On a Method of Supplying Community Facilities in Residential Areas in New Towns  
- A Case Study in Seishin-Minami New Town -

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Abstract
This research aims at clarifying methods of supplying community facilities in new towns by devising a plan which prepares spaces open in residential areas in advance where some facilities can be developed. We developed a model that calculates the number of facilities built in those spaces using the theory of quantification, after we surveyed several new towns that have been already developed and where some unplanned shops have been located. Since the model can explain the actual locations of the facilities in those new towns, we made a case study on a prediction of facilities development using the model of the Seishin-Minami New Town. Compared with the surveyed new towns and our prediction in Seishin-Minami New Town, we found that it has more community facilities in the residential areas; this result proves the effect of the preparatory development. In conclusion, it is important to supply basic commercial facilities by leaving spaces open in the residential areas in new town projects.

Keywords: number of facilities; location; the theory of quantification; prediction; mixed-use

Introduction
It is most important to consider when and where community facilities should be located in new town projects. However, it is often recognized that publicly-developed new towns were so well-planned that they are not as attractive as existing towns in terms of the diversity of available community facilities¹. This situation has also been seen in new towns in Japan because land-use zones for houses and community facilities are strictly separated in newly-developed towns by utilizing the law of new residential town development projects. Moreover, the law has prohibited facilities such as shops and clinics from being developed in residential areas in such new towns during a fixed period. On the other hand, commercial establishments can be freely built in some districts developed by a land readjustment project. Therefore, it is necessary to investigate how to create attractive and diverse new towns that give the inhabitants an opportunity to select facilities.

Needless to say, since residents living in areas without such facilities seem to evaluate their surroundings as nice and quite, there is a high probability that movement would arise against the deterioration of living environments by the generation of commercial establishments in residential areas. However, areas such as this are inconvenient for the elderly who cannot drive. That is why a method is needed of determining when, where and what kind of facilities should be attracted and developed, which match the surrounding environment.

We have already pointed out in our previous researches (kashihara 1986,1991,1994) that mixed-use in residential areas are needed to solve the above problems in order to make towns convenient with a diverse environment. In addition, we found that some new towns and districts have had commercial facilities located in residential areas by easing the regulations prohibiting commercial establishments.

This report aims to establish basic guidelines on the quantity and the locations of community facilities through a comparative analysis of various new towns by clarifying the planned and unplanned development of commercial establishments in some areas. In addition, we are searching for a prediction method to apply to towns under construction.

Technical terms
Technical terms used in this study are as follows:
1) Community facilities: educational, medical, cultural and retail facilities supplied for the convenience of inhabitants. Those in Table 1 are facilities surveyed in this report.
2) Density of facilities: the number of existing community facilities per unit area (ha).
3) Center: a district center or neighborhood center in a newly-developed town, or a shopping center in a residential development.

Methods
The research flow and the investigation method are shown below:

1) Data collection in various new towns
First, in order to better understand the actual conditions of facilities in various new towns where the development of facilities can be seen, we made up lists of facilities by extracting the names, addresses and telephone numbers of the facilities in the surveyed new towns from classified telephone directories. Then, we plotted the positions of all kinds of facilities on each map of the new towns, and analyzed the spatial distributions of both the public and retail facilities in them.

2) Analyzing by the theory of quantification
It seems that various factors effect the development of community facilities. In this report, we assumed that the surrounding population, land-use zones, distances from the town center and the relation to the main streets figured heavily in the development of facilities. Then, we clarified the relations between the above factors with the numbers and distributions of the facilities in several new towns except Senri and Senboku New Towns. Through analysis of these factors using the theory of quantification, we determined the relations between each item and the numbers of facilities. We also examined the validity of the prediction model by comparing theoretical numbers calculated using the theoretical model and the observed number of facilities.

