# Coming To Terms With Traffic Congestion

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## *Abstract*

*Traffic congestion is a significant problem for modern society, but it is a necessary evil. Congestion is the principal mechanism to resolve the surplus demand for road space during peak traffic areas. There is universal agreement that traffic from privately owned vehicles (POVs) will greatly increase in most parts of the world in the next 5-15 years. Acknowledging that traffic congestion will continue to be society's main solution to the competition for scarce road space, this paper proposes additional teleworking facilities with a door-to-door shuttle services with mini-offices. Whether stuck in traffic or not, time spent driving in POVs is unproductive, whereas near office conditions provided in trains, ferries and, nowadays, also in planes make it possible for passengers to stay productive . Teleworking in a door-to-door shuttle service with mini-offices would increase the attractiveness of public transit services in some large cities and, possibly, in larger quasi-urban areas in heavily populated countries. Such condition might provide leverage to deal with heavy traffic, especially traffic congestion. We suggest niches for an experimental transition to door-to-door shuttle services with mini-offices. We propose further systemic studies to find out what kind of industrial synergies would arise and how large society's leverage to deal with heavy traffic could be.*

## *Introduction*

Much is being said about traffic congestion both in the academic literature and the popular press. There seems to be universal agreement that traffic congestion is increasing and most people regard it as a bad thing. At an individual level people begrudge the time they waste in queues and stress levels are increasing while at a community level noise and emission pollution is spoiling the quality of life, accidents bring misery, emergency vehicles are slowed, metropolitan areas expand and businesses have to count the cost of indirect and direct time lost; further, at the global level the surge in inefficient transportation is threatening non-renewal energy stocks and pressuring governments to 'manage' strategic energy reserves, and emissions are increasing, leading to greater pollution, including "greenhouse gases."

Traffic congestion is costly. But Downs (2004, Ch. 2 The Benefits of Peak-Hour Traffic Congestion) has a qualified and thought-provoking point of view: He does acknowledge that traffic congestion is a significant economic problem in the aggregate (ibid, p. 28), but he makes the strong point that traffic congestion is the principal mechanism to resolve the surplus demand for road space during peak traffic areas.

Since traffic congestion has proven to be ubiquitous and "perennial" – since at least Roman times – one should concentrate on coming to terms with it. In practical terms, this means addressing two main questions:

- How to optimise policies to contain traffic congestion, i.e. make traffic congestion as solution to allocate scarce road space to competing users most effective.
- How to mitigate negative aspects of traffic congestion

In this paper we deal mainly with the second question, but we reduce the scope to investigating an approach that might make a special form of public transport attractive to a non-negligible number of commuters and travellers – a comfortable, a door-to-door, multi-occupancy shuttle-bus with onboard mini-office facilities. We will argue that the proposed approach could already be profitable in special situations and in some metropolitan and heavily populated areas. If it takes off, it could create new business opportunities and synergies in many countries: public transit services, vehicle manufacturers, manufacturers of computer and communication devices, wireless services, network software developers, multimedia companies, car rental companies, eLearning, eBusiness and others that would be invented to adapt to new business constellations. Since the envisioned approach spans quite far into the future and the "component" technologies and services are many, the possible paths are numerous and unpredictable. Equally wide is the number of settings where the idea could work and of configurations that could be experimented with. Creativity is needed to develop working and profitable solutions.

Our paper aims at raising awareness about the approach – what we term a "shuttle office" – to catalyse reactions among owners of component technologies and services and to encourage studies of specific business opportunities.

The structure of this paper is as follows: In the section "Congestion through history" we review traffic congestion as perennial problem, and as one that stubbornly has resisted "technological solutions." Thereafter, in the section "How costly is traffic congestion?" we discuss the main findings in an archetypal study of traffic congestion costs to US society (TTI 2002, 2002) and some objections raised against. Next, in the sections "About technological attempts to 'solve' traffic congestion" and "Policy resistance in traffic congestion" we review the ubiquitous approach to 'solving' traffic congestion by expanding traffic capacity, and express well-known explanations of the futility of such attempts using generic system archetypes (Wolstenholme 2002). In the section "Solo driving vs. public transit" we examine factors affecting preferences for (near) single occupancy vehicles versus using public transportation. Thereafter, in "Transitioning to shuttle office services" we analyse several scenarios that might provide profitable niches for first attempts to create door-to-door shuttle with teleworking services in various countries and circumstances. In "Policy analysis" we discuss the proposed policies in terms of so-called "solution archetypes." In the final section "Discussion and conclusions" we describe in very general and aggregate terms some probable repercussions – positive and negative – of establishing shuttle office services; we also propose follow-up studies that would be desirable to for better management, both public and private, of emergent scenarios.

## *Congestion through history*

Traffic congestion, it would seem, is a perennial problem. It also seems to be a problem that through the ages has not been solved. There is a much quoted story that ancient Rome suffered and, as Frosch (1999) observed, failed to solve it: “Many of these problems would be familiar to ancient Roman and medieval city residents and governments (although on a smaller, but similarly dense, scale), and like our earlier counterparts, we don't seem to have good engineering solutions, either. (In ancient Rome they attempted to deal with congestion by forcing delivery and pickup to night-time hours, with resulting problems caused by noise and irate citizens. We, too, haven't done very well with this problem.)”

The problem has persisted through the ages. England’s King Charles II issued a famous edict in 1660 to ban standing carriages, wagons, and horses from the streets of Westminster and London because they were excessive and creating a public nuisance. The order required that they wait for their passengers off the main thoroughfares to enable the traffic to flow more freely on the main streets. By the nineteenth Century, when industrialization brought urbanization, cities became more crowded still. Most people walked to work or lived above or behind their businesses, and what very basic horse-drawn public transportation there was, was often too expensive for most citizens.

