The Gram Junkies

Change in the Way Mobility Is Thought about Is Essential

John Thackara

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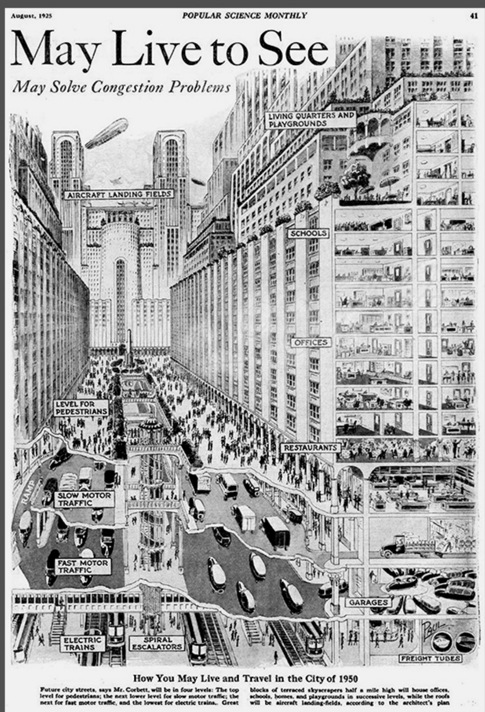
The many proposals advanced by policymakers and designers to tackle the ever more complex issue of mobility are merely spurious solutions, according to design critic John Thackara. We must radically change our thinking in this regard. In his view, we can learn a lot from the workings of the human brain, microprocessors and network topography.



'The Wonder City You May Live to See. Buildings Half-Mile High and 4-deck Streets May Solve Congestion Problems', Popular Science Monthly, 1925.

Gram junkies are those fanatical hikers and climbers who fret about every gram of weight that might be carried – from titanium cook pans to toothbrush covers. Reading their online forums you discover that excess weight is not just a performance issue for these fanatics: they take excess weight *personally.*

In the matter of sustainable mobility, we all need to become gram junkies. Modern mobility doesn't just damage the biosphere, our only home. Global systems of air, rail and road travel are also greedy in their use of space, matter, energy and land. Economic structures perpetuate the problem. Few laws or tax regimes take account of these hidden costs. Sustainable mobility is more about changes to economic structures and cultural perceptions than about the development of exotic power sources for vehicles.

The hardest design challenge is the complexity of 'transport' and mobility as a policy or design issue. Many transportation interventions help solve one or two problems – but exacerbate others. The best-known example of such a rebound effect is the way that the expansion of highways reduces congestion for a time – but tends to increase total vehicle traffic. Another rebound effect is economic: increased vehicle fuel efficiency conserves energy, but because it reduces vehicle operating costs, it tends to increase total vehicle travel.

These negative on-costs are compounded through time. The growth of theUS Interstate Highway System, for example, changed fundamental relationships between time, cost and space. We spend the same amount of time travelling today as we did 50 years ago – but we use that time to travel longer distances. The average German citizen today drives 15,000 km a year; in 1950 she covered just 2,000. A lot of our travel time these days is commuting and work-related travel which we believe we cannot avoid – but which we simply did not do 50 years ago, We also spend a lot of time travelling in order to shop and to take the kids to distant schools – 'essential' journeys that did not exist a generation or two ago.

These new patterns of use of space and time, which have been enabled by car ownership, have stimulated the growth, in turn, of a gigantic worldwide ecology of mutually dependent economic actors. It is not in the interest of these actors to reduce transport intensity; on the contrary, their economic survival depends on its perpetual growth.

