Station area developments in Tokyo and what the Randstad can learn from it

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Exploring the spatial development dynamics of station areas in Tokyo using the node-place model

This chapter is related to the theory of the node-place model (see chapter 2.1) and describes the application of the node-place model to a selection of 99 stations in Tokyo. The aim of this analysis is to gain a better understanding of the spatial development dynamics of station areas in Tokyo. More specifically, it will be used to explore which transport and land use factors are responsible for structuring station area developments and subsequently to what extent. Regarding the former, correlation analysis will be used to reveal which combination of transport and land use factors has the highest influence. In addressing the latter, three case studies of station area developments will be further analyzed to find out whether the development path expected by the node-place model unfolds or not and why. Explanations will then be sought for the matches and mismatches between the identified development potential and its actual realization, in order to identify the broader complex of factors that comes into play in structuring station area developments. A better understanding of the development dynamics in station areas might help those cities that are looking for ways to promote the integration of public transport and urban development, or ‘transit-oriented development’ (Cervero, 2004; Dittmar & Ohland, 2004; Dunphy et al., 2005).

In the first paragraph the node-place model is introduced, after which it is applied in the second paragraph to a number of station areas in the Greater Tokyo Area (GTA). In the third paragraph the results of the node-place model are discussed. Following this, in paragraph four, the results are compared to the actual investments taking place in the three case studies of station area developments. In the fifth and final paragraph some conclusions are drawn.

28 An earlier version of this chapter has been published in the Journal of Transport and Land Use 4 (1) 2011, pp.45-58.
5.1 Exploring the relationship between transport and land use in station areas

Generally it is recognized that land use patterns and transportation patterns are closely related to each other. It is easily understood that the spatial separation of human activities creates a need for personal travel and the transportation of goods. In other words it influences the mobility behaviour of actors such as households and firms. Less well known is the reverse impact from transport to land use (Banister, 1995; Wegener & Fürst, 1999; Giuliano, 2004). It is obvious that the availability of infrastructure makes certain locations accessible. However, it is less clearly understood exactly how developments in the transport system influence the locational behaviour of landlords, investors, firms and households. A typical way to illustrate the complex relationship between land use and transport is via the so-called ‘land use transport feedback cycle’ (Giuliano, 2004; Meyer & Miller, 2001; Wegener & Fürst, 1999). According to this cycle land use and transport patterns influence each other. Land use patterns partly determine the location of human activities such as living, working, shopping, education or leisure. The distribution of human activities requires trips in the transport system to overcome the distance between the locations of activities. These activities create new travel demand and, consequently, a need for better transportation services, whether in the form of new infrastructure or more efficient operation of existing facilities. The resulting increase in accessibility co-determines the location decisions of landlords, investors, households and firms. This results in changes of the land use thereby starting the cycle again. This process continues until a (provisional) equilibrium is reached or until some external factor intervenes (Meyer & Miller, 2001).

The node-place model of Bertolini (1999) follows the reasoning of the transport land use feedback cycle and aims at further exploring the underlying relationships between transport and land use, with a focus on station areas. The basic idea is that improving the transport provision (or the node value) of a location will, because of an improved accessibility, create conditions favourable to its further development. In turn, the development of a location (or an increase of its place value) will, because of a growing demand for transport, create conditions favourable to the further development of the transport system. The emphasis on ‘conditions’ is important as it refers to a development potential identified by the node-place model which in reality may or may not be realized, as other factors may also play a role.
Chapter 5 - Exploring the spatial development dynamics of station areas in Tokyo using the node-place model

Figure 5-1   The node-place model

The node-place model distinguishes five typical situations a station area can find itself in (figure 5-1). Each situation reflects a particular relative position of a station area on the node and place scale, or in other words its position in the node or place hierarchy in an urban region. The ‘balanced’ areas are found along the middle line. They have a relatively equally strong position on both the node and place scale. It is expected that these relative positions will be comparable in most cases, due to transport and land use interactions. At the top of the line are the ‘stressed’ areas. These are the locations where both the node and the place have been used to the fullest. Thus ‘stressed’ station areas have a relatively strong position on both the node and the place scale. Further development of these areas can be problematic as the multiple claims on the limited amount of space can easily cause conflicts. At the bottom of the line are the ‘dependent’ areas. Here the struggle for space is minimal. Both the node and the place are relatively so weak that intervention from factors other than the internal node-place dynamics (e.g. subsidization) is needed for the area to sustain itself. Furthermore, two unbalanced situations exist. Above the middle line are the ‘unbalanced nodes’. These are locations where transport systems are relatively more developed than urban activities. Below the middle line are the ‘unbalanced places’ where the opposite is true. An ‘unbalanced’ station area has thus a relatively (much) stronger position in either the node or the place scale.

