Road Transport Demand and Constraints: China 2010

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Abstract:

This paper discusses the deficiencies of current road system in China where economic reform has brought a rapid economic growth and in turn an increase of road traffic demand. The demand of road expanding is addressed in four aspects: the population growth; economic growth; international trade; and the limited alternatives of other transport modes. The rationale of increasing road infrastructure is also discussed in line with a balance of the estimated demand and feasible funding and other constraints. The tasks of road expending by 2010 will be focused on improving road capacity of the existing networks and accessibilities in rural areas. Opportunities of road related projects for Australian professionals are outlined. Technology transferring and soft loans for road projects are suggested.

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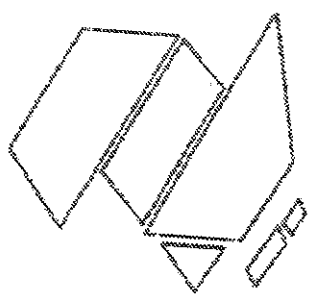

Road Transport Demand and Constraints in China by 2010

The economic reform initialised by the Chinese government, a decade ago, was originally designated to improve the state-run economy, but it has turned out to be a process of constitutionalising the concept of a market economy in China in a recent session of the national congress. Such a gradual but steady development contributed greatly to revive the once stagnated Chinese economy. This new turn that China has taken carries profound implications to the society and the rest of the world politically and economically. An efficient transportation system is an indispensable condition for a prosperous market economy as it requires a high degree of the mobility in outputs as well as inputs. The later include human resources. On both accounts, China's current transportation system in general and its road networks in particular are unsatisfactory For more than forty years, the authorities had discouraged free mobility in the society because they feared that it would undermine the order of its planned economy.

The main theme in this paper is that the evaluation of China's demand and constraints in road transportation has to be made in the context of a market economy. More specifically, section one will outline the current conditions of China's road transportation and its management system. Section two focuses upon major sources of demand for road transportation. Section three elaborates the estimated demand for road capacity in the near future. Section four deals with the constraints and their possible solutions. The final section discusses the likely involvement of the Australian government and private sector in the process of improving China's road transportation.

1. Under-Developed Road System and Ineffective Management

Despite the fact that transportation has always been a key sector drawing attention from the Chinese government and enjoyed priority in government budgets, large scale road construction was just recently considered as an urgent issue in comparison with railways development in China. For example, the Deputy Minister, Ministry of Communications, China, pointed out that it was time for the country to have high quality arterial corridors across the West and the East and the South and the North (Liu, 1993). The China's current road networks assemble to many of the developing countries at least in two aspects: poor coverage and low capacity.

The inadequate road infrastructure is firstly depicted by its low quantity measured in terms of road length per unit area, per thousand vehicles, and per unit population (Table 1). By 1990, about 4 per cent of all towns (officially defined as urban population is greater than 3,000 population and 70 per cent of the population are non-agricultural residents), and some 25 per cent of all villages cannot be accessed with automobiles. The links between many villages are still narrow, muddy tracks. Lacking of road coverage has partially contributed to the slow development in regions.

Table 1. Comparison of Road Density Criteria in Twelve Countries

Country	Year	Road(1000km)	km/1000km^2	km/1000Veh.	km/1000 Pop
Australia	1988	853.0	110	n/a	54.0
Canada	1987	874.4	85.0	55.0	34.1
USA	1987	6233.3	670.1	34.8	25.5
Former USSR	1988	1737.0	80	n/a	6.2
Japan	1988	1104.3	2920	21.1	9.1
Former West German*	1987	493 6	1980	n/a	8 1
UK	1988	352.3	1530	16.7	6.2
France	1988	805.1	1460	29.9	14.4
Italy	1987	301.9	1000	n/a	5.3
Brazil	1988	1673.7	200	100.8	11.9
Indian	1989	1932.0	650	n/a	2.4
China	1990	1028.4	107.1	186.5	0.9

Sources: Highway Research Institute, 1992, p 5-1.

