



## **Why We Need a New Mode of Surface Transportation**

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Transportation is vital to the social and economic development of civilizations. On the one hand, the efficiency to move people and goods is directly related to the efficiency and productivity of a society. On the other hand, transportation industry is a comprehensive industry that utilizes the latest technology advancements in many fields. A significant advancement in transportation technology often brings huge business and job opportunities in a wide range of industry sectors.

For a long time in history, horse-pulled wagons on the roads and boats on rivers and seas were the main transportation means. In the 19th century, railway made a great impact on the economy and bicycles provided more freedom in personal transportation. The widespread uses of automobile and airplane in the 20th century changed the way we live our life and do business. However, we are facing a serious transportation challenge around the world. Traffic congestion, energy shortage, air pollution, and traffic accidents are serious problems in cities around the world.

In order to understand the transportation problems, we will first examine the costs of existing transportation modes, as shown in Table 1. Transportation costs should include fuel, road construction and maintenance, vehicle, and insurance. The values listed in Table 1 are not real cost data, but estimates of reasonable costs achievable for personal transportation for one passenger and mass transit with full occupancy of all seats. The capacity is listed for a normal highway lane or equivalent at comfortable conditions. The direct costs are adjusted for the commuting time for both developed countries and developing countries. For simplicity, we assume the time cost in a developed country is \$15/hr or annual salary of \$30,000 and the time cost in a developing country is \$1/hr or annual salary of \$2,000. In countries with a considerable income distortion from the normal distribution, the costs should be adjusted differently for each class. Of course, the actual transportation costs vary considerably with the construction and operation conditions, excessive taxations, and ridership variations.

There are other factors for commuter's choice of a transportation means, such as convenience, comfort, safety, and availability. It is clear from Table 1 that walking and bicycling are too costly in developed countries except for very short trips. Bicycling is economically feasible only if we consider it as part of a physical exercise program, removing the associated time cost. This would be difficult since most people have other uses for the leisure time.

Automobile is the most cost-effective convenient and comfortable means for passenger transportation at present, but it is also the major source of traffic congestion, energy

shortage, air pollution, and traffic accidents. Motorcycle does have a cost advantage over automobile, but it is not a major transportation means in developed countries due to safety and comfort. Practically speaking, automobile is very effective for cities with (1) a moderate population density (less than 2500 per square kilometer or 6500 per square mile) and (2) a moderate total population (less than 750,000). The first condition is due to the low capacity of automobile transportation. The second condition is related to the complexity of traffic condition. In cities with a high population density or a large population, we will run into the problem of traffic congestion.

**Table 1, Commuting transportation cost estimation**

Vehicle type	Speed (km/hr)	Capacity (1000/hr)	Cost (\$/km)	Adjusted cost (\$/km @ \$15/hr)	Adjusted cost (\$/km @ \$1/hr)
<b>Personal transportation</b>					
Automobile	50-120(80)	2	0.17	0.36	0.18
Autoway	50-150(80)	4-40 (20)	0.03	0.22	0.04
Motorcycle	50-120(80)	4	0.05	0.24	0.06
Bicycle	10-20(15)	12	0.003	1.00	0.07
Walking	5	12	0.001	3.00	0.20
<b>Mass transportation</b>					
Subway	30	10-40 (20)	0.25	0.75	0.28
Bus	10-100(30)	1-40	0.04	0.54	0.07

Another shortcoming of automobile is that a considerable portion of the population cannot drive. School children are too young to drive and some senior citizens are no longer able to drive safely. As the senior population continues to increase, their transportation needs will become a challenge to the society.

It is a myth that mass transit can help reduce the traffic congestion. From the above cost data, traffic congestion is the precondition for a significant ridership on mass transit. Only when the speed of automobile is significantly reduced can we have a comparable cost for both automobile and mass transit. Especially for subway, its high direct cost means heavy subsidies are necessary almost everywhere in the world. In the United States, “subsidies to the average transit rider are around 60 cents per passenger mile, and subsidies to rail riders are greater”, according to the study of O’Toole. This amount of subsidies is about \$0.37/km, which is greater than the cost of automobile travel and the reasonable cost for mass transit listed in Table 1. Unless a new and more efficient mode of personal transportation is developed, traffic congestion can only be addressed by non-market measures such as vehicle license restriction and regulatory highway tolls. When there is already serious traffic congestion below the average speed of mass transit, then mass transit does help to prevent further deterioration of congestion. This is why a high ridership of mass transit always goes side by side with serious traffic congestion.

In addition, the service-based complex economic structure of a modern society further tilted the balance in favor of personal transportation. Public transportations like buses,

subway and railway trains are no longer convenient for the dispersed, distant and complex urban transportation. Owing to this change of traffic pattern of a modern city, a very high population density does not necessarily lead to the cost-effectiveness of mass transit. Facing the side effects of automobile traffic, many environmental groups advocate the shift to mass transits like buses and rails. These modes used to be effective in the past. Since automobile was able to replace these modes in the past, the change of the economic structure in favor of personal transportation makes it impossible to reverse the trend. The suggestion of mass transit is more a frustration with the traffic congestion, air pollution, land use, and soil erosion caused by automobile rather than a rational choice of alternative solutions.

Therefore, we have a traffic problem that cannot be addressed by existing modes of transportation. This is a fundamental gap of existing transportation modes and the traffic problem cannot be solved by spending more money on existing modes alone. This has been proved by the traffic realities in major cities around the world. Despite the significant investments on both highway and mass transit in the United States, “congestion has grown everywhere in areas of all sizes. Congestion occurs during longer portions of the day and delays more travelers and goods than ever before,” according to the 2004 Urban Mobility Report by Texas Transportation Institute. Realizing this fundamental gap is the first step to real progresses. It is time to think outside the box and to develop a new mode of transportation.

The transportation cost is the necessary condition for the widespread use of a new transportation mode. The new mode of transportation must be a personal transportation system. New mass transit system like maglev train will not work as an urban transportation solution. Although the Shanghai maglev train is very comfortable and has a high speed of 430 km/hr, it is not a solution to urban transportation since it cannot attract enough passengers at this speed. The average speed of buses and subway trains is low not because they cannot run fast but because they have to stop every mile or so to pick up enough passengers.

The new mode of transportation must be a personal transportation system that is competitive against existing transportation modes. Segway Human Transporter, which revolutionizes walking according to its inventor, is not a solution to urban transportation. As shown in Table 1, walking is not an economically viable transportation mode either in developed countries or in developing countries except for very short distances. Therefore, Segway Human Transporter, although useful to some people with special needs, will not become a significant mode for urban transportation.

In summary, we have a traffic problem that cannot be addressed by existing modes of transportation. It is essential to think outside the box and develop an effective new mode of personal transportation system.

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Note: Autoway is a personal transportation system concept developed at Acroscape.