When following the reasoning of the land use feedback cycle, it can be assumed that both latter location types will eventually move towards a more balanced state (or at least have a tendency in that direction). For example an ‘unbalanced node’ may, in principle, in the long term either see its place value go up (e.g. by attracting property development) or see its node value go down (e.g. by a relative reduction in transportation services). A reverse reasoning can be applied to the ‘unbalanced place’: either the connectivity of the location will be improved resulting in an increase in the node value, or the location will be developed in a relatively lower density leading to a decreasing place value. The unbalanced location types are the most interesting ones as these are the locations that have, according to the model, the highest development potential (either in land use or transport development terms). However, whether or not this potential will be realized remains to be seen, as other factors may influence the development of station areas. In the following paragraph the development dynamics of a range of stations within the Tokyo metropolis are explored. For this the node-place model is used.

5.2 The node-place model applied to Tokyo

The number of stations in the Tokyo Metropolitan Area is considerably large. On average the distance between two stations is 1.2 kilometres. It is quite common to find over 20 stations on one single suburban commuter line. There are 121 individual rail lines serving approximately 1200 stations in the Tokyo Metropolitan area. Most of the stations, however, fulfil a local role in the network and function as local centres for the surrounding residential community. Their passenger numbers are fairly small for Japanese standards. This is reflected by the relatively low intensity and diversity of activities found in and around these stations. The node-place model was applied to a number of stations that fulfil a regional role in the network. This regional role is illustrated by having at least one transfer option to another railway or subway line. Eventually 99
dedicated stations were found that matched this criterion. The stations were selected within a radius of 30 kilometres from Tokyo Station by using GIS (Geographical Information Systems). Tokyo Station is considered to be the official centre of Tokyo. Therefore in railway statistics the direction of a trip is always measured from the viewpoint of Tokyo Station. The node-place model analysis was conducted in 2006 using data from 2005 unless indicated otherwise.

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29 Initially 131 stations were selected but due to a lack of available data the list was reduced to 99 stations.
Chapter 5 - Exploring the spatial development dynamics of station areas in Tokyo using the node-place model

The node value

Four criteria were used to determine the node value (transport provision) of an area. These were developed through previous applications of the model (Bertolini, 1999; Reusser, 2008) and interviews with transport experts. They are the number of train connections departing from a station, the type of train connections present at a station, the proximity to the Central Business District by rail, and the number of bus connections departing from a station. Bertolini (1999) used 7 criteria and Reusser (2008) used 10 criteria for determining the node value. For practical reasons only four criteria were used in this application.

1. Number of train connections

Ridership and the number of train connections are closely related to each other. In general a station that offers multiple connections will attract more passengers than a station that only offers one connection. In addition, a station that offers multiple connections will also have a larger development potential then a station that does not. This leaves out the local stations which are in terms of development potential less highly valued, as is clearly illustrated by their weakly developed station areas. For the 99 stations that met this criterion the number of train connections has been calculated. Subways and Shinkansen lines (i.e. high speed railway lines) are included in the calculation. Transfers from a local express to a rapid express are not included as they concern the same line.

2. Type of train connections

In Tokyo private railway operators have several types of train services running on their lines. These vary from train services that halt at every station to services that only stop at a certain number of stations. Obviously the latter train service, the rapid express service, reduces the travel time to the sub-centre. This reduction is reflected in the land and real estate prices, as stations with a rapid express stop are more expensive in terms of land prices and rents than stations that only have a local express stop.

The types of train connections offered at a station were identified using the websites of the private railway companies.

3. Proximity to CBD by rail

Tokyo station is situated in the heart of the historical Central Business District. Over 4000 companies, among them many (inter)national head offices, are located in the surrounding area contributing to approximately 20% of Japan’s Gross Domestic Product. Around 240,000 people work in the area and another 700,000 people visit the area everyday (Okada, 2006). The highest concentration of jobs and workers within the Tokyo metropolis is in the traditional CBD of Tokyo (Kawabata, 2003). Therefore, proximity to the CBD by rail is considered important for identifying the development potential of a station area. The proximity of a station to the CBD by rail was calculated by using a Japanese train route finder website30.

30 http://www.jorudan.co.jp/english
4. Number of bus lines departing from a station

Buses in the Tokyo Metropolitan Area serve a secondary role to rail and usually supplement the railway system by transporting passengers to and from train stations. Most large private railway companies operate several bus lines that are complementary to their railway system. From their stations buses go into the surrounding residential areas. Each company has its own exclusive territory which matches the area where they operate railway lines. For example, the Tokyo Metropolitan Government (TMG) mainly operates buses within the 23 wards, while private railway operators go far beyond that. However, private buses are not allowed to cross the Yamanote line, the railway line encircling the city centre of Tokyo, for similar reasons as the private railway lines. Online maps of 20 different bus operators were used to determine the number of bus lines that departed from the selected train stations. Only the bus lines that had a bus stop in front of the station were included in the calculation. Therefore, some stations have a score of 0 as they did not have a bus stop near their station.

Together these four criteria make up the node value. Unlike the original application of the node-place model in The Netherlands (Bertolini, 1999), the number of car parking facilities and the number of bicycle parking facilities were not analyzed as most of the selected stations lack these facilities. The majority (60.6%) of people that go to stations in the Tokyo Metropolitan Area do this on foot (Institute for Transport Policy Studies, 2007). The high building densities typically to be found around stations in combination with the short distance between stations have made this possible. All housing agencies mention the walking distance from an apartment to the nearest train station in their housing advertisements. This underlines once more how important it is that stations can be reached on foot.