The existing road networks, especially the arterial roads connecting cities and towns, need to be upgraded. The average traffic speeds on most of the arterial roads are about 35 to 45 kilometres per hour. Three quarter of all roads, and 60 per cent of arterial roads, are unsealed surfaces. Intersections need also to be upgraded. Ninety per cent of intersections are uncontrolled and no priority rules applied (Wang, 1991). Congestions caused by mixed traffic of automobiles, tractors, bicycles and pedestrians are commonplace. When using volume/capacity (V/C) ratio to assess traffic conditions, the V/C ratio in 1990 had been 1.09 in all roads nationwide. A recent estimation indicated that the mixed traffic alone in long distance road transport cost extra 3 million tones patrol each year (1993). Furthermore, the vast amount of bicycles in urban streets created unique technical problem for transport planners and traffic engineers.

To a large extent, the relatively slow development of China's road construction in the past four decades was firstly due to the Chinese political and economic structure. Politically,

the "socialist planning economy" discouraged any commercial activities and minimised the mobility of people beyond local travelling. For example, in early 1980's, the trip rates on classified roads in many rural areas and small towns were below than 10 per person-year (Song and Kong, 1985). Economically, instead of automobiles, the mass transportation mode was primarily bicycles, whose requirement for road conditions was almost none. Also the Chinese economy was a typical dual economy where industrial and rural sectors operated quite independently. Limited exchanges of goods and services between the two sectors need less road provision.

Secondly, the system of road planning and management before 1987, the economic reform in China, has been proved ineffective for road development. The highly centralised system left provincial governments with less authority and less incentive to initialise road planning, construction and maintenance according to local social and economic development. On the other hand, the prevailing system is dominated by administrative rather than legislative mechanism. This ambiguity of a clear cut in financial responsibility was frequently a source for provincial governments to seek "free riding".

2. Major Sources for Better Road Transportation

In order to form an objective estimation for the road transport capacity in China in the near future, this section will identify the major sources from which the demand for road construction will come.

2.1. Population Growth

Population in China is expected to reach 1.3 billion in year 2010 even if the current policy of family planning is faithfully carried out (State Statistic Bureau, 1991). Therefore, the demand for road transportation will grow proportionally with the natural growth of population provided that other parameters unchanged. It has to be noted that the demand for road transportation is more closely related with the mobility of the population than its size. With less restrictions of personal mobility and a market economy the real strain upon road transportation will be much larger. It is estimated that by year 2010, the mean trip rates in non-urban roads will be doubled from 14.7 in 1990 (HRI, 1992).

2.2. Economic Growth

It is well established that economic growth will lead to an increase in the ownership of mobiles both for production and private purposes, and the increased number of automobiles will then require more and better roads. Several recent studies (HRI, 1992; ITTI, 1992) have used this theory as an important basis for their forecasting on the demand for automobiles in China (Table 2). They have concluded that, in the next twenty years, the increase of the number of motor vehicles will be dramatically faster than ever. The estimated total numbers of automobiles will range from 11.2 to 12.7 million in year 2000, and from 23.6 to 26.6 million in year 2010.

Given the size of China's rural areas, and the fact that the average automobile accounts only 57 per cent of the total traffic on rural roads, it is also necessary to consider the

extent of rise in the demand for tractors which form a considerable part of the traffic in rural roads. Table 3 contains the estimation of tractors in the year 2000 and 2010 respectively

Table 2. Estimation of Automobiles in Year 2000 and 2010 (Million)

Type of Vehicles	1990 (Actual)	1992 (Actual)	2000	2010
Coaches	0.1	n/a	0.6 - 0.8	1.4 - 1.6
Cars	1.5	n/a	3.2 - 3.7	9.0 - 10.5
Trucks	3.7	n/a	7.4 - 8.2	13.2 - 14.5
Total	5.3	6.1	11.2 - 12.7	23.6 - 26.6

Sources: Highway Research Institute, 1992, p. 6-9; *Economic Daily*, April 21, 1993

Table 3 Estimation of Tractors in Year 2000 and 2010 (Million)

Year	1990 (Actual)	2000	2010
Tractors	7.3	17.0	18.8

Sources: Highway Research Institute, 1992, p. 6-11.