Nineteenth century and especially Victorian London lead the movement in innovations that promised to be the solution to urban congestion and convenient local travel through multi-occupancy public transportation. The Stage Carriages Act of 1832 encouraged the gradual replacement of the hackney cab – the horse-drawn taxicab (and still the technical term for taxis in London) by the multiple occupancy ‘omnibus’ as the means of non-pedestrian movement around the city (and their rail-based equivalents the tramcar). Of course, as the ancient Romans also found, the solution to one problem often simply creates a new one. In 1850 a traffic count in Cheapside and London Bridge tallied a thousand vehicles an hour passing through these areas during the day. By 1900 three thousand horse-drawn buses were carrying 500 million passengers a year. However, as Perdue (2005) has observed in his review of Dicken’s life and times, “all of this added up to an incredible amount of manure which had to be removed from the streets.” However, mass transportation based on the omnibus is still subject to controversy. An op-ed article in the Boston Globe in 2001 (O'Toole 2001) condemned local plans to introduce large scale new bus-based public transit involving the circulation of four hundred 40-60-foot (12.5 -18.5 metre) buses – one every 4 minutes – on a suburban-downtown route. The article condemned this in emotive terms «…the city will smother in its own traffic … this fleet of chunky intruders would strangle movement in much more than this emerald core but impact communities from the periphery to the center.» (Kay 2001)

In Victorian London, the road traffic problem was considered so bad that some believed it threatened the smooth and efficient running of business. The solution was the other commuting innovation, the local urban rail transit system. The first section of track opened as the Metropolitan Railway in 1863 and provided an underground route for steam-powered carriages for local travel between Paddington and Farringdon Street. (Actually some earlier attempts at constructing cut-and-cover underground routes had been abandoned because of the impact on traffic and communities.) Most major cities now have some form of local (or light) rail network – under- or over-ground, or at ground-level, or a combination. Yet even this ubiquitous method of mass public transportation is also not without critics, who see such large systems as often failing to deliver the service numbers expected and as diverting investment form road infrastructure and other solutions to congestion. In an analysis of the early impact of San Francisco's BART (Bay Area Rapid Transit), it was found (Webber, 1976) that while costs exceeded all estimates, ridership was only at one-half of that predicted. The Cato Institute (1997) is even more damning: "Rail transit projects funded by the law increase congestion because they carry so few people and divert funds from activities that could improve traffic flows. Even Washington, D.C.'s well-developed but expensive rail and bus transit network moves fewer than 14 percent of all commuters. Light rail in particular is a 19th-century technology that is slow, inconvenient and expensive. Many cities now pouring hundreds of millions of dollars into light rail lines that will replace two or three bus routes could have doubled bus service on every one of their routes for far less money."

Communities and local governments are now looking to more fundamental changes to ease traffic congestion. These include purposefully designed integrated transportation systems and even TOD, Transit-Oriented Development (also called Transit-Focussed Development) which requires more dense and compact development around transit stops, in particular, rail station (see, for example, Cervero 1998). However, to be fully effective this concept requires that residential accommodation be located at transit nodes as well as commercial activities like malls and offices, and this may not be happening. Yet another transportation 'silver bullet' might not live up to its expectations, and for many living with congestion rather than avoiding or removing it might be the only option for the foreseeable future.

## *How costly is traffic congestion?*

Traffic congestion is costly – although there is some controversy about the validity of assumptions underlying estimates of traffic congestion costs. The Texas Transportation Institute (TTI) estimated that peak-hour congestion wasted $67.5 billion in seventy-five US metropolitan areas during 2000 because of extra time lost and fuel consumed, or $505 per person, compared with what would have happened without congestion (TTI 2002). Other estimates for the cost of traffic congestion in the United States range from $43 to $168 billion per year (quoted by Sterman 2000, p. 178). The situation elsewhere seems to be even worse: regions in industrialized societies like France, the United Kingdom, and Japan, and in economically still developing societies like India, China, Indonesia and Brazil have less mobility and greater traffic congestion than the United States (Downs 2004, p. 329). And worse it to come: Buoyant Asian economies, like e.g. Korea, Thailand, India and China, are densely populated countries and their total population surpasses two billion people. Their economic development will necessarily require growing traffic. The resulting increase in heavy traffic might deplete non-renewable resources too fast for the world economy to accommodate; oil prices could soar to prohibitive levels; the general health level would probably deteriorate; and pollution, including a potential increase in "greenhouse gases", would affect most people the one or other way.

Downs (2004, p. 25-28) criticises the estimate from TTI, viz. that peak-hour congestion wasted $67.5 billion in seventy-five US metropolitan areas during 2000 because of extra time lost and fuel consumed, compared with what would have happened without congestion. He argues, partly, that TTI *overlooks* important costs caused by traffic congestion; partly, that TTI *overestimates* the total costs. Two important cost factors not present in TTI's study are:

- Some experts (Weisbrod, Vary, and Treyz 2003) believe that losses experienced by businesses because of delays in shipping constitute a serious drag on the efficiency of the entire US economy (and, one would assume, even more so in more congested metropolitan regions in e.g. Japan, the United Kingdom, China, Brazil, etc).
- Businesses choosing sites for production facilities prefer – other things being equal – sites with lower traffic congestion. Hence, congested areas are in a disadvantageous competitive position.

The most relevant booby factors allegedly inflating the estimates of economic losses due to traffic congestion costs are:

- The baseline for comparison, viz. that it would actually be possible for all people who want to move during peak hours to do so at free-flowing speeds without any delays, is utopian. Hence, the computed costs are exaggerated.[1]
- TTI's assumption that time spent stuck in traffic can economically be equated in value with time spent working is questionable. If there were no congestion, converting the commuting time per day saved into compensated work would hardly be feasible for most people.
- Only part of the time spent travelling to and from work occurs while the commuter is in a vehicle on traffic arteries. Much time is spent walking to and from the vehicle, driving on minor roads and parking. Eliminating traffic congestion on highways and major roads would not necessarily reduce the total travelling time accordingly.

Downs concedes that traffic congestion is a significant economic problem in the aggregate. We are not concerned with the ultimate cost estimate if TTI's analysis were revised to meet Down's objections. Rather, we argue that current circumstances already are impacting their validity and that future developments might reduce the relevance of Down's objections even more.

The demand to obviate lost time while travelling is clear. Many drivers observed making calls on their mobile phones, despite the fact that it is dangerous, and possibly illegal, are business people. The better-off have even more opportunities – chauffeurs can allow busy managers and professional to work during car rides. Practices amongst longer-distance train commuters provide a further example – in standard class, where all seats are occupied and many passengers have to stand, the best that they can hope for is to gain a little respite

[1] This point had been made by other authors before (see e.g., Goodwin 1977, p. 9).

by reading a book, sleeping, or maybe enjoying an occasional telephone call, in the first-class compartments, on the other hand, the atmosphere is relaxed, working papers are spread on tables, and lap-tops are in constant use. Converting wasted travel time into productive time and reducing stress can be achieved, but still at a premium price.