The place value

Six criteria were analysed in order to determine the place value of a station area, or the quantity and diversity of human activities. These are the population around the station, the workforce categorized into four different clusters, and the degree of multifunctionality. These match the criteria that are used in the original application of Bertolini (1999).

1. Population around the station

In Tokyo, the construction of private railway lines went hand in hand with the development of the surrounding areas. Before constructing the railway line a private railway operator bought large tracts of land along its planned route. These lands were developed for commercial and residential purposes. By the time a station was completed the first inhabitation in the surrounding areas had also started (Cervero, 1998; Mizutani, 1994). The aim of the private railway developer was to create a so-called ‘railway-oriented lifestyle’ in which people greatly depend on the railways for conducting their daily activities. Thus, that people would live in the suburbs and use the train to travel back and forth to the centre or sub-centre of Tokyo to shop and work. This worked out quite well as is illustrated by the high share (over 50%) that the railways have in urban transport within the Tokyo Metropolitan Area.
The residential population around a station was measured from the centre of a so-called chome which is the Japanese name for a neighbourhood district. In the case where two stations were situated in the same chome, the station that was nearest to the centre received the whole population value. The maximum distance from a centre to a station is set at 700 metres following Bertolini (1999) and Reusser et al., (2008). A Japanese GIS-website\footnote{http://gisplaza.stat.go.jp (in Japanese only)} was used for making the calculations. At the time this analysis was carried out the most recent data available were of 2001.

The same Japanese GIS-website was used to calculate the number of workers within 700 metres of a station. At the time this analysis was carried out the most recent data available were of 2001.

2. Economic cluster 1: Services and administration
The GIS-data available for Tokyo were the number of workers in offices, branch offices and offices in a house.

3. Economic cluster 2: Retail, hotel and catering
The GIS-data available for Tokyo were the number of workers in stores and restaurants.

4. Economic cluster 3: Industry and distribution
The GIS-data available for Tokyo were the number of workers in transport distribution, centres and warehouses, private warehouses, gas stations, factories and work places.

5. Economic cluster 4: Education, health and culture
The GIS-data available for Tokyo were the number of workers in schools, hospitals, temples, inns and bathhouses.

The residents and the workforce together represent the potential users of the transportation services. In Tokyo, however, it is quite safe to say that the majority of them are also the actual users of the train as most people do not have an alternative mode of transport. The car is expensive because of high parking fees, a toll that needs to be paid on express ways, and the relatively low commuting allowances in comparison to public transport. In addition, travel speeds during rush hour are only 14 km/hour. The train on the other hand is punctual, frequent (every 2-3 minutes during rush hour and every 5 minutes during off-peak hours) and the travel costs are, in many cases, fully covered by the company.

6. Degree of multifunctionality
In Tokyo stations are the true urban centres of the city as most shops, restaurants, offices and amusement facilities are concentrated there. However, this does not mean that all stations have the same function. For example, the CBD of Tokyo is supported by several sub centres each fulfilling a different role in the urban network. They either play a role as an economic, entertainment, or cultural centre. Furthermore stations
play a different role in the transportation network. They can either have a local, regional or national role which in turn has consequences for the quantity and diversity of functions to be found in their areas. Determining the degree of multifunctionality can help to provide insight in this double role that stations have. How the degree of multifunctionality is calculated is demonstrated in box 5-1.

**Box 5-1**  
**Formula used for calculating the degree of multifunctionality**

\[\text{Degree of multifunctionality (x6)} \]

\[
x_1 = \text{population} \]
\[
x_{2-5} = \text{workers economic clusters} \]
\[
x_6 = 1 - \frac{a-b}{d} - \frac{a-c}{d} \]

\[
a = \max (x_1, x_2, x_3, x_4, x_5) \]
\[
b = \min (x_1, x_2, x_3, x_4, x_5) \]
\[
c = \frac{x_1 + x_2 + x_3 + x_4 + x_5}{5} \]
\[
d = \frac{x_1 + x_2 + x_3 + x_4 + x_5}{5} \]

Note: this is the same formula as used in the original application of Bertolini (1999).

### 5.3 The results

For plotting the node-place model the approach followed in Switzerland has served as reference (Reusser et al., 2008). The place criterion ‘workforce’ and the node criteria ‘number of train connections’ and ‘number of bus connections’ were log-transformed to reduce the unevenness in their individual scores. For the other criteria the original scores were used as the differences between them were very small. Furthermore, all criteria were rescaled to have a score between ‘0’ and ‘1’. A station with the highest score, e.g. the largest number of passengers, was given a score of ‘1’, a station with the lowest score, e.g. the lowest number of passengers, with a score of ‘0’. The two indices were Z-transformed to obtain comparable scaling. This means that the distances in the node-place diagram are in standard deviation units.