How to assess these estimations for the increase in motor vehicles will have important implications for the estimation on China's demand for road networks. Past experience seems to indicate that previous forecasting were consistently underestimated. Between 1983-84, similar models (He, 1984; Ying, *et al*, 1984) predicted that the total automobile ownership in China would be in the order of 4.4-5.1 million vehicles in 1990 and 5.8-5.9 million vehicles in 1992. Whereas the actual numbers of automobile ownership turned out to be 5.5 million in 1990, and 6.1 million in 1992. From that point of view the actual vehicle ownership may well surpass the predicted figures in Tables 2 and 3. In 1978, private ownership of automobiles in China was practically none, but the number jumped to 285,000 in 1985. The official statistics for 1991 was that 1 in every 6 of the total automobiles was private. Taking Taiwan as another example, there was 425,000 automobiles in Taiwan in 1980. In less than ten years, the automobile ownership in 1989 was 2 million which was nearly five times the figure in 1980 (Shen, 1993).

2.3. Trade Growth

As a result of promotion of international trading, exports to and imports from overseas

have been multiplied. The numbers of international constrainers (TEU) were 64,000 in 1980, 474,000 in 1985, 900,100 in 1988, and 1,108,000 in 1990, which indicates a seventeen times increase within ten years. Since the average distance of container movement in China was 70 kilometres, more containers shifted to road moving to and from ports. In the last ten years, the annual increase of the number of road container transport was 50 per cent. High standard and high capacity roads between major cities and ports are highly necessitated.

2.4. Limited Alternative

The closest substitute of surface transport for roads is railways. However, that alternative is very unlikely to alleviate the new demand for road transportation for two basic reasons. First, it is reported that most of railway routes linking major cities are already overloaded up to 30 per cent. For instance, because of the lack of capacity, the average number of passenger cars (115 seats) has been increased from 14.4 in 1980 to 16. 6 in 1992. Freight carriages can only cope with 70 per cent of current demand (Wang, 1993). Secondly, the nature of demand for road transportation is often different from freight carried by railways. This type of demand will be more often for short distance and more frequent stoppage. It will not be cost effective for railways transport to fulfil this role even if it had some extra capacity to spare.

2.5. Scale Economy

If China's transition from a central planning economy to a fully functioning market economy is to be successful, enterprises will seek scale economy in their production in order to lower their production costs. In other words, bigger plants will emerge to serve a large radius of distance. To achieve that objective, an efficient road transportation will be a fatal component.

It is clear that the transition of the Chinese economy will accelerate the demand for road transportation and further stretch the present road networks. At the same time, the transition will also provide a better platform for a quicker road development.

3. Estimated Increase of Road Capacity

The task in this section is to examine the supply side of the road development. It will not only consider the physical capacity to accommodate the increasing demand for road transportation but also its impact on central government budget. The following discussion is mainly based upon the estimation model adopted by Highway Research Institute (HRI) and Institute of Transportation Technology Information (ITTI) in 1992.

In this model the projection of traffic capacity is accomplished by first calculating the freight and passenger volumes, and then converting them into traffic volumes through "loading indexes" of different types of roads and periods of prediction. The estimated traffic in all categories of roads for China were summaries in Table 4. During the next two decades, the growth rates are set at 5 to 7 per cent on an annual basis.