Unsustainable transport is not, for the most part, the result of bad behaviour such as laziness. It's the result of human beings responding to economic stimuli. Todd Litman, who runs the Victoria Transport Policy Institute in Canada, explains one way in which simple tax arrangements amplify transport intensity. To a car owner, for example, depreciation, insurance, registration and residential parking are largely fixed costs – they are not directly affected by how much a vehicle is driven. Motorists therefore have an incentive to maximize their vehicle travel to get their money's worth from such expenditures. They receive no incentives to drive less. Litman describes these market distortions as 'economic traps' in which competition for resources creates conflicts between individual interests and the common good. Most insidious of all: the impacts of these economic traps are 'cumulative and synergistic: total impacts are greater than the sum of individual impacts', as Litman puts it. Seemingly innocuous fiscal distortions skew countless travel decisions and contribute to a long-term cycle of automobile dependency.

The damaging impacts of modern mobility on the biosphere tend to be indirect and hard to perceive. Curiously, the same goes for its impact on human bodies. Cars kill people too – but without causing much of a fuss. An average of 3,242 people die on the roads each day around the world [1] – a number similar to the total deaths in the 9-11 attacks. Children are especially vulnerable: traffic accident deaths account for 41 per cent of all child deaths by injury. But the carnage caused among children by cars barely registers on the public imagination. The threat of 'terrorism', on the other hand, has driven the growth of 'homeland security' as a new global industry.

Even when it doesn't kill people outright, modern mobility is bad for our health – and the on-costs of that, too, are astronomical. The highest rates of obesity, for example, correlate 1:1 with the proportion of car journeys taken by children – and the costs of obesity are heading for 10 per cent of US GDP. Increased auto dependency and air pollution also contribute to escalating respiratory illnesses, cardiovascular disease and hospital admissions. [2]

The movement of stuff is as much a burden on the planet as the movement of people. The

World Economic Forum estimates that 2,800 megatonnes of harmful emissions – or 5.5 per cent of the total – are contributed by the logistics and transport sector.[3] Even if modern mobility were not a climate-change or social problem, the fact that global mobility depends on a finite energy source – oil – means it is fundamentally not resilient as a system. Whether oil and gas are at a peak or on a plateau, increasing consumption means that the nine million gallons of petrol people currently use in the US each day simply will not be available, in future, in the quantities desired. And because 95 per cent of all transportation depends on oil, life-critical systems that are transport-dependent – such as food – are also vulnerable to any disruption in the prevailing logistical system.[4]

A dazzling array of solutions is being considered to deal with these complex challenges. The website Newmobility.org, for example, has identified 177 different projects and approaches to sustainable mobility.[5] These range from bus rapid transit (BRT), car-free days and demand-responsive transport (DRT) to hitchhiking, pedestrianization, smart parking strategies and vanpooling. The trouble is that every solution that assumes our present or increased levels of transport intensity turns out, on closer inspection, not to be viable.

Non-Solutions

To a car company, replacing the chrome wing mirror on an SUV with a carbon fibre one is a step towards sustainable transportation. To a radical ecologist, all forms of motorized movement are unsustainable. So when is transportation sustainable and when is it not? Chris Bradshaw, a transport economist, emphasizes that 'light' transport systems are not, per se, sustainable – only less unsustainable than commuting by car.[6] 'Light rail supports far-flung suburbs; street cars support, well, street-car suburbs,' says Bradshaw. 'A smaller, more efficient, or alternative-fuel vehicle is only less unsustainable than another private vehicle. It will still take up space on the road and in parking lots; it will still threaten the life and limb of others; it will still create noise, and it still will require lots of energy and resources to manufacture, transport to a dealer, and dispose of when its life ends.'

Bradshaw wants planners and designers to respect what he calls 'the scalar hierarchy'. This is when trips taken most frequently are short enough to be made on foot (even if pulling a small cart), while the next more frequent trips require a bike or street car, and so on. 'If one adheres to this, then there are so few trips to be made by car that owning one is foolish.'

Investments in high-speed trains such as the TGV are another non-solution. Europeans believe that high-speed trains are far more environmentally friendly than aircraft – but they're not.[7] When researchers at Martin Luther University studied the construction, use and disposal of high-speed rail infrastructure, they found that it takes 48 kg of solid primary resources for one passenger to travel 100 km by Germany's high-speed train.

