

The Development of Spatial Structure and Transportation Network in Japan

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Transport innovation is a key factor that changes the spatial structure (Janelle, 1969). Also, patterns of spatial structure are necessarily influenced by the shape of the space. Now, the purpose of this short paper is to study the development sequence of spatial structure in Japan as the result of transport innovation, particularly the changes in transport modes. This country, lying between the Sea of Japan and the Pacific Ocean, forms an arcuate shape. Most of the mountain ranges lie along the axis of the Japanese Archipelagoes. Plains are small and are scatteredly located. Here, assuming that the shape of Japan is an ellipse, a sequence model of the spatial development in this country may be designed. This model shows a certain broad regularities underlying the process of development. This paper is based on the studies of Taaffe, E. J. et al (1963) and Rimmer, R. J. (1969).

SEQUENCE OF SPATIAL DEVELOPMENT ON AN ELLIPSE SURFACE

A circle is, as Kohl, J. G. (1841) noted, the basis on which geographers study any sort of spatial relations. An ellipse is a modification of a circle, which has a major and a minor axes, and the surface of an ellipse is characteristic in that it can be divided into several smaller circles or ellipses along the major axis. Therefore, all the innovations are expected to always expand along this axis on the surface of the ellipse.

The development of transportation starts around nucleate centers. The first phase (Fig. 1A) shows a pattern of small centers being dispersed all over the country. Each small center has an extremely limited tributary area. There is little interconnection among those centers. The roads only connect the administrative center, which is located at the central part of the country, with each small center. The important transport mode is that of animals. In this phase, shape of the land has had yet little influence upon the pattern of the spatial structure.

With the development of sea transport by sailing boats, new centers and ports are nucleated along the seacoast. Thus, mass transport is made possible. In this phase (Fig. 1B), economic activities begin to concentrate on particular centers and ports, such as C_1 and C_2 . Emergence of these large centers is determined by the shape of the land. Then, a major sea transport route is opened between these two and a nation-wide sea transport system that focuses upon them is established. Activities in each area are, however, still isolated.

The next phase (Fig. 1C) is characterized by the two separating centralized structures. With the development of rail transport, the former sea transport system is destroyed and economic activities are spread all over the country. At the start, the main railway route is established between these two large centers. Then, it is expanded along the seacoast on the side where these centers are located, further stretching in a radial manner. In consequence, all the small centers are connected through them. The large two grow more and more and economic activities of the new stage begin to concentrate on the selected centers along the

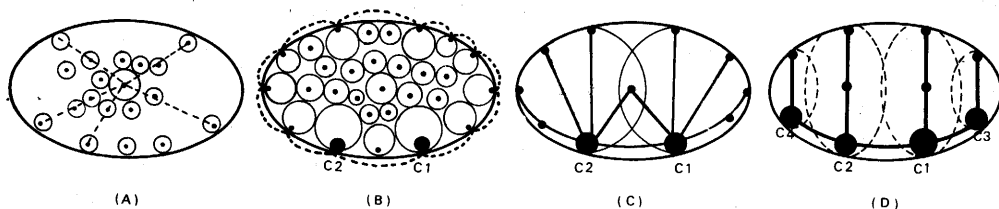


Fig. 1. Idealized development sequence of spatial structure in Japan

(A) First phase: scattered centers and road traffic (B) Second phase: concentration and rail transport (C) Third phase: centralization and rail transport (D) Fourth phase: decentralized centralization and motor traffic

railways, particularly on the side of the above two. Further, the speed-up of rail transport makes these two separating structures shift to one, that is, the largest center C_1 . Then, C_1 begins to grow more rapidly.

The fourth phase (Fig. 1D) starts when the largest center passes the limit of its growth. In other words, it is the phase in which motorization enables the decentralization of economic activities from the largest center. First, the trunk road is opened between the largest center C_1 and the large center C_2 . Then, it is expanded along the seacoast where the largest center C_1 is located. Several large centers, such as C_3 and C_4 , are found to emerge upon this coast. When arterial roads that focus on these centers are opened along the short axis of the spatial structure that focuses upon the largest center, there come about several sub-systems of separating spatial structures along the long axis.

FIRST PHASE: SCATTERED CENTERS AND ROAD TRAFFIC

In Japan, the first phase went on by the Muromachi Period (–1573 AD). Economic activities in those days are characterized by the fact that with the progress of agriculture, domestic industry began to grow and finally commerce and industry came to be separated from each other. As the result, small centers came out scatteredly all over the land. Most of the economic activities were, however, confined within the limit of each tributary area, namely the *sho-en* or the domain of a *shugo-daimyo*. There was little interconnection among those centers. Only the annual tributes and special products were conveyed by way of the roads which connected the local centers with Kyoto, the administrative center located at the central part of the land in that period, and which had administrative and military functions.

