Abstract: Japan was able to develop advanced transport system in a shortest possible time span, and the performance of the transport system is better than its OECD peers from the West especially in terms of desirable mode share structure in passenger transport. This was in fact achieved through deliberate policy initiatives made in the past. After reviewing Japan’s intercity transport system along with emerging issues, this paper makes an attempt to draw relevant policy insights for Asian developing countries. These includes, setting basic institutional arrangement at an early stage, utilizing publicness and commercial viability inherent in transport services, placing cost burden to the beneficiaries, adopt principle of sustainable fare level rather than politically attractive but financially disastrous affordable fare, devise schemes to mobilize domestic saving for transport investment, and develop and use railway mode to serve as backbone of transport system.

Key Words: Intercity Transport, Transport Policy, Japan, Asian Countries

1. INTRODUCTION

After the World War II, Japan experienced a rapid economic growth and development and joined the club of developed countries much earlier. There are several underlying factors behind this glorious success story, one of which is speedy development of transport infrastructure and continuous improvement in service provision to support and maintain the growth momentum. It is claimed that other East Asian countries, in particular Taiwan and Korea, closely followed the Japanese development model including some elements of transport development.

Speedy development is not only feature of Japanese transport system. Japanese transport system is also well known for the sizable role played by railway mode especially in passenger transport. This is particularly important in the context of growing concerns for negative externalities of transport sector, such as emission and traffic accidents since railway is much superior in minimizing such external effects.

In terms of lack of infrastructure acting as critical constraint for growth and development, developing Asian countries are now facing situations similar to what Japan faced after the World War II. In Asian countries too, rapid economic growth is requiring huge investment in transport infrastructure in order to meet increasing travel demand. The problem is becoming a major concern, especially in rapidly growing Asian developing countries, where transport bottleneck stands out a key factor holding back the growth momentum and international competitiveness. Moreover, developing Asian countries have their own characteristics in terms of speed of growth, population density, and settlement patterns, capacity and resource
availability among other, which calls for special approach in handling issues related to intercity transport.

With this background, the primary motivation of this paper is to examine the Japan’s intercity transport system in order to draw relevant policy insights for Asian developing countries from both successful and problematic experiences. Next section broadly examines existing situation of intercity transport. Section 3 runs a swift review of past institutional arrangements and major policy initiatives, which effectively contributed to the speedy development of intercity transport system. Relevant issues from Japan experience are identified and insights are drawn in Section 4. Section 5 presents concluding summary.

2. INTERCITY TRANSPORT SYSTEM IN JAPAN- PRESENT SITUATION

Japan had 127.7 million populations in 2008 (which is on declining trend) with a total land area of 377,944 square km. However most of the land area is not habitable as low land area is only 13.7 % of total land area. Japan population is therefore concentrated into the limited low land areas resulting in a very high density settlement, which is 2457 people per square km of low-land (habitable) area. Large section of country’s population is concentrated in metropolitan areas and other major cities. This sets a basic scene that Japan’s intercity transport faces high demand.

2.1 Road Network and Motorization

Figure 1 shows road network length and traffic volume by class of roads. Even though the total road length comes with an impressive figure of over 1.2 million km, over 1 million km of this network is local roads (city and town roads). The upper class roads such as ordinary national highway and expressway, which primarily serve intercity traffic, are much smaller in length. However, they handled larger share of total traffic volume. Out of a planned network of 14,000 km of higher grade roads such as expressways and ordinary national motorways, only 9468 km is under operation as of 2008. Remaining sections of this network are either
under construction or under planning and designing stage.

![Expressway length and density](image1)

**Figure 2: Expressway length and density**

Figure 2 shows comparison of expressway network in selected developed countries in terms of km per square km of land area and km per 100,000 population. Japan is placed just around average level for expressway per land area but at the near bottom for expressway km per population- which is understandable given the higher population density in Japan. But what is obvious is as compared with US and major EU countries (except UK), Japan’s expressway network is disproportionately smaller.