Correlation analysis is used to find out which transport and land use factors are responsible for structuring station area developments. First the node and place criteria are individually compared to explore what combination is most influential in structuring the development of station areas. Second, combinations of node and place criteria are compared to find out whether there are pair combinations with a stronger influence than individual pairs. In this is departed from previous applications of the model, where only combinations of all node and place factors were considered. This different interpretation stems from the different question that is asked: which transport and land use factors and interactions are more relevant. Fifty-four combinations of node and place criteria are explored to find out to what extent these combinations are related to each other. This has resulted in fifty-four possible relations, or fifty-four
possible node-place models (M). In the matrix below individual node criteria (N1 to N4) as well as combinations of node criteria (N5 and N6) are compared with place criteria. The reason for combining some of the node criteria is that in combination they appear to show a stronger correlation than when considered individually, which is thus more useful for structuring station area developments. The combined node criteria are calculated by simply adding up their individual values (see table 1 below). No combination of place criteria is shown because none showed a stronger correlation than when considering the criteria individually.

Table 5-1  Overview correlation scores of node-place combinations

<table>
<thead>
<tr>
<th>Place criteria (P)</th>
<th>Node criteria (N)</th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>N4</th>
<th>N5</th>
<th>N6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P1 Population</td>
<td>P2 Workforce</td>
<td>P3 Degree of Multifunctionality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of train connections</td>
<td>M1</td>
<td>M2</td>
<td>M3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of bus connections</td>
<td>Correlation: -0.225</td>
<td>Correlation: +0.558</td>
<td>Correlation: -0.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of train connections</td>
<td>M4</td>
<td>M5</td>
<td>M6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlation: +0.107</td>
<td>Correlation: +0.238</td>
<td>Correlation: +0.065</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proximity to CBD</td>
<td>M7</td>
<td>M8</td>
<td>M9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlation: -0.003</td>
<td>Correlation: +0.328</td>
<td>Correlation: +0.003</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M10 Correlation: -0.301</td>
<td>M11 Correlation: +0.520</td>
<td>M12 Correlation: -0.028</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proximity to CBD and number of train connections</td>
<td>M13</td>
<td>M14</td>
<td>M15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlation: -0.325</td>
<td>Correlation: +0.666</td>
<td>Correlation: -0.065</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M16 Correlation: -0.234</td>
<td>M17 Correlation: +0.645</td>
<td>M18 Correlation: -0.044</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5-1 demonstrates how the transport factors (the node criteria) are related to land use factors (the place criteria) and vice versa. The population appears to be negatively related to the node criteria except for the number of bus connections (M4) where there is a slightly positive correlation. This means that in Tokyo stations with a high number of rapid trains, a high number of train connections, or situated a relatively short distance from the CBD have a relatively small residential population. Stations with a limited number of rapid trains, a limited number of train connections or located further away from the CBD have a relatively large residential population.

The workforce is positively related to the node criteria. This means that stations with a high number of (rapid) trains, a high number of train connections, a high number of bus connections or situated a relatively short distance from the CBD have a relatively large workforce. The opposite occurs for stations with a low number of (rapid) trains. In the case of the combination of the number of train connections and the distance to the CBD (M14) this correlation is strongest. These are already interesting insights, which depart from the focus on generic correlations between density and public transport provision (e.g. Wegener & Fürst, 1999). They show a positive relationship between the network position of a station and the concentration of workforce, but a negative relationship when population concentration is considered. This means that functions (i.e. residential or commercial) and not only densities should be considered when exploring connections between transport and urban form. As for the degree of multifunctionality, the picture seems to be less clear. Models M6 and M9 seem to indicate that stations with either a large number of rapid trains or a large number of bus connections are more multifunctional. Stations that are situated closer to the CBD or have a high number of train connections tend to become more monofunctional, as is illustrated by the negative correlation of M12 and M3. Again, more subtle relationships than just density versus transport provision seem to be at play. However, neither of the correlations is particularly strong, pointing to the weak structural role of this place criterion to station area developments. Interestingly only some influences get stronger when transport supply factors are combined. Stations that are located a short distance from the CBD and have a high number of train connections and/or a high number of rapid trains, have a larger workforce than stations that “only” match the first criterion (M14 and M17 versus M11). However, adding the type of train connections to the node criteria does not seem to have an added value as the lower correlation score indicates. Model M14 seems to be the model that has the highest influence on structuring station area developments in Tokyo. It is therefore used in the rest of this analysis, which focuses on the second question: to what extent do these transport and land use factors structure development, as opposed to factors outside the node-place model.
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Figure 5-2 illustrates the relative position of each station area according to its node and place values following M14. A large number of station areas are balanced as they have a relatively equally strong position on the node and the place scales. It is assumed that these relative positions are comparable due to transport land use interactions. Examples of balanced station areas are Ikebukuro, Ryogoku and Inadazutsumi. Ikebukuro station is one of the urban sub centres along the Yamanote line and as such has a relatively strong workforce. At the same time it is a major transfer node for commuters coming from the suburbs in the north western part of the metropolitan area. Ryogoku station is situated next to the historical Central Business District and has an intermediate node and place value. Inadazutsumi station is located in Tama New Town, a residential suburb to the west of Tokyo which is relatively far away from the CBD. It has a relatively weak node and place value.