If an increasing number of people could combine “teleworking” (or other activities that people consider worthwhile)[2] with travelling, estimates of costs due to commuting would have to consider that a significant and increasing proportion of solo drivers are wasting their time, whether stuck in traffic or not. Hence the first two objections raised by Downs would become less valid. Accordingly, a crucial issue is how far teleworking can be combined with travelling, i.e. how and to what extent technological advances and policies can establish profitable ways to do so. A contribution to this effect would be to provide a door-to-door service in shuttles with mini-offices. Notice also the third and last objection posed by Downs would some validity if a significant and growing number of people were to adopt shuttle office services.

## *About technological attempts to ‘solve’ traffic congestion*

### The automotive Parkinson’s Law

Technological “solutions” of traffic congestion focus on open-loop cause-effect relationships: Congestion occurs because highway capacity is too low, hence – to solve the problem – increase Highway Capacity.


**Figure 1** Open-loop “solution” of traffic congestion

Highway Capacity, measured in vehicle-km per day, can be increased by building new roads; improving existing roads – more lanes, eliminating bottlenecks; increasing the flow of traffic – including emerging technologies such as optimizing traffic with computer models (Howard 1997; Helbing 1997); automating highways (Rillings 1997); other kinds of so-called Intelligent Transportation System devices to speed traffic flows (Downs 2004); etc.

Why do technological attempts to reduce traffic congestion only provide temporary respite, often leading to even worse congestion in the longer term and unintended added problems? The open-loop model of traffic congestion ignores several powerful compensating feedbacks that upset technological solutions and create nasty secondary repercussions (see §5.6 "Explaining Policy Resistance: Traffic Congestion" in Sterman 2000, p. 177ff). For the purpose of this article is suffices to explain two generic archetypes, the “automotive Parkinson’s Law” and the “mass transit death spiral.”

[2] We often use “teleworking” for simplicity of expression, although the context might allow for other passenger activities that people consider worthwhile doing (such as e.g. online shopping, online training & learning, etc. or even plain reading of books).

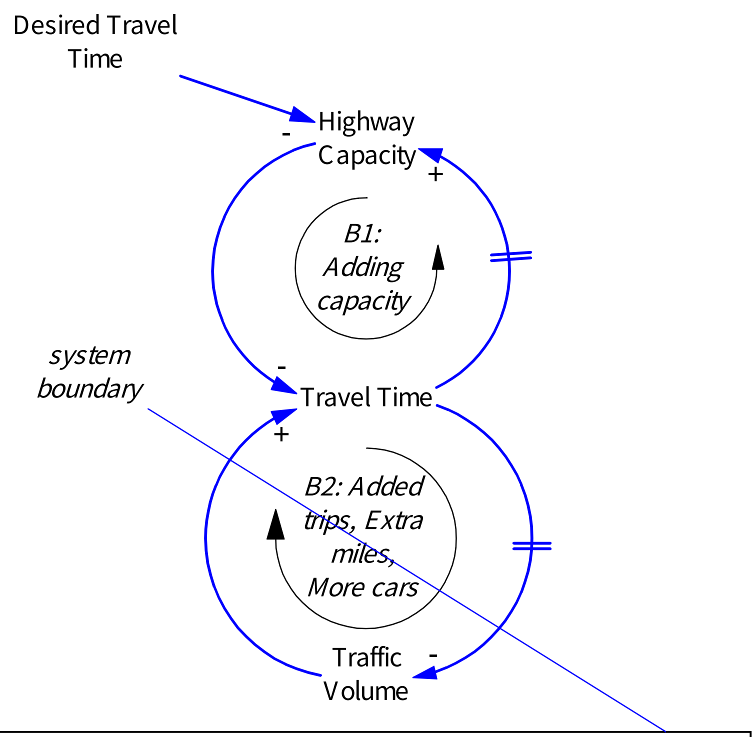


**Figure 2** Automotive Parkinson's Law: Traffic expands to fill available road capacity. Note the role of Desired Travel Time as the set point for the balancing loop

The automotive Parkinson's Law has the same causal structure as the famous Parkinson's Law which explains that "work expands to fill the time available for its completion" (Parkinson 1957). Both laws are special instances of a "relative control archetype" (Wolstenholme 2002), where the balancing (B) feedback loop ("*B1: Adding capacity*" in Figure 2) implemented by the political and technological establishment triggers another balancing reaction ("*B2: Added trips, Extra miles, More cars*") in other sectors of society, which then compromises the intended solution. Notice the time delays (indicated by //): It takes time before an unacceptably high Travel Time translates into increased Highway Capacity; similarly, improved Travel Time gradually attracts more traffic as people take more trips, travel longer distances and more cars are purchased.[3]

Wolstenholme (1990; 2002) has strongly emphasised the existence and importance of "boundaries" (physical and mental) as obstacles to systemic thinking. With respect to Figure 2, Wolstenholme would emphasize the role of the organisational/societal boundary for "hiding" the unintended consequence from the "view" of those implementing the intended consequences. But system boundaries do also "hide" the contribution of the single individual to congestions and delays, smog and "greenhouse gases," and depletion of non-renewable resources. Stanislaw J. Lec expressed the generic wisdom figuratively: "No individual stone would admit its contribution to the landslide." (Lec 1971)

[3] In the context of our analysis Travel Time refers to the average travel time for private car drivers.

Desired Travel Time is the set point, the determinant of the equilibrium value for traffic congestion. The lower the Desired Travel Time, the greater the gap between desired and actual Travel Time, and the greater the pressure on the establishment to increase highway capacity. Thus billions and billions have been spent for many decades, and are likely to be spent through capacity expansion programs in the futile effort to reduce traffic congestion.

The Desired Travel Time, so-called, is a near invariant across all societies: The late analyst Yacov Zahavi postulated that people devote on average a constant fraction of their daily time to travel – a fraction he termed "travel-time budget" (Zahavi 1973, 1974, 1979). Schafer and Victor (1997) claim that all the reliable surveys they found support Zahavi's hypothesis: The travel-time budget is in the range of 1 to 1.5 hours per person a day in all societies. Accordingly, we assume that the near-invariant travel-time budget expresses a strong human preference: the Desired Travel Time in Figure 2.