![Motorization trends in Japan and US](image2)

**Figure 3: Motorization trends in Japan and US**

Figure 3 compares trend of motorization in Japan and US. Japan experienced a wave of rapid motorization starting in 1960s, which came little later than in US (and the timing for motorization is closer to EU countries). Car ownership rate now in Japan appear to be stabilized at around little over 500 cars per 1000 population, which is significantly lower than
the car ownership rate in US which is close to 800 cars per 1000 population. Japan also shows much different trend in average annual driving distance of a car. On an annual average, in US a car travels over 18000 km, while the figure for Japan is little less than 8000 km. Such difference in the pattern of motorization (ownership and uses of automobile) can have significant implication in terms sustainability of overall transport system, putting Japan’s case comparatively in much better light.

2.2 Railway network

The national network of railway in Japan totals 17,645 km under the management of six privatized JR passenger rail companies. Of this network, 9,853 km is electrified, sections of 5,857 km are with double track, and 2,387 km is high-speed rail (Shinkansen). Even though Japan does not stand out prominently in terms of total network density, it is top in the chart of high-speed rail network. Japan started building conventional railways importing technology from Europe in late 19th century, but could outperformed western countries in term of technological innovation, network expansion and service maintenance. When the railway sector was in rapid decline in western countries in face of accelerated motorization in 1960s, Japan embarked on building world’s first high-speed rail system despite great deal skepticism from both academics and practitioners.

![Transport demand and mode share](image)

**Figure 4: Transport demand and mode share**

2.3 Travel demand, modal share and environmental implications

Usually as the economy grows, travel demand increases and Japan is not an exception. However, As compared with US and EU countries the intensity of travel in Japan is much less. As shown in figure 4 per capita annual travel in US is close to 30,000 km while the figure for Japan is little over 10,000 km, and EU countries fall in between. Likewise, the mode share structure, which demonstrates how efficiently and sustainably passengers are transported. Figure 4 shows mode share in Japan, UK and US for the year 2007. For passenger transport measured in terms of passenger-km, car is the dominant mode in each country, but with varying degree of domination. In UK and US car accounts for a high share
of 86 % and 79 % respectively, while car takes only 53 % mode share in Japan. Railway gets a respectable market share of 23 % in Japan, but only 1 % in US. On the other hand, a sizable share of 16 % in passenger market goes to air transport in US.

Primary reason for high share of railway in Japan is the early development of high-speed railway and continuous expansion of railway high-speed rail network. High speed rail is competitive for both auto and air mode for different range of travel distance. As a railway route serve multiple O-D pairs with frequency much higher than air and speed much faster than car, high-speed rail can operate competitively. However, as income grows and people’s travel preferences changes, particularly the value of time, air mode gains competitiveness for the longer distance O-D pair. Figure 5 (left-side panel) shows long-term trend of mode share

Figure 5: Trend of mode share by O-D distance, and time and fare in Japan
among the collective modes (rail, bus and air) for O-D pairs with different distance ranges. At the early stage, rail is dominant for all distance ranges, but the competitiveness of rail is gradually eroded over the time for distance over 700 km. However, for O-D pairs without high-speed rail (such as Tokyo-Ishikawa) the rail share is very small even though the distance is fit for railway dominance. Likewise, the case of Tokyo-Aomori with O-D distance of 728 km shows that the opening of high-speed rail service caused significant modal shift from air to railways. The right-side panels in Figure 5 shows time and money cost for different modes (for the year 2010), which can explain the mode share for different modes. For up to around 700 km, the time cost and money cost for air and high-speed rail is quite comparable, and as a result mode share is evenly split while for shorter distance both time and money cost is lower for high speed rail, and for longer distance both time and money cost is higher for high speed rail.

The respectable presence of railway mode in passenger transport market of Japan has placed Japanese transport sector in a relatively good light in terms of transport emission. The CO2 advantage of railway mode over other competing modes however depends on vehicle occupancy and fuel mix of electricity generation (emission factor of electricity). That is why CO2 per pass-km for different modes varies across the countries as shown in figure 6. For example, average passenger ridership per rail car in Japan is around 48 while that in US is only 24. Likewise, the emission factor for electricity generation (gCO2 per kWh) in Japan is 417 while that in US is 687. This explains why there is so much variation in CO2 load of passenger rail transport between Japan and US. Nonetheless, CO2 emission per pass-km from railway is less, if not much lesser as in Japan, than other modes even in UK and US. On the other hand, the commonly held notion that the electric traction and metal-to-metal friction is the source of railway advantage for energy efficiency is not much valid when passenger rail is compared with buses (RSSB 2006). Rather the primary factor for the energy advantage of railway over other modes is higher vehicle occupancy. Japan has therefore not only maintain a sizable network of railway but also managed efficient use of the facilities with desirable

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Figure 6: CO2 emission per pass-km by modes
3. REVIEW OF PAST POLICIES: HOW THE SYSTEM ARRIVED HERE?

