled at Bo'ness and could be used on stretches of rural rail networks that cannot be electrified.[3] The environmental impacts of lithium-ion battery electric vehicles, in particular the mining of minerals such as lithium in South America and the resultant pollution and health damage to people in developing countries is an important part of the global picture and should also be considered and reflected in future museum displays on the history of the development. Future generations, when looking back at our current choices and collecting decisions, will expect us to have included the social and environmental contexts for these developments.

Two recent acquisitions by National Museums Scotland aim to capture the hi-tech and low-tech responses to the challenges of modern urban transport, one a 'first' for a UK museum in representing a fully-connected autonomous vehicle, and the other a cooperative of ultra-local, emission free micro-delivery schemes.

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LUTZ Pathfinder pod

The LUTZ Pathfinder pod is the result of a ground-breaking research and development project that provided the UK's first ever self-driving vehicle trials in public, pedestrianised areas in Milton Keynes in 2015–16. Designed and manufactured by Aurrigo, a division of RDM group based in Coventry, the project used electric powered, two-seater 'pods' equipped with autonomous control systems (Transport Systems Catapult, 2016).

Figure 4

Lutz Pathfinder pod

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In the summer of 2020, between lockdowns, National Museums Scotland took delivery of one of three pods used for the LUTZ Pathfinder trials. During the trials it had full automated capability, although it retained a steering wheel and pedals, as well as a trained operator in each pod ready to take control of the vehicles if necessary. On delivery to the Museum the business-sensitive software was not included meaning what was in fact collected was the shell of a small Connected Autonomous Vehicle. This is a perennial issue for museums collecting around smart technology, and a question which museums looking to preserve digital heritage have been wrestling with for a decade at least (Young, 2012; Park and Samms, 2019). Without the software there is little that makes the Lutz pod different from any other electric vehicle, yet its unconventional design speaks to its role as a prototype and signifier for future industry direction. The design was specific to the project and is not intended to reflect how future commercially available autonomous vehicles will look. It resembles a very small Smart car with facets at each corner for the scanning sensor hardware, and it is still covered in its project livery, acknowledging all project stakeholders, and 'Trial Vehicle' in large letters across the rear. Finally, it has strips of LEDs around each wheel arch to add that futuristic touch. The LUTZ Pathfinder trials were completed in 2016 and fed into the larger-scale UK Autodrive programme with the aim of working towards the creation of a fleet of fully autonomous pods that will be able to operate without test drivers. Real-world applications have already started to be realised; in April 2021, Oxbotica joined forces with Ocado to further develop the technology into home deliveries (BBC News Online, 2021), proving the commercial appeal that drives the innovation, and further illustrating the overlap between the technology and changes in societal behaviour.

The project was carried out by the Transport Systems Catapult which brings together academic research with business and government to lead on innovation on behalf of the UK Automotive Council and the Department for Business, Energy and Industrial Strategy, formerly the Department of Business Innovation and Skills (Transport Systems Catapult, 2016). The Transport Systems Catapult has now combined with the former Future Cities Catapult under the new heading of Connected Places (Connected Places Catapult, 2021), another indication that smart transport is at the centre of urban development. Advocates for self-driving technology claim it has the potential to change the way people live and how cities are designed.

Intelligent mobility could help people who cannot drive due to age or infirmity to remain mobile and independent. It is anticipated that it will significantly improve road safety by eliminating human error as well as helping to reduce congestion in towns and cities by enabling vehicles to drive closer together. The connected autonomous vehicles of the future may be ordered on demand, meaning people no longer need to own their own car; the vehicle would simply meet you at your door, deliver you to your destination and then leave with no need to have parking spaces at your home or office. Space currently used for car parks could be used for real parks, thereby enhancing air quality and the liveability of cities. Driverless cars could change when and where we work, something already disrupted by the pandemic of 2020. Driverless technology would mean people have extra time in their vehicles when they do not need to be concentrating on the road but could be working, or relaxing. Of course, this technology would also have an impact on existing transport systems such as taxis and bus drivers; perhaps they will go the way of urban horse stables and farriers before them, only to be replaced by jobs we cannot yet imagine? By collecting this prototype, the museum can capture something of the uncertainty of the era. We know that future commercially available autonomous vehicles probably won't look like the Lutz Pathfinder pod, but it acts as a place marker for the multiple autonomous vehicle projects and trials happening all around the world, a staging post on the way to whatever will become the next dominant technology of the future.