## Mass transit death spiral as out-of-control archetype

As pressure to reduce Travel Time builds up, politicians expand Highway Capacity; but over time greater Highway Capacity creates adverse conditions for mass transportation. The transient situation with less traffic congestion, making driving longer distances more attractive, motivates people seeking cheaper housing and lower population density to move out of the city. As cities sprawl, mass transit becomes less adequate in lower density areas, and even fewer people use public transit. Public transport deficit increases and public transportation becomes even less competitive. The declining Adequacy of Mass Transportation leads to even higher private driving and, hence, to higher Traffic Volume. More Traffic Volume means increasing Travel Time, which again creates pressure to solve traffic congestion by increasing Highway Capacity.

The combined effect of the balancing feedback loop *Adding Capacity* and the reinforcing loop *Choking Mass Transportation* which acts as a vicious circle – *Choking Mass Transportation*. The resulting phenomenon is an instance of an "out-of-control" archetype (Wolstenholme 2002): The intended balancing loop *B1: Adding Capacity* creates an unintended reinforcing loop *R: Choking mass transportation,* with negative results for both traffic congestion itself and public transportation. Note again a system boundary indicating less than perfect vision of consequences from actors in different sectors of society (Figure 3).

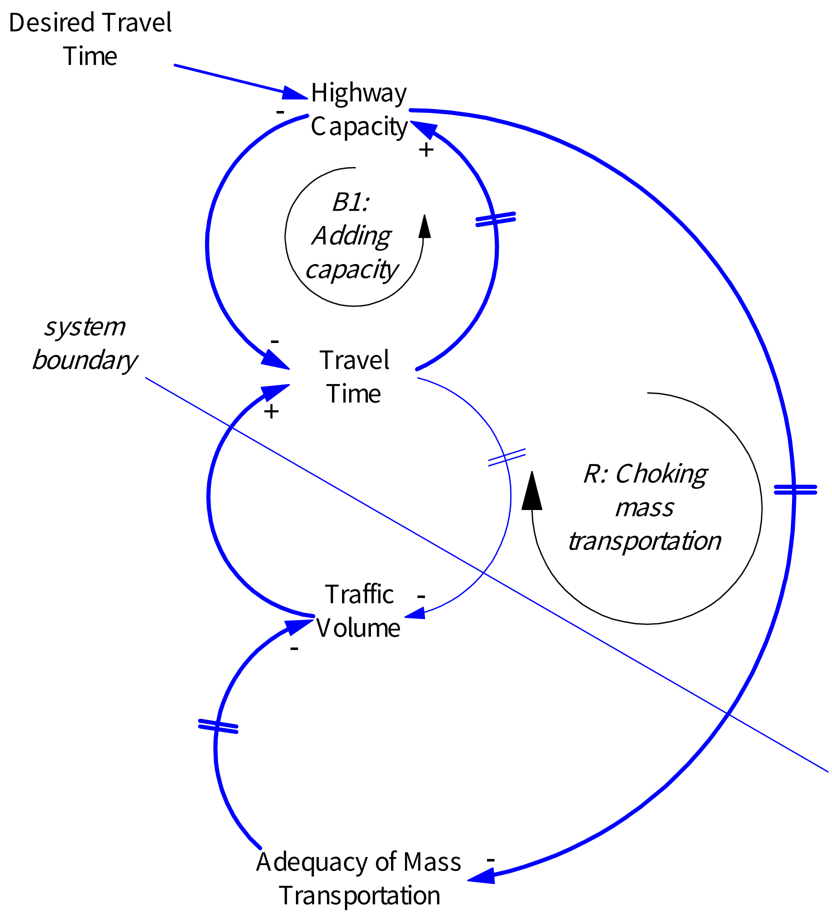


**Figure 3** Explaining the mass transportation spiral as an "out-of-control" archetype

## *Policy resistance in traffic congestion*

Figure 4 shows three main mechanisms for the persistence of traffic congestion and the handicaps on public transportation coming from attempts to decongest traffic with technological solutions. Such “policy resistance” is ubiquitous for measures addressing problem symptoms rather than fundamental causes of complex dynamic problems.

A fuller picture of traffic congestion would consider its impacts on demography, urban sprawl, economic and social activities, pollution, etc.[4] Yet, the mechanisms depicted in the combined system archetypes “the automotive Parkinson’s Law” and “the mass transit death spiral” are the most important ones in relation to policy resistance. Further, they contain the main features needed to explain the contribution of the door-to-door shuttle service with mini-offices to alleviate problems caused by traffic congestion.

[4] For an in-depth causal-loop analysis of traffic congestion’s policy resistance see Sterman (2000, §5.6).