Table 4. Transportations of Road Traffic in Year 2000 and 2010

Year	Total Mixed Traffic		of which, Motor Vehicle Traffic	
	vkm/y(bil)	% Change	vkm/y(bil)	% Change
1990	367.5	--	240.2	--
2000	689.8-762.0	+ 6.5-7.6	495.0-528.8	+ 7.5-8.2
2010	1235.3-1364.6	+ 5.5-6.5	951.2-1016.2	+ 6.4-7.2

Source: Highway Research Institute, 1992, p. 7-13

Based upon the estimation of road traffic, the estimation of road demand was achieved by the following steps. Firstly, the total tone-kilometres of freight haulage and the total passenger-kilometres of haulage were predicted. Secondly, the freight haulage and passenger haulage values were conversed into traffic volumes in vehicle-kilometres. Thirdly, the derived total vehicle-kilometres were allocated to seven different road classes based on observed distributions of the Annual Average Daily Traffic (AADT) in each class in 1990. Fourthly, the predicted roads that meet the required traffic volumes were estimated with the traffic volumes and "target" volume/capacity (V/C) ratios. The differences of the predicted road lengths and the existing lengths in each road class would be the net increases of road supply in terms of road length.

The comparison between lengths of each road classes in 1990 and the predicted road provisions in year 2000 and 2010 is shown in Table 5. The figures in the table suggested that the major task of road development will not simply to increase the total road length but more importantly to upgrade the quality of existing roads.

Table 5. Predicted Road Length and Distribution in 2000 and 2010

Year	1990 (Actual)	1992 (Actual)	2000	2010
Total Length (000 km)	1,030	1,057	1,200	1,36
Freeways (%)	0.1	0.1	0.5	1.6
AER Class 1 (%)	0.3	0.7	3.9	6.5
AER Class 2 (%)	0.1	0.8	2.9	4.0
General Class 2 (%)	4.0	8.2	10.7	24.0
General Class 3 (%)	16.5	n/a	42.0	53.2
General Class 4 (%)	51.0	n/a	36.2	9.0
Substandard (%)	28.0	n/a	Nil	1.7

Source: Highway Research Institute, 1992, p. 7-9; *Economic Daily*, Feb. 1, 1993.

Also in the study by (HRI and ITTI), they found that the estimated relationship between GNP per capita and road freight and passenger volumes in terms of elasticity for several countries remained at the elastic level (larger than unity) as long as GNP per capita is below US$7,000. The elasticities tended to be more elastic when the GNP per capita moves further down the scale. In other words, the increasing rates of road freight and passenger volumes rise faster than GNP per capita growth rates (Table 6). Based on their findings, they concluded that road transportation has to be given continuous priority if the government wants to maintain a steady economic growth rates. It is predicted that the equivalent GNP per head in China was US$620 in 1990, and would be US$ 1,200-1,300 in year 2000 and US $ 2,000 - 2200 in year 2010

Table 6. Elasticities of Freight and Passenger Volumes over Economic Increase

Country	Year	GNP/Head, $, (1980 price)	Elasticity of Freight to GNP/head	Elasticity of Passenger to GNP/head
United Kingdom	50's-60's	4400 - 5400	2.52 - 1.77	2.04 -1.88
France	50's-70's	3300 - 7700	1.93 - 1.40	N/A
W German (fmr)	60's	5700	1.48	1.12
Japan	50's-60's	1550 - 3183	1.62 - 1.76	2.26 - 1.51
United States	50's	7140	1.60	1.46
USSR (former)	50's-70's	inconsistent	1.63 - 1.29	2.64 - 1.22

Source: Highway Research Institute, 1992, p. 5-12.

4. Major Constraints of Road Developments and Their Possible Solutions

According to the conservative road construction scheme, which was set on a V/C ratio of 1.05 and the mean traffic speed of 40 kilometres per hour (HRI, 1992), the total construction for the 1990-2000 period would cost AU$ 78 billion (RMB312 billion), and a further amount AU$ 160 billion for 2000-2010. However, the available funding resources can only come up with 40 per cent of the total cost for 1992-2000, and 39 per cent of the total cost for 2000-2010. The shortfall can be met through the following possibilities. The first is to initialise "dollar for dollar" policies to provide additional incentives for various local governments to be involved in road construction. Secondly, making use of foreign loans both from official channels and private banking systems. Thirdly, to privatise some of the road projects by issuing specific bonds. In fact, all of the alternative ways to raise funds for road construction have taken place at different scales in China.