SECOND PHASE: CONCENTRATION AND SEA TRANSPORT

Sea transport by sailing boats began to make rapid growth in the middle of the fifteenth century. It advanced the growth of many centers and ports and economic activities gradually came to be concentrated upon a particular center. This period (the second phase) corresponds to the Azuchi-Momoyama and the Tokugawa Periods (1573–1867). At the end of the fifteenth century, port towns of Sakai and Hakata (today's Fukuoka) grew into prosperous centers of foreign trade, but later the national isolation policy made these towns to decline. Being located at the mouth of the river Yodo, Osaka played a role of an outer port of Kyoto. In the Momoyama Period, it came to be the administrative center and at the same time it grew into the largest center of the nation-wide sea transport system at that time

that centered around the Hokkoku and the Setouchi routes. Remarkable concentration was attained in economic activities.

As the frontier of the land proceeded on towards the north, the administrative center moved to Edo (today's Tokyo), which had been one of the small centers before. In the Bakufu System, the structures of economic activities that focused upon each castle town were established. Sea transport was quick to be opened between Edo and Osaka. Then, Osaka was the center of commodity supply to Edo. Sake, oil, soy, and rice were the main goods which were carried through this route. Before long, other sea routes were opened to directly connect Edo with the domains of local daimyo. The one was the "anti-clockwise" route that connected Edo with those domains on the side of the Japan Sea through the straits of Tsugaru, and the other the "clockwise" route by way of Shimonoseki (Fig. 2). The "anti-clockwise" one was, however, often attended by a disaster. And in consequence, economic activities were rapidly concentrated upon Edo.

On the other hand, in this period also the road traffic developed into a large system of a nation-wide scale. During the Tokugawa Period, the system of the Gokaido was established; that is, Tokaido (from Edo to Kyoto), Nakasendo (from Edo to Kyoto by way of Shimo-Suwa), Nikko-Kaido (from Edo to Nikko), Oshu-Kaido (from Edo to Shirakawa), and Koshu-Kaido (from Edo to Kami-Suwa). They formed a trunk-road network that radially focused upon Edo. However, most of their functions were administrative and they were of benefit only to, for instance, a daimyo's procession for alternate-year residence in Edo.

Thus, the development of transportation brought about still more remarkable concentration of economic activities on Edo and Osaka, while most of the local activities had yet confined themselves within the tributary area centering around a castle town. They were not organized into a large-scale economic system as yet.

THIRD PHASE: CENTRALIZATION AND RAIL TRANSPORT

Construction of a railway as well as introduction of a steamship destroyed the former sea transport system, while they were the basis on which new activities of the national economy were organized. This period corresponds to the beginning of the Meiji Era through the World War II (1868–1945). In the year 1872, a railway was first constructed, linking the metropolis Tokyo with the opening port Yokohama. In the next place, the Tokaido line (Tokyo – Osaka) was opened to connect the two large centers and there terminated the Tohoku line (Tokyo – Aomori) in 1891 and the San-yo line (Osaka – Shimonoseki) in 1902. These were the railways traversing the mainland. A new railway, the Shin-etsu line (Tokyo – Nao-etsu) crossed the land for the first time in the year 1893 (Fig. 3). In 1915, the railway network attaining the length of about 1,200 km was established, and Tokyo and Osaka were connected with many small centers scattered all over the country.

Development of the railway network made the spatial structure of economic activities in this country a considerably centralized one. There could not be independent activities within the limit of each center any longer. Economic functions came to be performed in two separating spheres of the country. Concentrations of economic activities were also brought about onto the small centers, that is, the developing cities along the railways. Thus, specialized centers, or industrial cities, were formed on the side of the Pacific Ocean; for instance, Yahata, Nagoya, and so on. Further, they grew into the big four industrial areas; Kita-Kyūshū industrial area, Hanshin industrial area, Chūkyō industrial area, and Keihin industrial area.