3) A case study on the prediction of facilities development
After we investigated the contents of the plan for community facilities through communication with the staff of Kobe city hall, we calculated the number of community facilities in each residential area in Seishin-Minami New Town as a case study using the above prediction model before its development in 1989. The model used to predict the facilities development adopted the same four factors: the surrounding population, land-use zones, distances from the town center, and the relation to the main streets. The parameters of the model were derived from the results of the analysis on the facilities distributions in the surveyed new towns.

4) Comparison between the real and the prediction
In 2000, we investigated the actual locations of community facilities in Seishin-Minami New Town in 2000 discovered by using telephone directories and town maps with the exception of facilities located in town centers. Then, we compared the actual numbers and locations of the community facilities with those of the prediction.

Finally, we discussed the development of community facilities in residential areas in new towns.
projects from the viewpoint of mixed-use.

Surveyed areas
1) Senri and Senboku New Towns
Fig. 1 shows Senri and Senboku New Towns, each of which is one of the most representative publicly-developed large new towns in Japan. They were planned in the north and south of Osaka-city, respectively, based on C.A.Perry’s Neighborhood Unit. All retail facilities are in the district centers and the neighborhood centers; few are in residential areas due to strict regulations.

2) Other surveyed new towns
The other new towns surveyed are shown in Fig.2. Since those towns were mainly developed by land readjustment projects, there were many facilities developed with no public regulations.

3) Seishin-Minami New Town
Seishin-Minami New Town, shown in Fig. 3, has been under development by Kobe city in 2000, and is located on a hill in the west of Kobe city about 15km west of Sannomiya, the center of Kobe city. The total area of the new town is about 330ha and its planned population is about 24,000.

Supplying community facilities has been a major plan of Seishin-Minami New Town, which has prepared some spaces open in advance in residential areas where community facilities are to be developed. Its planning has been expected to equip the town with the convenience by avoiding uniform planning of residential areas in the new town, and gives a more natural feeling there. Assuming in this study that unplanned community facilities are developed in some residential sites in Seishin-Minami New Town, we examined where and what kind of facilities needed to be developed in it.

Types of surveyed facilities
Various types of facilities surveyed in Senri and Senboku New Towns and the other new towns are listed in Table 1. It was discovered that most facilities are located in central neighborhood districts, while few are located in the more exclusively residential districts, except facilities such as clinics and schools.

In the investigation of Seishin-Minami New Town, community facilities are clarified in Table 2 according to whether goods or services are offered. In addition, those facilities are classified into two types: Type 1 that provides goods or services necessary for residents’ daily lives, and Type 2 that do not provide them.

Actual distributions of community facilities in Seishin-Minami New Town
1) Types of community facilities developed
Following are three types of community facilities in Seishin-Minami New Town by location.
Type a-1: A clinic located on a specific site in a residential area; two clinics have been located by the developer in Ibuikidaiishi-machi and Ibuikidaihigasi-machi respectively (four clinics in total).
Type a-2: Community facilities located on the first floor of a multi-dwelling house; when these design project for multi-dwelling houses in the new town are carried out, these houses should be planned with shops on the first floor.
Type b: Community facilities located along a main street in a residential area; the easing of regulations on location of community facilities by using the district plan enables such facilities to be built on a block facing a main street.
Type c: Community facilities built on an upper floor of a multi-dwelling house or anywhere in a residential area without a plan; this is a completely unplanned facilities located according to the resident’s intention.

Type a was invited by the developer, type b was built on a housing sites, which had been reserved for developing a shop by the district planning, and type c