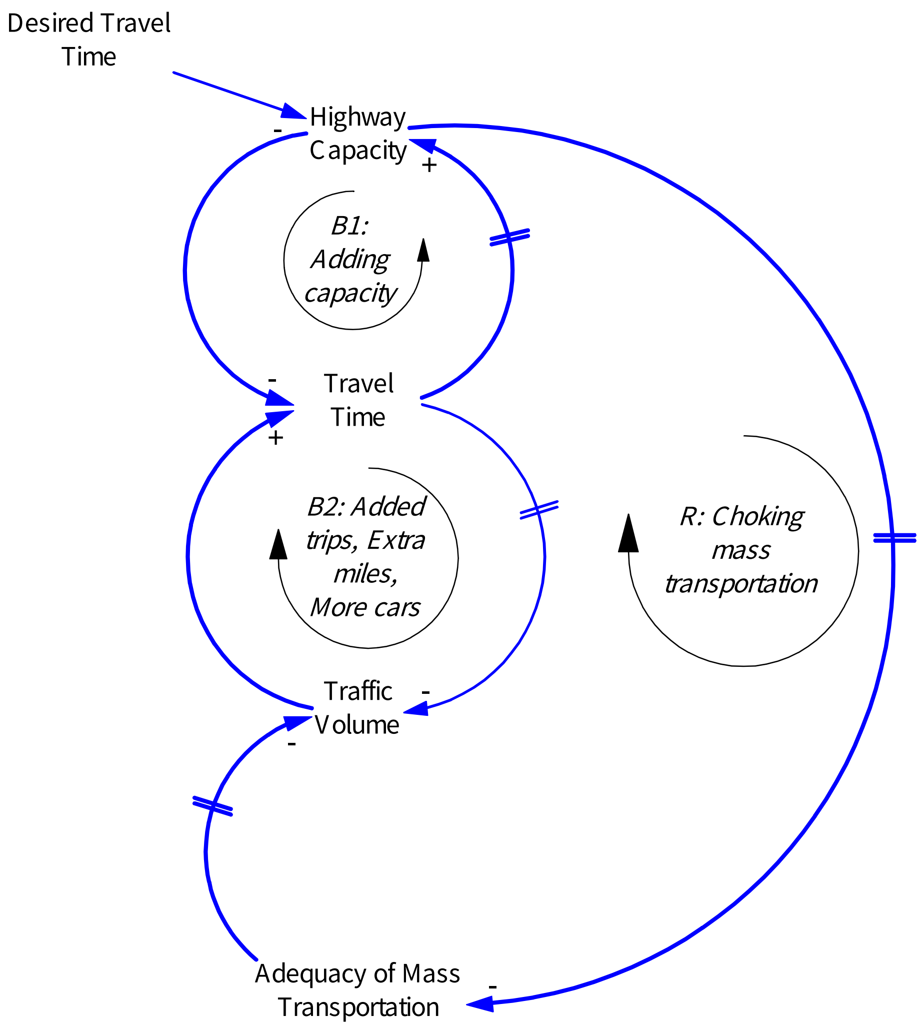


**Figure 4** The intended reduction in travel time by adding highway capacity is ultimately self-defeating and it creates unfavourable conditions for public transit

## *Solo driving vs. public transportation*

Most people prefer travelling in privately owned vehicles (POVs), and most of them prefer to drive alone, because of higher privacy, convenience, comfort, speed and accuracy of timing as compared to public transport. Hence the ubiquitous shift to POVs as the average income rises in poorer parts of the world. An important factor affecting convenience, speed and accuracy of timing is the fact that current public transportation is bad at serving low-density settlements – as many people have observed.[5] An admittedly old study (Pushkarev and Zupan 1977, p. 177) concluded that bus transit in the US needs

[5] See e.g. Downs (2004), especially Chapter 4 and 9, where most of the studies mentioned in this section are reviewed and discussed.

residential densities of a minimum of 4,000 persons per square mile[6] to be efficient; for train transportation the threshold was even higher. In the United States no bus service was available in 1995 to 30.6 percent of household for areas with gross densities between 1,000 and 4,000 persons per square mile[7] and for lower-density areas the corresponding fraction was 59 percent or higher (Ross and Dunning 1997, p. 149). All this ties well with the fact that in year 2000 only 4 percent of the 476 urbanised areas in the US had population densities of 4,000 persons per square mile or higher and only 4.7 percent used public transit (Downs 2004, p. 52).

Low-density settlement patterns, so characteristic for the US, are otherwise found only in a few other parts of the world. Still, in most wealthy economics, such as e.g. Germany, Japan, the United Kingdom, public transportation is not a preferred option for many people. People prefer door-to-door travel to walking to and from transit stops and changing modes of transportation; and people prefer flexible choice of departure/arrival time to inflexible transit schedules. Public transport has further disadvantages such as exposure to weather; necessity to carry objects while walking to and from public service; waiting and waste of time at bus and train stations; frequent service delays; loss of privacy; and public transport often means longer travelling time. Despite heavily subsidised public transportation in the European Union, all forms combined provided 15.6 percent of passenger ground travel in 1997. The corresponding figure for the United States is 2 percent (Downs 2004, p. 286-287, especially Table 16-4). Another interesting point is the length of commuting time: Roughly speaking, the more people use public transportation, the longer the commuting time: in 1996, the average one-way commuting time was 22 minutes in the United States and 38 minutes in the Europe Union (fifteen countries).

In addition to not being particularly successful at attracting a high-number of passengers, most forms of public transit in the EU lose money – hence the necessity of subsidies.

## *Transitioning to shuttle office services*

Many commuters use laptops while travelling and services for in-travel work are sometimes offered in, for example, trains. We can see a transition to universal in-travel use of computers and wireless networks. This leads to the notion that equipping shuttle-buses to provide door-to-door transport with office facilities might offer an attractive proposition.

Imagine the scenario – Deborah is a busy professional located in her company's head office in the business district of a major city. It is lunch-time and she has a late afternoon flight to visit the companies' office in an overseas city. She makes these journeys quite frequently, and always finds the process tedious and inefficient – if only tele-conferencing were a viable alternative, but unfortunately it is not, as face-to-face interaction with the client is essential. The whole activity always used to start badly – in order to maximise the time in the office before leaving, she always left departure to the very last minute. Usually the taxi-cab arrived at the time booked, but traffic congestion is always bad - sometimes so bad that

[6] 1,600 persons per square kilometers
[7] Roughly 390 – 1,550 persons per square kilometers

she only just made the flight, but has not infrequently missed it completely. At best stressful, at worst a major headache. The other end was just as bad!

Today, things should be different. For the last month or so, she has been travelling to and from airports by shuttle mini-office. The shuttles are comfortable and have personal compartments with a full set of wireless computing and telecommunication facilities. For one person, the cost is certainly more than a regular shared-ride shuttle-van, but is comparable with a personal limousine and in some cities with regular taxicabs. The service is booked on an individual door-to-door basis and uses GPS and congestion analysis software to make pretty accurate predictions on the travel time. Ironically, however, because the travel time is productive, not lost-time, she is comfortable leaving the office much earlier. Today she has a schedule of last minute details to deal with en-route, downloading some data, reviewing charts and statistics, and using the chat-room type facility to get the latest views of colleagues. She will also have a stress-free opportunity for a last call or email to her children. She is even looking forward to the airport-to-office transfer at the other end. She knows she will not be at her best after a long flight – she flies business class, but it is still not like a good night's sleep. However, she has the shuttle mini-office booked – her arrival at the office will be at a predictable time, and there will again be opportunity en-route for some last minute updates. In particular she has to download and evaluate some numbers her colleagues in the overseas office are preparing overnight in advance of the meetings.

In the following we discuss various scenarios offering a favourable starting point for a transition to shuttle office services

## Scenario "Shuttle to airport"

The scenario described above exhibits the potential value of the idea to the individual executive and key worker. Such a service would be a natural complement to existing services which include regular cabs, scheduled buses or other public transportation services, limousines for a more luxurious journey, and shared vans offering door-to-door services at a modest price. The shuttle office would be a natural product extension for existing shared-ride van operators like *Supershuttle International* or 'the Blue Van', which currently serves 20 plus US airports, or the many smaller firms worldwide. This could be through a fleet of special designated shuttle office vans, or through offering more comfortable, technology-enabled seats as an up-grade on regular vans.