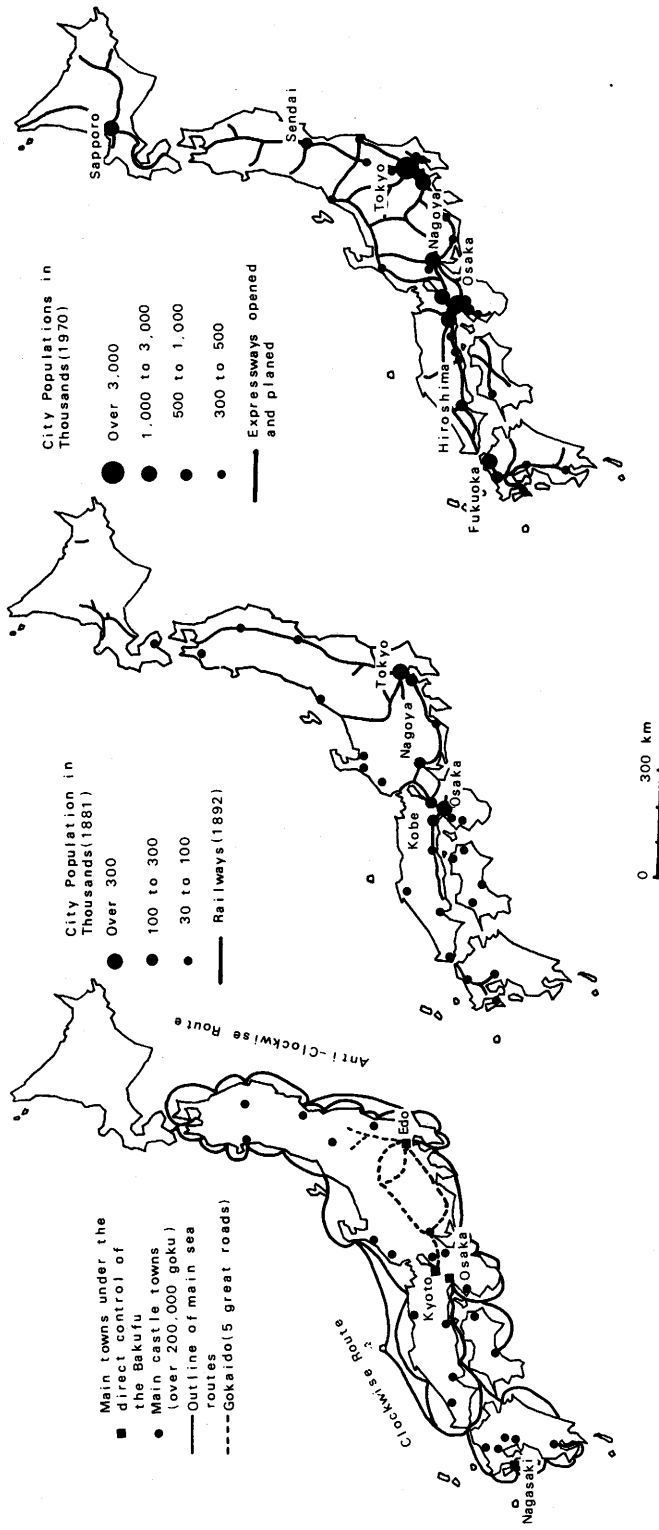


Fig. 2. Towns and sea transport systems in Tokugawa period

Fig. 3. Cities and railway networks in Meiji Era

Fig. 4. Cities and expressway networks today

Together with the new type of concentration, a technological innovation for the speed-up of the railway was attained. In 1891, the Tokaido line ran at the rate of 30 km per hour, but in 1931 when the special express Tsubame appeared, it was improved to 68 km. This accelerated the rapid growth of Tokyo.

FOURTH PHASE: DECENTRALIZED CENTRALIZATION AND MOTOR TRAFFIC

This period started after the World War II when motor traffic suddenly began to grow. The volume of commodity transportation by motor-cars had so rapidly increased for the late twenty-one years that it was 7.4 times in 1973 as much as that in 1952. Share of the motor-cars in the whole commodity transportation had increased from 68% to 90%. Motor traffic came to have an advantage over the rail transport in the length of 300 km. In 1957, the Law of Arterial Motorway for National Development was established, in which expressways were schemed in thirtytwo routes ranging over 7,200 km (Fig. 4). The Meishin expressway (Kobe — Nagoya) was opened in 1965, and the Tomei expressway (Nagoya — Tokyo) in 1969. Since then, other expressways have been under construction traversing or crossing the land.

However, during the process of development, the largest center Tokyo and the large center Osaka nearly passed the limit of growth with concentration of economic activities upon them. And then, such activities began to decentralize towards the other areas on the seacoast of the Pacific Ocean. This means formation of the Pacific Coast Belt Zone: Sapporo, Sendai, Nagoya, Hiroshima, and Fukuoka grew to be the central city in their own region. Eventually, the seven sub-systems of economy that focused on each center were established, which made up parts of the national economic system that focused on Tokyo. Structural re-organization has been steadily going on with the opening of the Tokaido superexpress railway in 1968 and the San-yo superexpress railway in 1975.

CONCLUSION

This paper was intended to outline the changes in spatial structure of our country as the result of transport innovation. As mentioned above, patterns of spatial structure are necessarily influenced by the shape of the land, which extends itself north and south, and consequently, transport innovation always expands along the axis traversing the mainland. Whole of this paper deals only with the economic spatial structure, particularly on the level of the nation. Therefore, the next theme should be the analysis of administrative spatial structure. Furthermore, both of these may be described on the level of a region.

The author presents this paper with great respect to Prof. Saburo Noma in commemoration of his retirement from Tokyo Metropolitan University.

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