The Chinese government is now facing a real dilemma. On one hand, the promotion of a market economy is well under its way, and its development implies adding more pressure over the road networks. On the other hand, it is very difficult to upgrade road networks in the short run. Therefore, how to manipulate the excess demand for road transportation might be an effective measure in the short term. This method can be classified into two

groups, namely active and passive managements to reduce the excess demand for road transportation. The former group includes speeding up telecommunication and computerising freight information so as to reduce one-way loading trips. One estimate indicates that there are about 500, 000 trucks with one way loading in and out Beijing every year. The later approach is to allow other indirect constraints, such as the petrol prices which has been tripled for the last two years to force road users to discriminate their priorities. In fact, sometimes knowing the congestions itself will make people think twice before they embark upon trips. In certain situation, demand management may be effective even in the long-run, for example, encouraging people to keep the bicycle tradition in China accounts to one of the best demand managements.

In a country of such a large size and variety, the benefits gained from decentralised authority in many aspects have proved very effective for local governments to solve their problems. Road construction should not be an exception. A typical example took place in Henan Province. After a negotiation between the central and the provincial governments on road matters, a comprehensive package covering both financial arrangement and road construction target was implemented in 1987. Within five years the ranking of road quality and coverage in Henan province was lifted to the 8th from its previous standing of 13 in China.

5. Australian Participation in China's Road Development

Australia has already involved in many of the transport projects in China in the last decade. More opportunities should not be overlooked especially during the period of long suffering recession.

A feasible channel for Australia to assist China's road development is exporting australian technical and expertise in this aspect. Australian road transport planning and traffic engineering techniques in regional and metropolitan scales have a sound reputation in various levels of Chinese road authorities. Both government and private sectors, such as ARRB, PPK, Travers Morgan, and SMEC, have involved in many such projects in China since 1980's. With further decentralisation of road management and administration, more responsibilities will be shifted to provincial levels from the central. This will provide Australian transport planners and engineers with more contact chances and higher flexibilities to get into the market.

Techniques needed for road development in China include regional road transport planning; traffic engineering computer package development and training; urban traffic management policy and countermeasures; integrated urban transport planning with light rail; bitumous concrete technique in various climate conditions; techniques in design and constructing low cost rural roads, and establishment of traffic safety management system. For environmental friendly technology, Australian technicians can cooperate with their counterparts in using slag as road-bed material.

As discussed in the previous section, foreign financial assistance is an important source for obtaining the necessary funding. Soft loans and loans by private banks may be considered to some specified projects in line with Australian technique and consultants involvement.

Possible examples include a soft loan package with Telecom using its high-tech advantage to create telecommunication market; and loans for road project together with providing consulting in Environment Impact Study (EIS) and professional training in Australian institutes.

6. Conclusion

The rapid growth of economy has induced the increase of road traffic. The deficiencies, reflected by the inadequate road capacity both in terms of quantity and quality, have hindered the economic development in China. An ambitious AU$700 billion plan for road development has drawn an attention on improving low road coverage and on upgrading arterial roads.

Traffic demand was estimated from four aspects. Population increase is a major factor of increasing trips in absolute numbers. Automobile ownership in year 2000 and year 2010 was predicted by various methods. The numbers of automobiles in the next seventeen years in China are expected to be as four times higher as that in 1992. Some 25 million automobiles with 20 million other types of motor vehicles, such as tractors, will strain the existing road capacity. With the promotion of international trade, better linkage between ports and major cities is urgently needed. It was predicted that in the next ten years, the road traffic will rise at the rates of 6.5 - 7.6 per cent each year. This situation will continue to year 2010 with a slight lower rate.

The rationale of expanding of road network was also discussed in line with a balance of the estimated demand and feasible funding. The total length of classified roads will be 1.20 million kilometres by year 2000 and 1.36 million kilometres in year 2010. Tasks will be concentrated on improving the existing networks, as shown in the change of the proportions of high class roads.

The opportunities of road related projects for Australian professionals were outlined in the last section. Technology transferring and soft loans may be some of the options for these involvements.

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