## Scenario "Silicon Valley"

High tech firms tend to cluster in industrial zones, typically away from residential areas, and the clustering thereby causes severe local congestion. High tech firms have often been the pace-setters in home-working - the professional climate in firms, the self-actuating nature of employees, and the nature of the work itself means that companies and staff alike see working from a home office/design station via broadband connection having many benefits. However, travelling into the office has not been eliminated, and many activities still require individuals and particularly groups to assemble on site. This is potentially disruptive to the seasoned home-office worker, as they have to break away form working during the travel to and form the office, and many will therefore choose to make the whole day an office-day, travelling to and from during the peak rush-hours. The shuttle office means they could work at home as normal until they need to travel, and could then immediately catch the office and continue working via the shuttles broadband. A high demand for such a shuttle service in 'silicon valley' type areas, means that the service would be extremely efficient and could also make maximum use of special highway lanes for multiple occupancy vehicles.

### Scenario "Stagecoach"

Global public transit companies such as e.g. Stagecoach have both the market knowledge and the financial muscle to establish prototypes of shuttle office services in promising regions or niches within their economic empire. Investing in such prototypes would allow them to shape future options in alliance with other component technologies and services while developing know-how in what might turn out to be a major future scenario. Failure to make an early start might put them at a permanent disadvantage in relation to smaller competitors who might surf to prominence on shuttle office services.

### Scenario "Buoyant Asian Economy"

Buoyant Asian economies, like e.g. Korea, Thailand, India and China, are densely populated countries. Their total population surpasses two billion people. Their economic development will necessarily require growing traffic. As Down (2004) puts it: «… efficient operation of both the economy and school systems requires that people work, go to school, and even run errands during about the same hours so they can interact with each other. That basic requirement cannot be altered without crippling our economy and society.» If the same patterns of traffic congestion, oil consumption, pollution and stress were to develop in, say, China, non-renewable resources may be depleted too fast for world economy to accommodate, oil prices would soar to the prohibitive levels and pollution, including production of "greenhouse gases," would be of unimaginable extent.

In such situation where traffic is needed and required for Asian economies to approach levels comparable to USA, Europe, Australia or Japan, global public transport enterprises such as e.g. Stagecoach or car rental companies like Avis, Budget or Hertz, would have a tempting opportunity to establish large fleets of shuttles equipped with mini-offices operating on environmental friendly basis, such as e.g. hydrogen cell engines. There would be interesting options for policy design[8] spanning traffic planning, production of new types of vehicles, wireless technologies and services, scheduling a wide variety of in-travel opportunities (working, planning, learning, training, shopping, etc). It is not unthinkable that impetus from such development would turn into competitive advantage – deserving systemic studies (cf. Section "Discussion and conclusions").

## *Policy analysis*

To understand how the door-to-door shuttle service with mini-offices could help alleviate problems caused by traffic congestion we turn back to the two "problem" archetypes, "the automotive Parkinson's Law" – Fig. 2, and "the mass transit death spiral" – Fig. 3.

[8] The "authoritarian" political patterns in societies like China might be here a competitive advantage.

Wolstenholme (2002, p. 10-11) argues that for each problem archetype there is a closed-loop “solution” archetype. For obvious reasons we will call such archetypes “mitigating” archetypes. We first look separately at each problem archetype and discuss how the door-to-door shuttle service with mini-offices could mitigate problems caused by traffic congestion. Afterwards, we combine the two “mitigating” archetypes into one causal-loop diagram and discuss its policy implications.

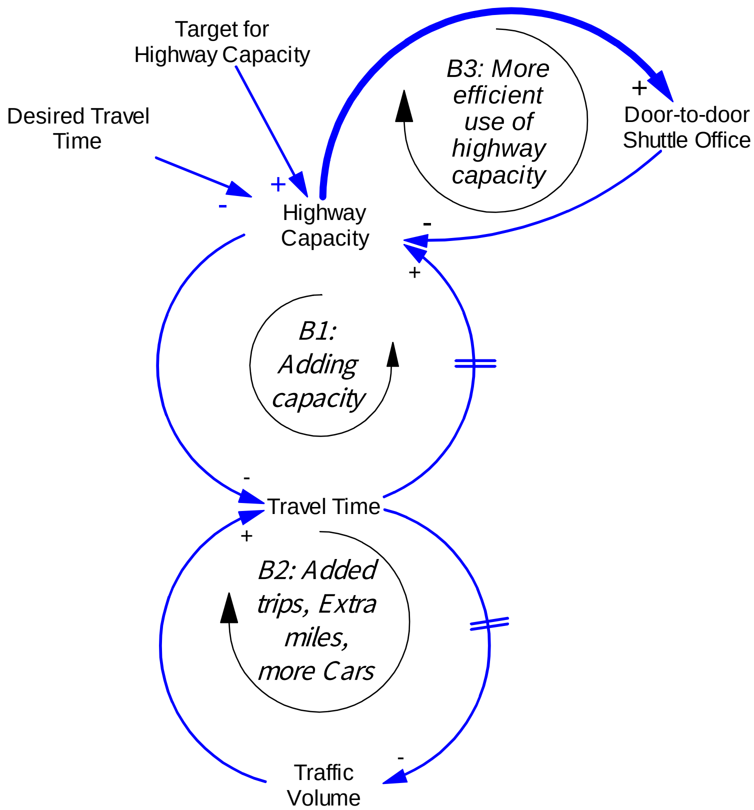


**Figure 5** It is proposed that more attractive multi-occupancy vehicles, e.g. by door-to-door services with online connection might help keep highway expansion at a lower, more “stable” level

The automotive Parkinson’s Law is a relative control archetype, intending to keep travel time within acceptable limits by increasing highway capacity. The intended outcome is nullified by the unintended system reaction (expansion of traffic to fill available highway capacity). The “mitigating” archetype would be the definition of an absolute target with a new balancing feedback loop to achieve that target. For traffic congestion this translates to establishing a target for highway capacity combined with more efficient use of highway capacity. Mass transit could be an important contribution to more efficient use of highways, but its poor traditional adequacy (inflexible schedules, “can’t get there with bus”, crowded space, travelling time = wasted time) have greatly reduced its efficacy. A door-to-door shuttle service with mini-offices, if consciously designed as systemic policy, could help stabilise highway expansion. The target for highway capacity would have to take account of long-term planning goals, dependence on demography, economic and social activities and urban planning. But a careful planned initiative to make mass transit more adequate to public needs (door-to-door service, if necessary in combination of shuttle with ordinary bus and train routes; workspace and mini-offices) could help stabilise highway expansion demands while society adapts to new high-tech solutions. We would also expect the appearance of new high-tech based services and derived new employment opportunities.