As discussed in the previous section, Japan was able to develop advanced transport system in a shortest possible time span, the performance of transport system is better than its OECD peers from the West especially in terms of desirable mode share structure in passenger transport. Now the question is how Japanese system arrived here? Is it just an outcome of some random process or result of deliberate policy effort? Following paragraphs examines the past policy efforts to answer these questions and further explore possibility of extracting useful lessons for Asian developing countries. Coverage of past policies exhaustively may entail a substantial task which is beyond the scope of this paper. What is instead pursued here is pick up the most important policy effort keeping possible relevance developing countries in view.

3.1 Institutions and guiding principles

When Japan embarked on the ambitious agenda of national rebuilding and accelerated industrialization and economic development, inadequate transport infrastructure was immediately felt as a major bottleneck. As result, Japanese government enacted range of laws and established various institutions to ensure speedy development and sustainable operation of transport infrastructure and services. In each of these laws and institution, a common thread of broad guiding principle can be traced out. For the sake of brevity, only the major elements of guiding principles inherent in transport related laws and other institutional provision are briefly discussed in the following paragraphs.

3.1.1 Transport a key element of national development strategy

Recognizing the fact that transport infrastructure and services are most essential ingredients for modernization, industrialization, and economic growth, the sector received high priority in national development agenda. When the rapid economic growth in the early phase produced widening regional disparity, role of transport was further expanded also to contribute positively to balanced spatial development. In particular, transport investment was extensively utilized to stimulate economic growth process in lagging regions.

3.1.2 Beneficiaries should take cost burden to the extent possible

Developing transport system requires huge financial resources for large-scale capital investment and service operation. For financial sustainability, there should be provision of adequate financial resources. The most efficient and also fair way to secure necessary funding is to put the burden on the project beneficiaries. However, the benefits of transport projects are direct and indirect. For direct benefits, such as transport service to passenger, Japan put users’ charges (fare) as it is most appropriate instrument to make the beneficiaries take the burden. For indirect benefits, it is not straight forward to put the burden on beneficiaries. Indirect benefits also may fall into two categories, private indirect benefits such as gain in property value due to transport investment. The other is public indirect benefits, which is about the broader socio-economic benefits (positive externalities) they goes to whole society in diffused way. For the first case, so called value capture approach is extensively utilized in Japan. For the second, proportional burden is taken by the national and local government in
the form of providing subsidies (mainly for capital investment).

3.1.3 Adoption of commercial principal in service operation where possible

In the early stage, the role of public sector was dominant for infrastructure investment and even service operation as private sector was not so developed or the transport management practices was not amenable to private sector. In Japan, even under such circumstances, the transport service has to be operated under commercial principal, that is financial soundness of operation is the prime criteria and getting public subsidy for operation is very rare. In the later stage, this concept was increasingly realized by direct involvement of private sector mainly through privatization or deregulation. This principal contributed much in freeing financial resources otherwise to be used for subsidizing operation for much needed capital investment.

3.1.4 Mobilization of domestic saving

The financial constraint for capital investment is much common issue for transport sector. It was much binding for Japan as the country charted an ambitious plan of transport development when government revenue was already under much pressure. Japan adopted a unique strategy of mobilizing domestic saving as Japanese household had substantial saving. The mechanism is known as Fiscal Investment Loan Program (FILP), which channeled household deposits in postal saving system and pension funds to a government trust fund available for lending to various infrastructure projects including transport (figure ##). This scheme made it possible to mobilize domestic saving otherwise not available for infrastructure financing.

3.2 Policy approach for railway development in Japan

Japan boasts a successful experience of developing railway infrastructure, advancing railway technology and efficiently operating railway services on a more sustainable basis. In particular, passenger railway in Japan is serving as the backbone of intercity and urban transport. Major past policy approaches adopted in Japanese railway sector are discussed below.