Table 1. Density of community facilities

| category of business | use zones | use zones | use zones | use zones |
|----------------------|-----------|-----------|-----------|-----------|
|                      | Category 1: | Category 2: | Residential | Neighbor- |
|                      | Exclusively | Exclusively | district | hood | Mean of |
|                      | residential | residential |         | central | all zones |
| supermarket          | 0.00       | 0.00       | 0.06      | 0.28    | 0.02    |
| coffee shop, snack bar| 0.04      | 0.03       | 0.40      | 0.59    | 0.08    |
| restaurant, sushi shop| 0.05      | 0.04       | 0.38      | 0.61    | 0.09    |
| watch, glasses, and camera | 0.02   | 0.02       | 0.11      | 0.14    | 0.03    |
| barbershop, beauty parlor | 0.05    | 0.01       | 0.28      | 0.48    | 0.07    |
| cleaners             | 0.04       | 0.03       | 0.09      | 0.21    | 0.05    |
| physicians or dentists| 0.09      | 0.03       | 0.27      | 0.22    | 0.08    |
| drug store, cosmetic shop| 0.02    | 0.01       | 0.06      | 0.18    | 0.02    |
| cram or culture school| 0.11      | 0.03       | 0.13      | 0.29    | 0.10    |
| general store, stationary| 0.01    | 0.00       | 0.04      | 0.13    | 0.02    |
| grocery store        | 0.07       | 0.04       | 0.32      | 0.49    | 0.09    |
| clothing shop        | 0.02       | 0.02       | 0.11      | 0.22    | 0.03    |
| book store, record shop| 0.00      | 0.01       | 0.06      | 0.18    | 0.02    |
| other offices        | 0.22       | 0.08       | 0.87      | 0.75    | 0.23    |
| other facilities     | 0.16       | 0.11       | 0.76      | 0.97    | 0.21    |

Total: 0.91 0.45 3.95 5.73 1.15

[density] = [number of facilities] / [district area (ha)]
was not contained in the development plan of community facilities in advance.

2) Actual distribution of community facilities

Community facilities came to be seen in residential areas at the time of research seven years ago since the development of the new town in 1993. Those facilities were introduced by using three methods in Seishin-Minami New Town: the planned development, the unplanned development and the reservation of sites for developing shops through deregulation as described above.

Table 2 shows the number of community facilities by industrial classification and Fig.4 shows their distributions. It was found that some facilities were built on the first floors of multi-dwelling houses facing the Ibuki-chuo Line by the plan in advance (see Photograph 1).

Moreover, shops in specific districts, such as an internal medicine clinic and a dental clinic have opened in Ibukinishi-machi, and an internal medicine clinic has opened in Ibukihigashi-machi as well.

Community facilities have also been built in a district of low-rise housing due to a deregulation of district planning. In particular, in the residential area facing the Ibuki-Chuo Line in Ibuki-nischimachi, community facilities have been built on nine to twenty sites. This has created a busy atmosphere (see Photograph 2).

According to Table 2, there are eighteen community facilities in the residential district consisting of low-rise housing. Thirteen community facilities have been built due to deregulation. Since 139 sites in the residential district consisting of low-rise housing have already been built, the rate of development, meaning the number of community facilities per number of house sites is 9.4%. Many of these are service facilities including cleaners and beauty parlors. Moreover, unplanned community facilities are limited to schools, special good shops, and type 2 facilities.

3) Comparison of Seishin-Minami New Town and Senri and Senboku New Towns

We compared the actual numbers of facilities in Seishin-Minami New Town with those in Senri New Town and Senboku New Towns, both of which were developed by the new residential town project.

Fig. 5,6,7 and 8 show the density of facilities, which means the number of facilities per 1,000 inhabitants in each new town. It is shown in Fig. 5 that densities of restaurants and commodity retailers in the district center in Seishin-Minami New Town are smaller than those in the other new towns. On the other hand, it is shown in Fig.7 that the densities of commodity retailers and services in residential areas in Seishin-Minami New Town are grater than those in the Senri and Senboku New Towns, while the densities of type 2 are smaller than those of these two new towns.

Because parts of the center of Seishin-Minami New Town is under construction, the densities of many types of facilities such as daily goods shops in it are not as great as those of the other new towns. However, some types of shops such as cleaners and cultural facilities are larger than those of the other two new towns. It is presumed that the method of reserving sites for shops is effective on the view of rising
number of facilities.