Figure 5 shows the “mitigating” archetype addressing the undesired outcome in the automotive Parkinson’s Law. Notice the balancing feedback loop *B3: More efficient use of highway capacity* and the thick influence arrow from (increasing) Highway Capacity to Door-to-door Shuttle Office. By this we mean a *policy*, i.e. a planned systemic activity.

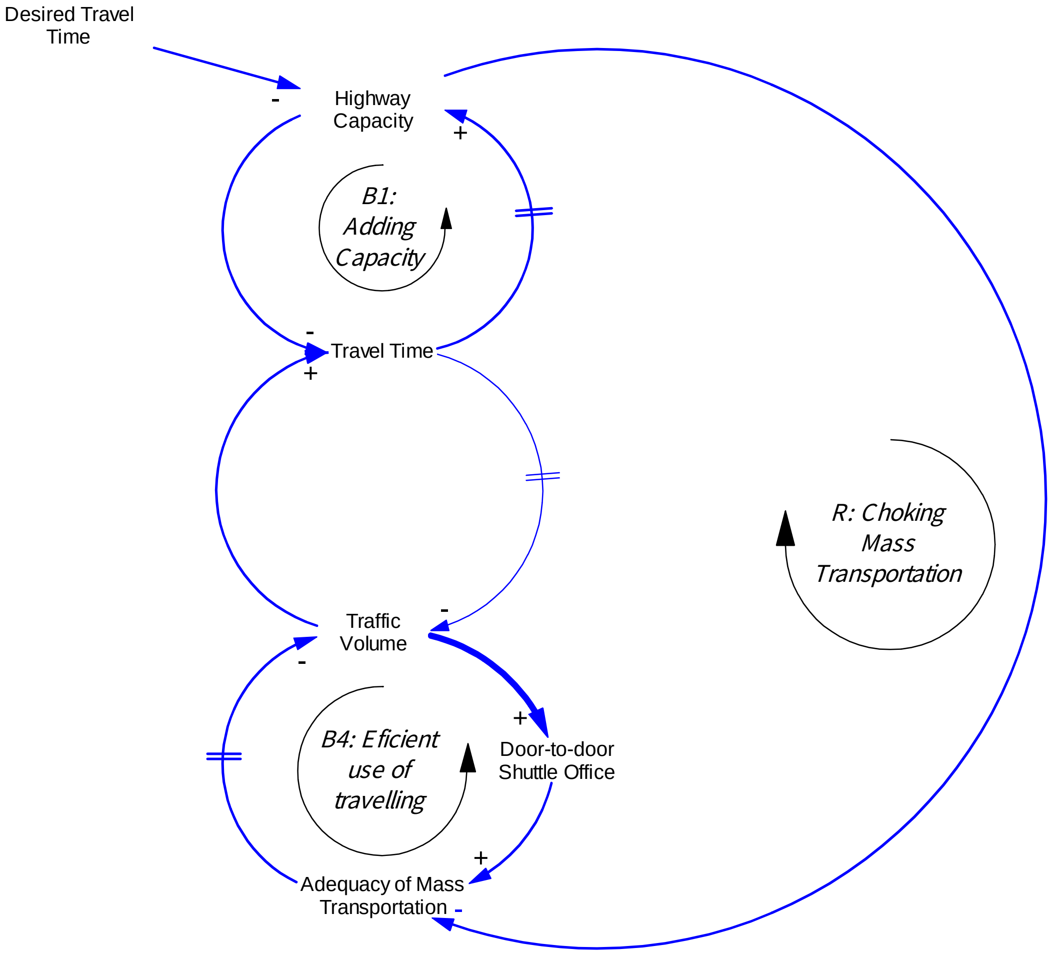


**Figure 6** Linking increasing traffic volume to more efficient use of travelling time, e.g. by door-to-door transport services with teleworking and other meaningful online activities (training, education, etc) could initiate long-term mechanisms to increase adequacy of mass transportation

The mass transit death spiral is an out-of-control archetype, where the intended outcome is a balancing feedback loop to minimise traffic congestion by adding highway capacity, and the unintended system reaction is a vicious circle (a reinforcing a downward spiral) for mass transit ridership. There are consequences in the future (urban sprawl, more POV's, etc) that further aggravate traffic congestion. The "mitigating" archetype is a direct link between the problem and the system reaction. For traffic congestion this would translate as a conscious policy (thick influence line) linking increasing traffic volume with added shuttle services (see Figure 6). The resulting balancing feedback loop *B4: Efficient use of travelling* would improve mass transit adequacy and help mitigate the negative impact of the reinforcing loop *R: Choking mass transportation*.

Finally, Figure 7 combines the two previous figures into a causal-loop diagram. The two suggested policies are marked as thick influence lines. To summarise, we suggest that *design* (Highway Capacity) and *use* (Traffic Volume) of highways should be consciously coupled with incentives and facilities for enhanced teleworking while travelling door-to-door.