There are, however, also examples of station areas in more extreme positions. In the upper right corner are the so-called 'stressed' station areas. In Tokyo they are represented by the stations of Shibuya and especially Shinjuku. Both stations are major transfer nodes in the urban transportation network of Tokyo and are used by millions of travellers each day. At the same time these stations are important urban sub-centres in the Tokyo metropolis with large concentrations of commercial, amusement and business facilities. This explains their high node and place values.

Moving away from the middle line one finds the examples of unbalanced station areas. To the left of the middle line are the so-called unbalanced nodes. These are the station areas that have a relatively stronger node value, meaning that the workforce in these station areas is relatively small compared to their distance from the CBD and the number of train connections they have. Tokyo station is an example of an unbalanced node. Tokyo station is situated in the very heart of the CBD and has, after Shinjuku

32 The distances in the diagram are in standard deviation units.
station, the highest number of workers. It has the highest node value of all the 99 analysed stations. This is because Tokyo station is not only an important transfer node in the urban network like Shinjuku station, but also an important transfer node in the national network as it is the terminus for all high-speed railway lines in Japan. This might explain its relatively high node value.

Ueno station is also an example of an unbalanced node. Just like Tokyo and Shinjuku it is an important transfer node in the urban transportation network of Tokyo. Its surrounding area, however, is relatively underdeveloped in terms of workforce. Other examples are the stations of Okachimachi, Machiya and Ushida. The reason why these stations have a relatively small workforce is at least in part explained by their local context. For example, a large part of the area surrounding Ueno station is occupied by a park and some important national museums. Furthermore Ueno station is located in the historical down-town district of Tokyo. It is one of the few traditional residential areas left in Tokyo and can be recognized by its typical low-rise high density wooden houses. Generally it is the area where the working class live. The stations of Okachimachi, Machiya and Ushida are also situated in such a traditional residential neighbourhood which partly explains why their station areas contain a relatively small workforce.

On the right side of the middle line are the so-called unbalanced places. These are the station areas that have a relatively stronger place value, meaning that the workforce in these stations is relatively large compared to their distance from the CBD and the number of train connections they have. The stations of Kannai, Sakuragicho Urawa and Shin-Yurigaoka are examples of unbalanced places. Kannai station is regarded as the political and economic core of Yokohama and houses many governmental offices such as the city hall, and corporate headquarters. Sakuragicho station is located near the Minato Mirai district, one of the main business areas in the city of Yokohama. Around Urawa station many of the prefecture’s governmental agencies and cultural facilities are concentrated such as the prefectural office, the city hall, the prefectural library and court, and the prefecture’s convention centre. The relatively strong concentration of public functions which are less subject to market forces including accessibility might explain why these stations have a relatively large workforce. Shin-Yurigaoka station is a regional centre on the Odakyu line, a railway line radiating outwards from Shinjuku to the south western part of the metropolitan area. Around the station many department stores can be found as well as the public library and the ward office. As Figure 3 illustrates there are no ‘dependent’ areas among the selected stations. This can be explained by the fact that only the stations that fulfil a regional role in the railway network were selected. This role is determined by having at least one transfer option to another railway or subway line. However, this does not mean that these types of station are not present in the Tokyo metropolis. Their number is, however, likely to be limited due to high population densities (the average density in the Greater Tokyo Area was 3,200 persons per square kilometres as of 2009), an extensive integrated railway network, and market forces that determine developments. These are all circumstances that favour a transit-oriented mode of development in Tokyo.
5.4 Model versus reality

Now that the development potential has been identified for each of the selected station areas the question arises of whether this development potential is actually realized or not. If the station areas indeed follow the development path that the node-place model assumes then why is this so? And if not, why do they differ? Here not only transport and land use factors, but also other external factors come into play.

Potential answers to these questions have already been mentioned in the discussion of ‘unbalanced station areas’ in the previous paragraph. Here they are further explored by looking, in a more dynamic fashion, at the recent developments of three station areas each representing one of the most extreme situations the node-place model distinguishes. Shinjuku station is used to illustrate the stressed station area. Urawa station is used to provide an example of an unbalanced place. Ueno station is used to represent the unbalanced node. The dependent station area is not described as in the selection this type was not present. Several interviews were held with officials involved in the development of the three station areas and related documents available on the internet were analysed. The aim of this analysis, in line with the rest of the paper, is not to predict or advice a certain development path for station areas in Tokyo; rather it is to gain a better understanding of the forces that are responsible for their development.

A stressed station area; the case of Shinjuku station

Shinjuku station is the busiest station in the world in terms of passenger numbers. Daily the station is used by an average of 3 million people. Shinjuku station is an important terminal where millions of commuters coming from the western suburbs have to switch trains to go to the city centre (see figure 5-3). Stimulated by the important strategic position in Tokyo’s railway network, Shinjuku station has managed to evolve into one of the main urban sub-centres found within the Tokyo metropolis. Shinjuku station is identified by the node-place model as a stressed station area. This means that both the node and place functions have been used to the fullest. Improving the transport provision and/or the further development of the station area can easily cause conflicts between transport facilities and land uses due to the limited amount of space available.

