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Views & Comments

Human-Centered Mobility: A New Approach to Designing and Improving Our Urban Transport Infrastructure

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1. Introduction

This paper presents a new perspective for engineers when planning, designing, and managing transportation systems—as well as for those restoring and replacing ageing infrastructure. It provides evidence on how taking a "human" approach to transport will enable engineers to find smarter ways to move people and goods across cities, countries, and continents. Human-centered mobility puts the user directly at the heart of design and decision making. By adopting this approach, we can create efficient and resilient transport solutions that are mutually beneficial for both passengers and operators and which shape better cities and communities.

2. Challenge and opportunity

It is predicted that by 2050 the human population will reach 9 billion with 75% of the world's inhabitants living in towns and cities. With this continuing shift to urban living, cities are facing far greater social, economic, and environmental pressures. From London to Shanghai, our cities are facing many issues associated with rapid urbanisation and, inevitably, our transport infrastructure is taking the strain. Widespread congestion has become the norm, which impacts urban life through carbon emissions, air and noise pollution. We need to find ways of addressing these issues whilst delivering additional capacity.

But it is not all bad news. Greater population density also brings opportunities and urbanization can unlock the funding of large scale transport infrastructure projects. We, as designers, can help conceive city-wide integrated transport systems that are efficient and reduce the impact on the environment whilst delivering economic growth, health benefits, and social cohesion to the places we live. In doing this we must not lose sight of the most important element—the individual passenger and their desire for a simple seamless journey. We must focus on accessibility and mobility, as opposed to modes of transport in isolation.

The development of transport infrastructure remains high on governments' and city planners' agendas, but transport must not be viewed in isolation. Policy inter-relationships need to be recognized and addressed as part of an overall strategy. In 2014, the Mayor of London launched the city's first long-term infrastructure plan, which Arup significantly contributed to. It was the first attempt to identify, prioritize, and cost London's future infrastructure. The plan set three overarching objectives for long-term strategic transport investment: to support London and the UK's economy; to serve a growing population; and to make London more liveable. The plan clearly citied "human-centered" modes of travel as a priority.

It is increasingly recognized that transforming our transport systems can help improve the economic and social quality of neighborhoods. Even micro measures, such as introducing tree cover and green space as part of city planning and infrastructure projects, encourage people to seek alternative methods of transport and pursue healthier lifestyle choices. Our "Cities Alive" research into the implementation of green infrastructure has shown that promoting healthier, more outdoor-oriented lifestyles can reduce deaths by 2 to 6 in 1000. This also has a considerable economic benefit. A UK Forestry Commission report states that motivating a permanent 1% reduction in the sedentary population of the UK is estimated to deliver a benefit of up to £1.44 billion a year in economic benefits to the economy, equivalent to £800 per person.

The impact on health is an important element of human-centered design as transport systems have a highly significant role to play in helping to tackle the major public health challenges our cities face. Transport can be the cause of poor health (physical inactivity, poor air quality, noise) but it can also be the cure (active travel, improving air quality, and reducing noise). The World Health Organization data estimates that physical inactivity accounts for nearly one in ten premature deaths worldwide. Coronary heart disease, colon cancer, diabetes, stroke, and breast cancer are all linked to physical inactivity. It is estimated that, in Europe, inactivity could be killing more than twice as many people as obesity. University of Cambridge researchers have stated that getting everyone to do at least 20 minutes of brisk walking a day would have substantial benefits. And it is not just physical health. Inactive people have three times the rate of moderate to severe depression compared to active people. Being active is central to

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our mental health and feelings of general well-being. Dementia is now the leading cause of death for women in England and Wales as it is now responsible for 12% of all female deaths. Undertaking regular exercise, such as walking, can cut an individual's risk of getting dementia by 30%.