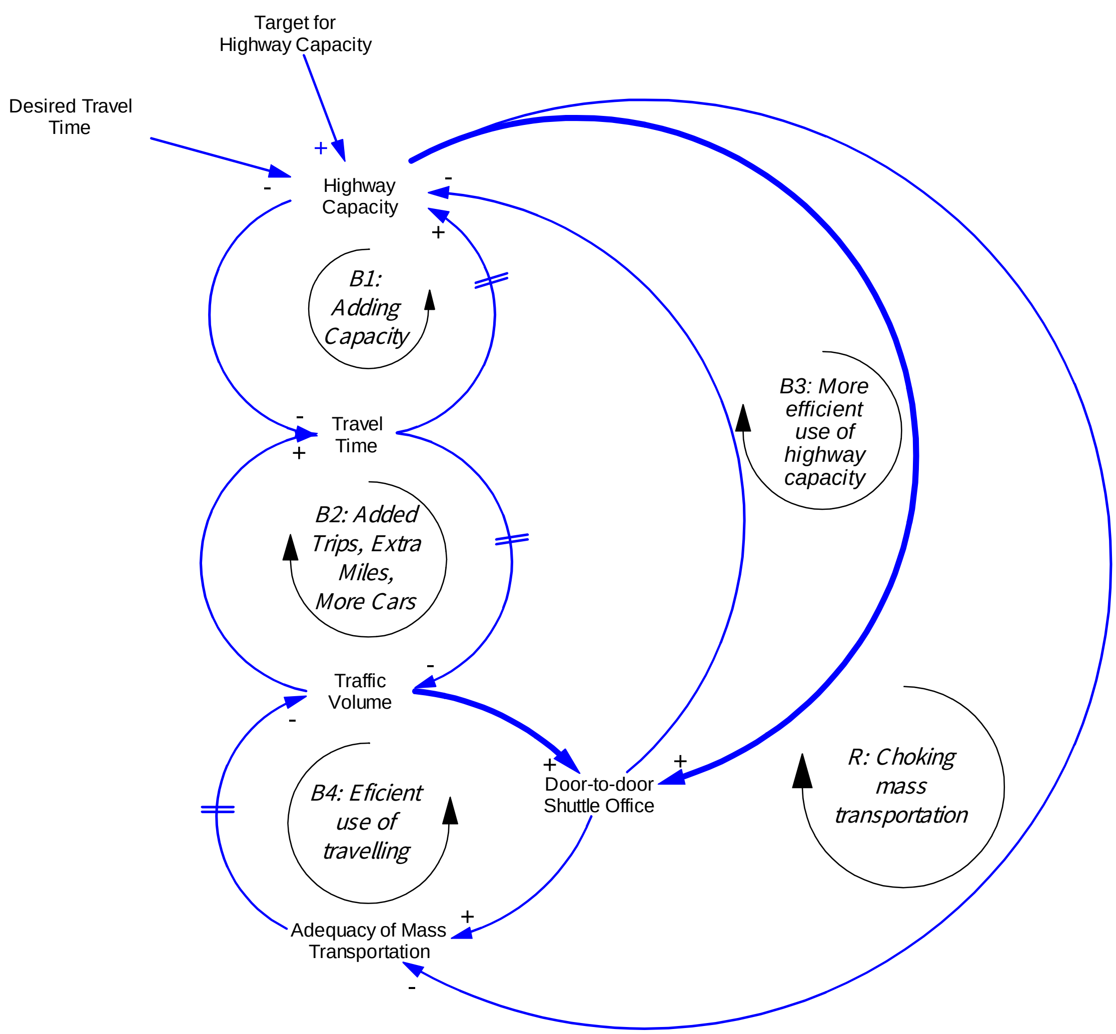


**Figure 7** It is proposed that door-to-door transport services with online facilities for teleworking and other meaningful online activities should be part of long-term policies in the *design* and *use* of highway capacity. (Thick influence lines indicate policies with potential leverage.)

## *Discussion and conclusions*

Traffic congestion in major – and not so major – cities has been a feature of life for centuries, even millennia. Experiences at the end of the 1990s and beginning of the 2000s suggest the problem is as bad as ever, and worsening at an accelerating rate. Our review of the literature confirms the inexorable conclusion that all trends driving the problem will continue and even harden still further in the foreseeable future.

So are there solutions? We have examined the two most obvious proposals in detail – the expansion of highway capacity and the potential of rapid-transit public transportation alternatives, focussing on the cause and effect linkages that surround each. Both are doomed to failure. The former fails due to what has been called the 'automotive Parkinson's Law', whereby, because this is in many respects a self-clearing market, then if travel times are perceived to be reducing as highway capacity increases, then travel becomes less unattractive and demand will simply increase proportionately. The observations of Zohavi that people seem to allocate a more-or-less constant daily travel-time budget, estimated at 1 to 1½ hours, across many different cultures and economic areas supports this notion. In the second "solution", urban sprawl (driven by increased highway pressures makes rapid-transit solutions less and less viable as rail network size increases and ridership on individual routes weakens) drives the system out of control into the 'mass transit death spiral'. Mass transportation systems might be more effective with fundamental changes like the so-called 'Transit-Oriented Development' policies which, long-term, could alter the pattern and demand for local travel. Lower infrastructure cost alternatives, like large buses with designated highway lanes, are not universally attractive as they effectively reduce existing highway capacity.

Congestion is going to be with us for a long-time; attempts to alleviate it are doomed to, at best, very long time delays while the necessary holistic view is developed and the collateral policy changes needed to make them effective are also implemented, or, at worst, total failure. This has prompted us to seek alternate ways of approaching the problem. Starting with the notion of travel-budget led us to think about how people might wish to accept a situation where they know their travel needs would inevitably lead to their travel-budget being exceeded. Some people have personal solutions to making journeys bearable – they read novels, plan shopping, snooze, and so on; others try to make travel time more productive by trying to read business materials on trains and buses or using their mobile phones in cars.

The shuttle-office offers a neat solution to facilitating the dual-tasking of at least some people's travel time. We have identified a number of scenarios where the shuttle-office could operate for the benefit of particular travel groups and were, as a result, a viable business model is likely to offer itself. These include airport transfers, large companies or company groups, or self-help groups in hi-tech cluster type environments might take the initiative for employee commuting, broader and more diverse geographic regions and medium-haul travel opportunities spearheaded by the mass transportation industry itself. Perhaps in rapidly developing economic areas, mass commuting might move from the regular buses and train based travel of the present time to the shuttle-office model without going first to mass POV-based travel.

Most of society's problems are self-inflicted and derive from fixes that fail. We do not pretend that our proposal would not have unintended *negative* outcomes. On the contrary, side aspects like shuttle office services favouring the already more fortunate sector who capitalise on computer literacy should be carefully considered and solutions should be searched at an early stage. Just to mention another potential negative outcome, car manufacturers might fear that a reduced demand for POV's would threaten their position. Whether this is a likely outcome or whether positive repercussions at a global scale (some of them *unintended* or, at least, unanticipated) would compensate for such local decrease in demand would require systemic studies, encompassing the essential aspects of the proposed approach.

Systemic studies would be needed also because of the many boundary-crossing aspects, such as potential for reduced pollution, boosting non-polluting hydrogen cell-based engines (as vehicles of mass transportation with teleworking facilities their initial immature technology would be less of a handicap), helping establish wireless technologies such as WiMax and UMTS. In other words, it is likely that some of the initially unanticipated outcomes would turn out to be positive. While it is always nice to get pleasant surprises, a systemic analysis should help accelerate their coming into age.

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