The infrastructure investments since 2004, the year most data for the model were collected, seem to illustrate that Shinjuku will maintain and even further improve its status as an important hub in the transportation network. Since June 2008 a new subway line has commenced its services between the sub-centres of Ikebukuro, Shinjuku and Shibuya on the western section of the Yamanote line. This line was built to relieve the congestion on the Yamanote line. The subway line is to form an integral part of a larger regional network that offers through services to the northern and southern parts of the Tokyo Metropolis. For this five different railway operators use each other’s railway tracks and share each other’s rolling stock. Out of the 13 subway lines that are operated in Tokyo 11 lines offer this kind of regional through services. Another planned investment is the earlier mentioned JR Keiyo line that will
be extended to Shinjuku station and eventually end at Mitaka station. The extension should be under construction by 2015. Both investments illustrate that the number of railway connections to Shinjuku station will further increase, which means that at least in absolute terms the node value will further improve.

Figure 5-3 Position in the railway network and investments targeted at Shinjuku station

--- To be opened by 2015
••• Under construction by 2015
--- Existing lines except Tokyo and Yokohama subways
----- Prefectural boundary

Source: adapted from Suga, 2000
As far as the place dimension is concerned, currently the south side of Shinjuku station is being developed. An artificial ground has been created above the railway tracks, on which a multi-storey structure will be built. This building is to function as an integrated traffic junction and will include a highway bus facility, a taxi depot, a public parking lot and station facilities. Furthermore, JR East is planning to construct a new building at the south side of the station. The latter investment will cause the workforce in the surroundings of Shinjuku station to increase somewhat in absolute terms.

The further increase of the node value can be explained by the huge number of people that use Shinjuku station every day. As was mentioned before the new subway line was built to relieve the congestion on the Yamanote line. Many private railway operators in the Tokyo metropolitan area are dealing with congestion rates on their lines that are well over 180%. To relieve congestion rates tracks are quadrupled or new lines are built. An increase in frequency is no longer possible without additional investments as during rush hour a train departs every three minutes from the main commuter lines. The policy of the TMG is to reduce the congestion rate to 150% (Transport Policy Council, 2000). For this goal to be reached additional investments are required.

The reason that the place value further increases is because Shinjuku is one of the designated sub-centres, and as such has higher permissible Floor Area Ratio (FAR)-values. In addition, the national government has designated the area around Shinjuku station as one of the areas where urban development is considered an urgent matter. In these so-called ‘priority development areas for urban renaissance’ various incentives are provided to encourage private sector investments. Last but not least, the local situation around the south exit of Shinjuku station (traffic congestion, lack of pedestrian space and inconvenient transfer from trains to highway buses) required some attention. Taken all together, these developments suggest that in absolute terms the node and place value will increase. The development direction of both node and place value seems thus to be contradictory to the expectation of the node place model. Both developments should, however, be assessed with respect to trends in other station areas, as it is this relative change that the model is concerned with. Some of these other trends are discussed below.

An Unbalanced Node; the Case of Ueno Station

Ueno station is an example of an unbalanced node. Following the reasoning of the land use transport feedback cycle, it should either decrease its transportation services (in relative terms) or attract more property developments. In addition a combination of the two is also possible (Reusser et al., 2008). Ueno station is, just like Shinjuku station, one of the sub-centres located around the Yamanote loop line (see figure 5-4). It distinguishes itself from the other sub centres by having a large concentration of cultural facilities in its station area. For example the Ueno Zoo, the Tokyo National Museum, The National Museum of Western Art and Tokyo National University of Fine Arts and Music are all located in the vicinity of the station. Therefore, Ueno is considered an important cultural centre in Tokyo. In addition, Ueno station is also an important hub for commuters and it used to be the terminus for the high speed trains.
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(the Shinkansen) going to the north of Japan. However, this role terminated when the Shinkansen network to Tokyo was extended in 1991. Investments since 2004 show that the function of Ueno station as an important node in the metropolitan railway network is about to change. As of 2010 a new through route will be established between Ueno and Tokyo station (see figure 5-4). This investment will reduce the travel time between the northern areas and the centre of Tokyo. Passengers from three commuter lines no longer have to transfer at Ueno station to go to the centre of Tokyo. This could well cause the position of Ueno station as an important transfer hub to further diminish in the future.

Figure 5-4  Position in the railway network and investments targeted at Ueno Station

- To be opened by 2015
- - Under construction by 2015
- — Existing lines except Tokyo and Yokohama subways
- - - Prefectural boundary

Source: adapted from Suga, 2000
As for the place dimension, since 2004 no spatial developments occurred in the station area of Ueno. Two years earlier, however, the station itself was rearranged. Obsolete station facilities were removed and additional commercial space of about 6000 square metres was created. This was done in order to attract more passengers to the station which according to the owner, Japan Railways East (JR East), they managed to succeed in. Up until now no other investments are planned in the station area. Therefore the workforce is expected to remain the same.