The debate around autonomous vehicles nevertheless continues to prioritise the car as the answer to future transport problems with its inherent dominance of shared spaces instead of encouraging public transport or improved infrastructure to empower active travel. This raises questions about who this technological revolution is for. Are autonomous vehicles intended for those who are unable to drive due to health, physical or mental ability or age? Or will self-driving technology continue to be a luxury of the wealthy? Certainly, owner demographics for the best-known commercially available vehicles using self-driving technologies, the Tesla range,[4] suggests at present the market is dominated by 'white middle-aged home-owning men who have higher household incomes and no children' (Stillerman, 2020). Whether autonomous vehicles will become tools for improving independence for the infirm, elderly and for less advantaged groups will depend on factors largely economic and social. To date we are still too early at the beginning of this development to have reached anything like 'closure and stabilization' (Bijker, 1997) for this technology. As with the cable-guided car in the Science Museum, it is likely to be 'human factors' (Rooney, 2009) such as public perceptions of safety[5] that remain the rate-determining step. Even if the benefits of this technology for disadvantaged groups are proven and come to pass, the problems of car-centric urban design persist.

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Edinburgh's Cargo Bike Collective

In June 2021 National Museums Scotland acquired a collection of cycling clothing and posters from members of an Edinburgh cargo bike collective to illustrate a recent, radical movement away from carbon-emitting vehicles in urban areas, towards a sustainable zero carbon delivery system. They represent not only an environmental story with the use of pedal-powered cargo bikes replacing petrol and diesel power for city centre deliveries, but also represent changes in wider societal behaviour: the increase in home deliveries for food and online purchases accelerated by the lockdowns of 2020 and 2021 in response to the Covid-19 pandemic.

Bicycle use for local deliveries is nothing new, and this doesn't represent a 'first' for National Museums Scotland as there is already a delivery bike in the collection, a Hercules low-gravity tradesman's bicycle, used by 'R. McIntosh, Grocer and Wine Merchant' in the borders town of Jedburgh, from about 1950. However, what is new about the resurgence in the use of delivery bikes is the context of the pandemic coupled with the response to the global climate crisis creating new conditions for rethinking urban transport.

Edinburgh Cargo Bike Collective launched the Cargo Bike Movement, a Community Interest Company, in April 2020 as a direct response to the Covid-19 emergency. Cargo Bike Movement share premises at Tollcross with Farr Out Deliveries, Edinburgh's zero emission city wide cargo bike deliveries service. Farr Out Deliveries started their business during lockdown and are Scotland's largest, cycle-only logistics company. Cargo Bike Movement and Farr Out Deliveries use the following as their marketing statement and manifesto: 'Shifting hearts, minds and other stuff by cargo bike – for fairer, greener, healthier communities' (Cargo Bike Movement, 2020). Together they aim to cover both charitable and business sectors, promoting cargo bikes as both a suitable and genuinely sustainable method of transporting goods around the city.

Figure 5

Cargo Bike Movement and Farr Out Deliveries share premises in Edinburgh

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Both initiatives were born out of the Covid-19 pandemic, one as a charitable response to food poverty and waste, the other as a business opportunity identified when the city's festivals were cancelled forcing a creative response to the lack of work.

Cargo Bike Movement collects surplus food from supermarkets and delivers it to those experiencing food insecurity. At the start of the first lockdown during the 2020 Covid-19 pandemic a team of volunteers using a fleet of cargo bikes delivered food directly to people being accommodated in hotels, shelters and hostels, but as the year progressed the volunteers began to take food to various community organisations around Edinburgh to distribute it through groups such as the Refugee Community Kitchen and the SHRUB zero waste co-operative. Cargo Bike Movement also cite the benefits of the scheme to its own volunteers, who found that it 'offered a positive outlet for volunteers whose health and wellbeing was bolstered through helping others' (Cargo Bike Movement, 2020).