Is one answer to go by banana boat? Not really. The world's merchant fleet contributes nearly 4.5 per cent of all global emissions – a huge amount, up there with cars, housing, agriculture and industry.[8] (Like aviation, shipping emissions are omitted from European targets for cutting global warming.)

Electric cars are the biggest distraction of all. The assumption in European and US policy is that smart grids powered by renewable energy will power millions of electric or hybrid vehicles.[9] Unfortunately, these technology-driven solutions are not viable once the economics of electrical grid modernization, and sheer time, are factored in. The German branch of the World Wildlife Fund (WWF) published a study in May 2009 (conducted with IZES, a German institute for future energy systems) – electric cars reduce greenhouse gases only marginally, they found.[10] The manufacturing processes of both the hybrid and the fully electric car require more energy than those of any conventional petrol-powered car. A worst-case (and frankly most likely) scenario is that most electric cars will run on electricity from coal rather than from renewable sources.

The least talked-about obstacle to electric transportation concerns the raw materials needed to manufacture the vehicles. Rare earth metals are key to global efforts to switch to cleaner energy and therefore cleaner transportation. But mining and processing these metals cause immense environmental damage. Each year, China's rare-earth industry produces more than five times the amount of waste gas, including deadly fluorine and sulfur dioxide, than the total flared annually by all miners and oil refiners in theUS. [11] Alongside that 13 billion m3 of gas are 25 million tonnes of waste water laced with cancer-causing heavy metals such as cadmium. And, just as we already have a problem with peak oil, a shortfall looks likely in the world's capacity to produce lithium. One rare-metals expert, William Tahil, claims the production of hybrid and electric cars will soon tax the world's production of lithium carbonate. [12]

Think More, Move Less

Politicians dissemble, or lie, or both, in response to a perceived dilemma: transportation damages the biosphere, costs a fortune and kills people – and yet transport, they believe, is essential to economic growth. This false belief is based on grossly inadequate ecological accounting and the power of the myriad industries involved. Every actor in the aviation industry, for example – airplane manufacturers, airlines, airports – is subsidized by direct grants and tax breaks. Remove these hidden subsidies, and also charge aviation the true costs of its environmental impact, and the whole enterprise becomes un-economic even on its own terms. [13]

Politicians are also scared that no voter will tolerate a curtailment of air travel. A better way to put it is that no *rich* voter will. Only 5 per cent of the world's population has ever flown. Aviation is overwhelmingly an activity of the rich, and strong measures to combat the environmental impact of aviation would not adversely impact poor people.[14]

We once hoped that the Internet would replace trips to the mall, that air travel would give way to teleconferencing and that digital transmission would replace the physical delivery of books and videos. In the event, technology has indeed enabled some of these new kinds of mobility – but in addition to, not as replacements for, the old kinds. In the same way that roads built to relieve congestion have increased total traffic, the Internet has increased physical transport intensity in the economy as a whole. Rhetorics of a 'weightless' economy, the 'death of distance' and the 'displacement of matter by mind' sound ridiculous, in retrospect.

Rather than tinker with symptoms – such as inventing hydrogen-powered vehicles, or turning petrol stations into battery stations – the more interesting and pertinent design task is to *rethink the way we use time and space* and to reduce the movement of matter – whether goods or people – by changing the word 'faster' to 'closer'.

Our transportation challenge can be compared to distributed computing. The speed-obsessed computer world, in which network designers rail against delays measured in milliseconds, is years ahead of the rest of us in rethinking space-time issues. It can teach us how to rethink relationships between place and time in the real world, too. Embedded on microchips, computer operations entail a precise accounting for the speed of light. The problem geeks constantly struggle with is called *latency* – the delay caused by the time it takes for a remote request to be serviced or for a message to travel between two processing nodes. Another key word, *attenuation,* describes the loss of transmitted signal strength as a result of interference – a weakening of the signal as it travels farther from its source – much as the taste of strawberries grown in Spain weakens as they are trucked to faraway places. The brick walls of latency and attenuation have led computer designers to speak of a 'light-speed crisis' in microprocessor design.