Ueno station seems thus to follow the development path that is suggested by the node-place model. The railway investments indicate, at least in absolute terms, that the node value will decrease. The explanation for this is that JR East, the owner of the station, is facing intensifying competition on its network from rival subway companies and other railway operators who are developing their networks and services. In response to this JR East is increasing its services, reducing its transfers and eliminating the number of transfers. The investments carried out at Ueno station are an example of the latter measure. JR East regards Ueno station as just one of the stations in its network; a decrease in the position of this station is compensated by an increase in the position of another station elsewhere in the network (in this case Tokyo station). In the end the number of passengers using the JR East stations will not decrease.

The place value, here represented by the workforce, will more or less remain the same which is, considering the decrease of the node value, in line with the expectations of the node place model. What might have also contributed to this is the fact that JR East in general owns little land around its stations and thus basically has no means to attract a significant number of new workers into the area. The majority of the land it owned was sold after the Japan National Railways privatized in 1987. Therefore JR East mainly focuses its investments on an efficient utilization of the station building itself and of its railway tracks. The latter is done by using either the space above or underneath the railway tracks. In addition, the government also seems not to regard the area of Ueno as its priority as no special policies, unlike many other sub centres, were developed for this area.

**An Unbalanced Place; the Case of Urawa Station**

An example of an unbalanced place is Urawa (see figure 5-5). This station should, following the reasoning of the land use transport feedback cycle, either increase its level of train services or develop in a lower-density fashion (in relative terms). Alternatively, a combination of the two is also possible (Reusser et al., 2008). Urawa station is an important government centre as many of the prefecture’s governmental offices are concentrated in the area such as the city hall, the prefectural office and court, and the prefectural library.

Currently Urawa station and the railway tracks within 1.3 kilometres of the station are being elevated. This will eliminate the chronic traffic congestion for cars and pedestrians as they no longer need to wait for closed at-grade crossings. Along with the elevated
railway tracks a new passenger’s platform will be built for the Tohoku passenger and freight trains that currently pass through Urawa station. Also the Shonan Shinjuku line running between Omiya in the northwest of Tokyo and Ofuna in the southwest of Tokyo will be able to stop at Urawa in the future. Previously this was not possible as this line ran on tracks originally laid only for freight trains and therefore platforms were missing. The elevation of the railway tracks will make it possible to increase the number of trains, especially during rush hour. Furthermore, it will improve the access for passengers wanting to travel towards Ikebukuro and Shinjuku as the Shonan Shinjuku line will directly serve both stations from Urawa in the future.

**Figure 5-5  Position of Urawa station in the railway network**

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To be opened by 2015
- Under construction by 2015
--- Existing lines except Tokyo and Yokohama subways
- Prefectural boundary

Source: Adapted from Suga, 2000
In the comprehensive development plan of Saitama city, Urawa station is regarded as one of the urban centres of the city. In conjunction with the railway elevation project the area around the station is being developed. In the vicinity of the station area four development projects are or have been carried out. One project that was completed in 2006 concerns the construction of a residential high-rise building of 31 stories and one of 9 stories. This is a typical example of the many urban developments that have been carried out in recent years around station areas. An explanation for this is that the areas along railways are usually the oldest parts of the city. Here there are still many low-rise high-density wooden areas which are inefficiently used and at the same time vulnerable to damage from earthquakes. In order to make these areas more efficient in terms of land use and layout the low-rises are being replaced by high-rises.

Furthermore, the area around the east exit of Urawa station has been developed. A public square and an underground parking area were completed in 2007. Followed in 2008 by a mid-rise building of ten stories housing a department store, a cinema complex and community facilities.

Taken all together these developments seem to suggest that, at least in absolute terms, the node value will increase and the place value will not increase (no significant growth in workforce) and possibly decrease in relative terms (as the workforce in other station areas is growing). Both values seem to develop in line with the expectations of the node place model. The developments around Urawa station mainly concern residences and therefore hardly affect the workforce concentration and thus the place value as defined in this application of the node place model. Things could, however, change in the future. The prefectural government of Saitama regards Urawa as one of the important urban centres in Saitama and as such it has assigned the station area with higher FAR-values than its surroundings. In this way the government hopes to promote the further development of this area. If this will actually happen remains, of course, to be seen. The railway investments indicate that, at least in absolute terms, the node value will increase which is in line with the expectations of the model. This can be explained by the chronic traffic congestion which made it almost impossible to cross the railway tracks especially during rush hour. Removing this barrier was the only option to eliminate the traffic congestion. In turn the elevation of the railway tracks made it possible to build a new passengers’ platform allowing more trains to stop at Urawa station. JR East may have also been prompted to carry out this investment by the fact that the national and local government provide subsidies for grade separation projects and for the comprehensive improvement of railway stations.
5.5 Discussion and conclusions