Far more than a transport story, Cargo Bike Movement can be seen in the context of wider social changes. Their own manifesto states that the Cargo Bike Movement seeks to build fairer, greener, healthier communities by being a direct response to:

- The necessity for better air quality in our cities
- Global climate and ecological crises
- Social inequalities across our communities
- The need for good examples of suitable sustainable transport options (Cargo Bike Movement, 2020)

The posters for Cargo Bike Movement were designed by one of their volunteers, Emily Willing, and were printed by Bare Branding in Leith. Farr Out Deliveries poster designs and logos on the branded clothing were created by David Squire, co-founder of the business with Alex Fitzhowle in Edinburgh, reflecting the grassroots, hyperlocal nature of these ventures. By collecting the artworks and branded clothing associated with the movement, rather than the cargo bikes (which are still very much in use and cherished by the riders) the museum captures the aesthetic and feel of the moment, builds a connection with

the people creating the change, and stakes an interest and intention for further collecting in the future.

The social changes implicit in the Lutz pod and created and reflected by collecting the Cargo Bike Movement material can be seen happening globally. This is illustrated by the rise in popularity of Facebook group NUMTOT (New Urbanist Memes for Transit-Oriented Teens), dedicated to discussions on new urbanism and public transport. Started in 2017, by December 2020 the NUMTOT group had over 210,000 members, largely from the US and Europe, but membership is global and growing. There is increased interest in doing transport differently within the context of a climate emergency, low carbon technology, and with a social conscience, as demonstrated by this emerging international and young demographic, expressing themselves though the creation of memes.

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Systems and infrastructure

The systems and infrastructure of transport are also worth considering for museums collecting changes to contemporary urban culture as we see an almost endless series of 'firsts and lasts' in every area of transport. The end of paper ticketing systems is approaching as all forms of public transport from buses to airlines issue electronic tickets. Smartcards such as TfL's Oyster card and the Scottish National Entitlement cards have replaced the need for cash and ticket machines, although even these smartcards are being phased out now in favour of the 'tap and go' use of contactless payments. These changes are already having an impact on social behaviours. For example, data suggests the pandemic has already influenced behaviour around contactless payment potentially to the detriment of some vulnerable groups (Jones, 2021), and may influence how people choose what transport to use, and which demographic is travelling on what mode of transport. Online booking and unlocking technologies have created a growth in on-demand car clubs, hire bikes and scooters, and apps such as Uber have disrupted the established taxi and mini-cab systems. Mobility-as-a-Service (MAAS) platforms, such as GO-HI being trialled by the Scottish Highlands and Islands Transport Partnership, will provide a single smartphone app to access all modes of transport, including car clubs, bike hires and traditional public transport in the region. The platform will allow users to book, pay and get a ticket all online. As with all digital-only systems, this is a difficult area to collect as the changes are increasingly virtual and are marked by a lack of the usual physical outputs such as virtual tickets and timetables replacing paper equivalents. The challenge is to be aware of the change when it comes and be ready to act to collect the last paper bus ticket or timetable. In the future museums need only display a smartphone to represent ways in which we hail and pay for anything from taxis to airline tickets since 'the physical elements of digital objects do not solely represent how they function and perform' (Park and Samms, 2019); the born-digital object has a 'performative element' (Park and Samms, 2019) which is manifested by the interaction with the user.

One burgeoning area of transport-related technology hardware is that around traffic management, which is largely aimed at monitoring and influencing road users' behaviour. New and expanding pieces of smart transport management equipment include the gantries and cameras on 'smart motorways' such as the Active Traffic Management (ATM), also known as Intelligent Transport Systems (ITS) in Scotland. These cameras control traffic through average speed monitoring; large digital displays announce weather conditions which may affect driving, or other real time information to drivers on motorways. There is an ever-increasing multitude of equipment that manages and monitors congestion or for road charging. Indeed, cameras are everywhere: Automatic Number Plate Recognition cameras, cameras that feed to the traffic control centres, and a host of speed cameras of different types. For monitoring the impacts of traffic there are the roadside air quality monitoring units, and there will be technologies associated with managing the Low Emissions Zones. As Professor Kate Pangbourne says, 'there is so much more "behind the scenes" that enables a car or a goods vehicle to be on the road' (Pangbourne, 2019). These smart traffic management systems are as much a data and communication story as they are transport technology.