3.2.1 Early stage: Technology transfer and network expansion

As a part of modernization drive after the Meiji Revolution, agenda of railway development was considered and an intensive debate was initiated on the appropriateness of railway technology in Japan. Finally it was decided to commission the first railway line in Japan (Shimabashi-Yokohama), which was opened in 1972. At the time, Japan had almost zero technical capacity and required financial capital, and had to rely 100% on British experts and capital market. Japanese government borrowed funds from London capital market with an annual interest rate of 12%. Such scarce fund had to spend to pay wages of British engineers and technicians, which was several times higher than the local wages. Most of the construction materials also came through import. This situation compelled Japanese policy makers to think seriously for developing domestic capacity for railway development, operation and management as quickly as possible. Accordingly, there was a concrete plan for transferring technology swiftly during the construction of the first line. By 1880, construction of new railway line accomplished with mostly Japanese inputs, both manpower and materials (except locomotive). Japan made locomotive was ready by 1890. Complete self-reliance in
technological and managerial capacity along with supportive government policy triggered rapid growth private sector railway. By 1907, Japan had 7165 km of rail network- in impressive figure by any measure.

3.2.2 Continuous technological improvement

When railway business was exposed to automobile competition and subjected to often irrational regulatory control in the western countries during early 20th century, railway was celebrated in Japan as the backbone transport system. Continuous efforts were made to improve technology and operational practices. In the early stage, safety concerns were the major issues as accidents such as fire or derailment were more frequent. Over the time, safety and reliability was significantly improved. Likewise, Japanese engineers never took rest from advancing technologies to speed up trains. The travel time for an express train running from Tokyo to Osaka consciously dropped from 12hr (1912) to 9hr (1930) to 7hr 30min (1956) to 6hr 30 min (1960). As the conventional rail technology was reaching the limiting speed, a new high-speed railway technology (Shinkansen) was introduced and first line was opened in 1964, which brought the travel time between Tokyo-Osaka to 4 hours. The quest for speedy travel however continued to bring down the Tokyo-Osaka travel time to 2 hr 25 min. presently, a new high-speed rail technology (Maglev) with max speed of 581 km/hr is under consideration for implementation.

3.2.3 Innovative approaches in strategies and reform

When it comes to deciding on key strategies on railway, Japan followed unconventional path. Adopting railway technology as backbone transport mode in late 19th century when country severely lacked any know-how was a risky decision. Likewise, Japan decided on high-speed rail in late 1950s (first line opened in 1964), when a bleak picture of railway technology was painted worldwide in the face of rapid advancement of more competitive automobile technology. Likewise, when Japan National Rail, following the patterns of other railway entities worldwide, was plagued with various operational inefficiencies including union problems, Japanese government adopted a model of regional monopolies unlike vertical separation advocated by western experts. All these unconventional and risky strategic approaches, at least from short-run perspective, have worked well and have made Japanese passenger rail system one of the most successful venture in the world.

3.3 Policy approach for road development in Japan

As mentioned above, railway in Japan was relatively developed even before World War II, but road sector was completely underdeveloped as correctly noted in the Watkins’ Report (1956), which stated that “the roads in Japan are incredibly bad. No other industrial nation has so completely neglected its highway system”. To respond the challenge, Japanese government enacted various laws and institutions to expedite development of road network. The major policy initiative for road development and improvement includes;

- Basic Road Law (1952)
- Road special account (1953), which earmarked revenue from fuel and vehicles taxes basically for financing investment for general road (revenue in 2008, 5,366 billion Yen)
- Japan Highway Public Corporation (1956) to develop expressway network to be
funded primarily by toll fee (can be considered as public sector BOT)

- Provision of financing of expressway construction through FILP (public borrowing) and other bonds
- Toll pooling system for expressways (1972)
- Privatization of Expressways Public Corporations (2005)
- Road special account transferred to national general account (2009)

The provision of fuel tax and vehicle taxes (earmarked for general road construction) and FILP schemes for public borrowing for expressway construction make it possible to mobilize financial resources for large scale investment for roads, and greatly expedited network expansion or upgrading. Road sector investment in Japan at its peak reached as high as 3 percent of GDP, which is exceptionally high by international comparison. Figure 7 shows allocation of investment by road types, and source of financing. Apart from financing from special road account, local tax revenue was also substantially used. At the early stage, effort was mainly for upgrading (improved pavement) existing general roads, but soon overall network was aggressively expanded with higher grade roads.