The node-place model has been used to gain insight into the development dynamics of 99 station areas in Tokyo. More specifically, it has been used here to explore which transport and land use factors are responsible for structuring station area developments, and to what extent. In addressing the first question, the correlation analysis has revealed that the combination of proximity by rail to the CBD and number of train connections versus workforce (model M14) seems to be the model that has the highest influence on structuring station area developments. In other words, this combination of transport and land use factors is thus evidence of a powerful force shaping station area developments in Tokyo. In order to address the second question, three case studies of station area developments have been further analyzed to find out whether the development path expected by this node-place model is unfolding or not and why. The analysis has demonstrated that, at least in absolute terms, Ueno and Urawa seem to develop in line with the expectations of the node-place model. Here the development dynamics could be explained by following the reasoning of the land use transport feedback cycle, as defined in this paper. In the case of Shinjuku (and possibly Urawa in the future), however, factors that seem to play an important role in the development of the station area fall outside the scope of the node place model and the transport land use feedback cycle. Government policies have played an important role in triggering developments around Shinjuku station (and might be in the future at Urawa station). Both stations were given a special status by the government of which they have greatly benefited in terms of permissible FAR-values. Furthermore local conditions such as chronic traffic congestion, and in the case of Shinjuku station a lack of pedestrian space, and an inconvenient transfer from train to highway buses have further stimulated their development. Finally, also the subsidies provided by the national and local government for the comprehensive development and for grade separation projects have, especially in the case of Urawa station, triggered its development.

As the three examples have illustrated the node-place model is not a model that can ‘predict’ developments, but rather a model that can be used to gain a better understanding of the development dynamics of station areas. Without the node-place model we would not be able to know the relative position of a station within the urban regional network. This would have made it more difficult to explain their actual development patterns. However, also some critical remarks can be made about the node-place model. First, the balancing measures proposed in line with the thinking of the transport land use feedback cycle are not always realistic ones. Reducing transportation services is not a measure that anyone is likely to suggest regardless of market conditions as this would mean a great loss of sunk costs of both transit and built environment investment. Furthermore, downsizing developments is not likely to happen in metropolitan areas that are looking for ways to promote transit-oriented development. In Tokyo, for example, the scarcity of land in especially the central areas would not justify such an approach. In addition, many areas in Tokyo are characterized
by inefficient land uses and an inefficient spatial layout. As was mentioned before, many of these areas are situated along railways and have or are currently being developed. The government is stimulating the development of these low-rise high-density areas by rewarding developers with higher permissible FAR-values for carrying out particular investments (e.g. the provision of a public road or park) in these areas.

Upgrading is, thus, a more likely balancing measure than downgrading. The node-place model might then help identify development opportunities in the metropolitan area. For example, the application of the node-place model in Tokyo identifies a range of locations (the unbalanced nodes and places) that could serve as ‘natural’ alternative development locations for the overcrowded Central Business District. An insight in these alternatives could help the government in promoting a more balanced growth of the Tokyo metropolitan area. More specifically, the node-place model could help realizing the TMG’s city planning vision called the ‘Circular Megalopolis Structure’ (TMG, 2002). This structure focuses on the development of a framework of circular urban axes linking a number of core cities around the central area of Tokyo. The core cities are the places where urban functions should be concentrated, while the urban axes should promote exchange between them. The government hopes that this new structure will help to alleviate the imbalance between the daytime and night-time population (see paragraph 3.1.2). Furthermore it hopes that this structure will contribute to creating a city where work places and homes lie in close proximity. In other words, it means that work is to be promoted outside of central Tokyo and living is to be promoted in the city centre of Tokyo. The node-place model could help by pointing out the locations where opportunities for developing employment or transport services are greater, because there is enough transport provision to accommodate employment growth and vice versa. On the land use side the government could stimulate the development of these locations by assigning these areas with higher FAR-values than its surroundings and by widening the roads to accommodate these more intensive land uses. However, the latter measure in particular can be time-consuming and very expensive as large parts of the built-up area in Tokyo still consist of narrow road patterns. Widening the roads will arouse a lot of opposition from the community, as it can disrupt, complete neighbourhoods, because often houses need to be moved or demolished.

On the transport side the position of stations in the network could be further improved by establishing new connections with other railway lines and extending the number of rapid services, thereby reducing the number of transfers and travel time.
Last but not least, we also realize the limits of the specific application of the node-place model in this paper. Three case studies cannot give a sufficient insight into the development dynamics of station areas within a metropolitan area. For this a more systematic analysis is needed in which preferably developments in all stations belonging to a metropolitan railway network should be analysed. Also, it would be interesting to monitor how stations develop over a period of time as this would indicate whether stations develop according to the node-place model. Such an analysis was carried out in the Amsterdam urban region between 1997 and 2005. The patterns identified seem to confirm the development patterns identified by the node-place model in general terms (Bertolini, 2007). Also, a systematic comparison of the Tokyo application of the node-place model with the Swiss application by Reusser et al., (2008) and the Dutch applications by Bertolini (1999, 2007) would be very interesting. The present applications, however, are too heterogeneous to allow this.