The clever design solution to the light-speed crisis is to move processors closer to the data – in ecological terms, to relocalize the economy.

Network designers, striving to reduce *geodesic distance*, have developed the so-called storewidth paradigm or 'cache and carry'. They focus on copying, replicating and storing web pages as close as possible to their final destination, at content access points. Thus, if you go online to retrieve a large software update from a file library, you are often given a choice of countries from which to download it. This technique is called 'load balancing' – even though the loads in question, packets of information, don't actually weigh anything in real-world terms. Cache-and-carry companies maintain tens of thousands of such caches around the world.

By monitoring demand for each item downloaded, and making more copies available in its caches when demand rises and fewer when demand falls, operators help to smooth out huge fluctuations in traffic. Other companies combine the cache-and-carry approach with smart file sharing or 'portable shared memory parallel programming'. Users' own computers, anywhere on the Internet, are used as shared memory systems so that recently accessed content can be delivered quickly when needed to other users nearby on the network.

The Law of Locality

My favourite example of decentralized production concerns drinks. The weight of beer and other drinks, especially mineral water, trucked from one rich nation to another is a large component of the freight flood that threatens to overwhelm us. But first Coca-Cola and now a boom in microbreweries demonstrate a radically lighter approach: export the recipe, and sometimes the production equipment, but source raw material and distribute locally.

People and information *want* to be closer. When planning where to put capacity, network designers are guided by the *law of locality*. This law states that network traffic is at least 80 per cent local, 95 per cent continental and only 5 per cent intercontinental. Communication network designers use another rule we can learn from in the analogue world: 'The less the space, the more the room.' In silicon, the trade-off between speed and heat generated improves dramatically as size diminishes: small transistors run faster, cooler and cheaper. Hence the development of the so-called processor-in-memory (PIM) – an integrated circuit that contains both memory and logic on the same chip.

So, too, in the analogue world: radically decentralized architectures of production and distribution can radically reduce the material costs of production. We need to build systems that take advantage of the power of networks – but that do so in ways that optimize 'localness'.

Nowhere is this design principle – 'the less the space, the more the room' – better demonstrated than in the human brain. The brain, in Edward O. Wilson's words, is 'like 100 billion squids linked together' – an intricately wired system of nerve cells, each a few millionths of a metre wide, connected to other nerve cells by hundreds of thousands of endings. Information transfer in brains is improved when neuron circuits filling specialized functions are placed together in clusters.

Neurobiologists have discovered an extraordinary array of such functions: sensory relay stations, integrative centres, memory modules and emotional control centres, to name a few. The ideal brain case is spherical, or close to it, Wilson observes, because a sphere has the smallest surface relative to volume of any geometric form. A sphere also allows more circuits to be placed close together; the average length of circuits can thus be minimized, which raises the speed of transmission while lowering the energy cost for their construction and maintenance.

The mobility dilemma is not as hard as it looks. I have tried here to look at the issue through a fresh lens and to borrow from other domains, such as microprocessor design, network topography and the geodesy of the human brain. The biosphere itself is the result of 3.8 billion years of iterative, trial-and-error design – so we can safely assume it's an optimized solution. As Janine Benyus explains in her wonderful book *Biomimicry,* biological communities, by and large, are localized or relatively closely connected in time and space. [15] Their energy flux is low; distances covered are proximate. With the exception of a few high-flying species, in other words, 'nature does not commute to work'.

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John Thackara is a writer, educator and design producer. He is the author of *In the Bubble: Designing in a Complex World* (2005) and of a widely-read blog at www.designobserver.com.

Footnotes

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Tags

Design, Media Society