4. EMERGING ISSUES

Despite a generally successful story of development of advanced transport system in a relatively short span of time, Japanese transport system now is not without challenges. Major issues, which are currently concerns for policy makers are listed below.

- Challenges of securing or maintaining efficiency of investment and operation
  - Increasing trend of non-profitable infrastructure
  - Lower efficiency of operation by public agencies
- Necessity of investment for major infrastructure renovation but difficulty in flexibly mobilizing diverse source of financing, such as cross-subsidies, due to deregulation
and market orientation.

- Conflict of interest between the metropolitan areas and rural areas in terms of public investment in transport infrastructure
- Aging and declining population and possibility of declining transport demand, which may have direct impact on profitability of service operators
- Possibility of increase in interest rate, which may have serious implication for payback of outstanding debts from transport agencies
- Increasing political pressures for reduction in fuel tax and expressway toll, which can have significant adverse effect on modal competition (certainly erode competitiveness of public transport modes) and environmental aspect (due to possible increase in auto use)

5. POSSIBLE LESSONS AND INSIGHTS FOR DEVELOPING COUNTRIES

Obviously, for developing Asian countries, there is good scope of drawing policy insights and learning valuable lessons that emerges out of the success story of Japan in rapidly developing advanced transport system and operating services sustainably from both economic and environmental view points. Likewise, the currently emerging issues may also provide important insights in considering possible future scenario, and help to make proactive policies. The key areas and themes where Japanese experience can be relevant for Asian developing countries are listed as follows.

- Most important lesson Japanese experience reveals is that the institutional setup at the early stage is very important. As the economic development advances, various stakeholders and interest group may resist otherwise desirable policies. For example, Japan instituted higher level of fuel and vehicle tax in early 1950s, which was much important to secure financing for road investment. At that stage, population of car owner in Japan was very low, and probably because of that there is least resistance. But despite much positive impact of fuel tax, vehicle taxes, and toll system in Japan—which is subject of envy for other OECD countries- there is growing pressure from political parties to reduce transport related taxes and expressway toll. This phenomenon should be instructive for developing countries policy makers.

- Transport infrastructure and services includes elements of both publicness and commercial viability, and Japanese approach has realized this fact well and make use of both aspects optimally. The broad picture in this regard seems to be
  - Utilization of public corporation model at the early stage
  - Privatization and deregulation at the later stage (promoting public-private partnership (PPP))

- Another important lesson is that it is possible to make beneficiaries bear the burden to the maximum extent. This needs utilizing various instruments, such direct users’ charge, value capture, and burden sharing between local and national governments.

- The factor that determines fare level in Japan is the sustainable financing of operation, which is quite unique approach as public transport is often required to provide so called affordable service with fare control to the degree of sheer irrationality. That is why in Japan transport operation is rarely subsidized. This approach has avoided the common case of financial resources being used for subsidizing operation, which
causes lack of resources for much needed capital investment.

- Japan successfully demonstrated need and possibility of mobilizing domestic savings (public borrowing with commercial discipline) for transport investment. Of course, the Japanese system is not without critics since easy availability through public borrowing always pose a risk of wasteful investment, and some of the Japanese infrastructure projects are criticized on this ground, especially projects at the later stage. Yet, there is much to learn and inspired by the financing schemes adopted by Japan.

- Finally, most important inspiration Asian developing countries can take from Japan is successfully developing and sustainably operating railway system. In the context of growing need of low-carbon transport system, Japan’s approach of modal balance, particularly making railway attractive and putting real cost of driving is something developing countries can adopt as strategic approach.

6. CONCLUSION

Japan was able to develop advanced transport system in a shortest possible time span, and the performance of the transport system is better than its OECD peers from the West especially in terms of desirable mode share structure in passenger transport. This was in fact achieved through deliberate policy initiatives made in the past. After reviewing Japan’s intercity transport system along with emerging issues, this paper makes an attempt to draw relevant policy insights for Asian developing countries. These includes, setting basic institutional arrangement at the early stage, utilizing publicness and commercial viability inherent in transport services, placing cost burden to the beneficiaries, adopt principle of sustainable fare level rather than politically attractive but financially disastrous affordable fare, devise schemes to mobilize domestic saving for transport investment, and develop and use railway mode to serve as backbone of transport system.

REFERENCES

DfT (2007). Delivering a Sustainable Railway, UK, Department for Transport