There is also infrastructure for managing pedestrian crowds, such as the large metal arches on the Royal Mile and the Spaces for People temporary barriers extending pavements and cycle lanes into roadways. The street furniture associated with transport is changing with the technological changes; dock-less hire bikes will do away with the on-street cycle hire docking stations that are vulnerable to vandalism and are being phased out; eventually petrol stations will be replaced with electric vehicle charge-points. Pay-by-phone and automatic number plate recognition will replace parking ticket machines with number plate recognition cameras. The old infrastructures, even those which are still quite recent, could be collected to demonstrate

these developments, but the speed at which these technologies are changing may make many of them a meaningless footnote in future histories of our age. These fleeting attempts at reorganising transport for the twenty-first century may be the best way that museums can reflect this moment in history, in what Mullins describes as 'the banality of everyday consumption' (Mullins, 2014). Mullins champions collecting 'things that inspire involvement and imagination…to seek things that fall outside or are at the margins of dominant urban narratives' and 'underscore that history is not an orderly grand narrative' (Mullins, 2014, p 50), which is a helpful approach to collecting the uncertainty of contemporary culture.

The far-reaching changes in behaviour that will arise from the multiple options provided by sustainable and intelligent transport are almost impossible to guess and museums collecting in these areas take an educated gamble on what emerging or re-emerging technology will sum up our present time the best. The range of new transport technologies is at a turning point in history, impacting on everything from vehicles, systems, infrastructure and ultimately human behaviour. The challenge to museums is to embrace and reflect this potential and the inherent uncertainty in the objects we collect.

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Tags

- Museology
- Museum collections
- Science and society
- Curating
- Science museums
- Twenty-first century
- Contemporary collecting

Footnotes

1. See Edinburgh Napier University's Transport Research Institute publications such as Downey, L, Fonzone, A, Fountas, G and Semple, T, April 2021, 'Impact of COVID-19 on travel behaviour, transport, lifestyles and residential location choices in Scotland', Cornell University arXiv [https://arxiv.org/abs/2104.10440v1 accessed 16 June 2021] and Motherwell, S, February 2018 'Are We Nearly There Yet? Exploring Gender and Active Travel', Sustrans Research and Monitoring Unit publication [https://www.sustrans.org.uk/media/2879/2879.pdf] accessed 12 June 2021. Also, Scottish Transport Studies Group, Scottish Transport Review, August 2021: Is Scotland Setting an Example on Transport for COP 26? John Yellowlees, and August 2016 https://stsg.org/when-will-there-be-autonomous-vehicles-on-scotlands-roads, accessed 12 September 2021.
2. The Museum didn't acquire a full-sized aircraft until the Supermarine Spitfire was donated by the Ministry of Defence in 1971 and became the foundation of the National Museum of Flight's collection.
3. A 314 Class Electric Train, ex-Scotrail, 314209, built 1979, used extensively by Scottish operators, scrapped 2019, is being converted to hydrogen fuel by SPRS/Arcola Energy 2021 for COP26 and tests in northern Scotland. See press including: https://www.theengineer.co.uk/scottish-hydrogen-train-debut-glasgow-cop26/
4. Multiple major car manufacturers now include self-driving technologies in their ranges typically for assisted parking, lane-keeping, and cruise control, see https://www.cars.com/articles/which-cars-have-self-driving-features-for-2021-433821/
5. Multiple studies on the public perceptions of self-driving technologies have been published, such as Hewitt, Politis, Amanatidis, and Sarkar, 2019, 'Assessing public perception of self-driving cars: the autonomous vehicle acceptance model', in Proceedings of the 24th International Conference on Intelligent User Interfaces (IUI '19). Association for Computing Machinery, New York, NY, USA, 518–527. DOI: https://doi.org/10.1145/3301275.3302268, and Richardson, E and Davies, P, 'The changing public's perception of self-driving cars', Bournemouth University, Researchgate, DOI: 10.13140/RG.2.2.34641.02402

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