Active travel is the most viable option for significantly increasing physical activity levels across the population and the choice to walk or cycle is strongly influenced by urban settings and transport policy. Policies to encourage walking should be placed at the heart of future urban mobility strategies and indeed all our decisions about the built environment: Walkable cities are better cities for everyone. The built environment needs to encourage healthier choices so we need to design physical activity back in to our everyday lives by incentivising and facilitating walking and cycling as regular daily transport. Wayfinding systems like Legible London (Fig. 1), which saw the implementation of on-street signage tailored specifically for pedestrians, are one example of a step in the right direction.

In addition to the host of health benefits, there are many economic benefits for developers, employers, and retailers when it comes to walking. It is the lowest-carbon, least polluting, cheapest, and most reliable form of transport. It is a great social leveller and having people walking through urban spaces makes them safer for others and, best of all, it makes people happy. Getting more people walking and cycling to work would make for a healthier workforce and research also shows that absenteeism rates are lower among staff who cycle and that active commuters are better able to concentrate and under less strain than those who travel by car.

Bringing about change is challenging but cities can consider both trials and incremental steps to achieve their ambitions. The Korean city of Suwon embarked on a radical experiment in 2014: For one month the neighborhood became a car-free zone, which allowed the residents to envisage a low-carbon alternative. After the trial, people did not want to return to the way things had been, but chose to adapt their behaviors and keep elements of the trial.

Fig. 1. Legible London, Transport for London (TfL)'s wayfinding system. ©Arup/Thomas Graham.

In Freiburg, Germany, they spent 40 years making incremental changes to the transport system to take it toward its long-term vision of a city that promotes walking, cycling, and public transport. This is a prime example of how a series of interventions can build a sustainable transport system, if there is the foresight by government and a holistic approach to transport is adopted.

3. Human-centered mobility

Historically, different modes of transport have been considered separately—with separate policy teams, separate funding, and separate providers. While this reflects how the industry operates, it does not reflect the way people think about their journeys. The primary objective of the real life person at the heart of our engineering solutions is to get from A to B at an affordable cost in the most efficient way. And while shaping the new architecturally impressive airports, stations, and transport hubs, we have too often lost sight of the human element and the seamless journey.

So what would good human-centered mobility look like?

The transport system needs to be user-centric with all elements from ticketing to wayfinding highly intuitive. It needs to be efficient, cost-effective, and accessible to the widest population, so it can support a growing and vibrant city. The system should be mode agnostic, so a passenger can switch between walking or cycling, or taking a bus, tram, or car as this provides flexibility, but is also inherently resilient if there is failure in one mode or maintenance is required. The ticketing system and real-time information should enable seamless end to end journeys across all modes.

This sounds simple yet behind those straightforward principles, lie multi-layered complexities. It is our job to tackle that complexity and use behavioral knowledge with our engineering expertise to create networks that are seamless and simple for the user.

4. Future trends and influences

If you look around the globe there are clear examples of what the future of transport might look like and how transport is indeed becoming more focused upon the needs of the passenger. High-speed rail in many regions, including China, is slashing journey times and diminishing the need for short-haul air travel. Arup has been a strong advocate of high-speed rail, even before our first involvement in the UK Channel Tunnel Rail Link in the 1980s. High-speed rail offers a sustainable, progressive means of managing the economic and environmental cost of road and air travel, as well as offering fast connectivity and a positive passenger experience. For example, the planned high-speed rail network from London to Birmingham and to Manchester and Leeds, High Speed 2, could transfer 4.5 million journeys a year from the air and 9 million from the roads, removing lorries from busy routes (Fig. 2(a) and (b)). High Speed 2 will reach speeds of up to 250 miles·h^{-1} (about 402 km·h^{-1}), which is faster than any current operating speed in Europe, and would cut Birmingham–London journey times from 1 h 21 min to 49 min.

There is a growing trend in shared ownership of vehicles (and bicycles) which is fuelled by mobile applications. This can free up much city space previously taken up by parked cars for other urban uses. In Berlin, the city's excellent public transport and bicycle paths combined with the opportunity for sharing mean that most residents do not own a car and most visitors do not require one.

Whilst awaiting the arrival of autonomous vehicles, the devel-