**Analysis using the theory of quantification 1**

Prior to the analysis, each of the surveyed new towns was divided into small areas. Fig. 9 is an example of the division of the new town created by a private developer and located in the suburbs of Osaka city. Then, by using the theory of quantification [1, 2], the number of facilities was estimated. Each multiple correlation coefficient is tabulated in Table 3, which expresses the strength and weakness of the relation between the actual numbers of facilities observed and the theoretical round numbers of facilities calculated by the theory of quantification. It was found that most of the values stand at more than 0.5, and some stand at more than 0.8.

**Prediction of development of facilities**

1) **Calculation of total numbers of facilities**

The total numbers of facilities in Seishin-Minami New Town is calculated by the following equation (1) on the basis of the population (see Fig. 10) and the density of facilities (see Table 1).

\[
N_i = M_i \cdot \frac{Z}{Z_o} \quad \text{(1)}
\]

Where
- \(N_i\): each number of generated facilities of business category i in Seishin-Minami New Town
- \(M_i\): total number of existing facilities of business category i in the surveyed new towns

2) **Prediction of distribution of facilities**

The number of facilities at each divided area in Seishin-Minami New Town is calculated by following equation (2) on the basis of the category values obtained through the analysis by the theory of quantification.

\[
Y_m = C + C_{A1} \cdot X_{1m} + \cdots + C_{An} \cdot X_{nm} \quad \text{(2)}
\]

Where
- \(Y_m\): the number of facilities in the divided area m in Seishin-Minami New Town
- \(Z\): the population of Seishin-Minami New Town
- \(Z_o\): total population of the surveyed new towns

![Fig. 5. Density of facilities in the district centers](image)

![Fig. 6. Density of facilities in the neighborhood centers](image)

![Fig. 7. Density of facilities in the residential areas](image)

![Fig. 8. Density of facilities in the whole areas](image)

![Fig. 9. An example of division](image)
The community facilities in each area on the basis of the calculated values rounded off to the decimal point are allocated. As a result, the following is inferred:

a. It was found that supermarkets and various kinds of retail facilities aggregated in the 47th and 48th areas, where the train station is located and the land-use zone for commercial use is allocated.

b. Retail facilities were apt to be developed on streets connecting district centers and inner residential areas, or streets running along the edges of the new town.

c. It was also found that facilities such as culture schools, cram schools, various offices and clerens were developed in residential areas as well as district centers.

### Comparative analysis on number of facilities

#### 1) Predictions and actual conditions of community facilities in Seishin-Minami New Town

The results of the prediction of the development of community facilities in 1989, shown in Fig. 11, show that many shops were built along the main street that runs parallel to the Ibuki-Chuo Line. Since the green belt was prepared between the main street and the residential areas in the actual plan, access to each site is limited from inside the residential area. Therefore, few community facilities were actually built. In short, each design of the approach space from the main street to the site seemed to influence the development of facilities.

Moreover, it was found that there seemed to be differences between the prediction of shop locations and the actual distribution of shops. It seemed to be

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**Table 3. Multiple correlation coefficients of community facilities in the surveyed new towns**

| Category of business | A    | B    | C    | D    | E    | F    | G    |
|----------------------|------|------|------|------|------|------|------|
| supermarket          | 0.82 | 0.79 | 1.00 | 0.86 | 1.00 | 0.47 | 0.54 | 0.61 |
| coffee shop, snack bar | 0.82 | 0.71 | 0.95 | 0.66 | 0.91 | 0.66 | 0.66 | 0.57 |
| restaurant, sushi shop | 0.67 | 0.69 | 1.00 | 0.37 | 0.85 | 0.50 | 0.50 | 0.43 |
| watch, glasses, and camera shop | 0.64 | 0.74 | 0.87 | 0.47 | 0.92 | 0.41 | 0.70 | 0.33 |
| barbershop, beauty parlor | 0.67 | 0.77 | 0.89 | 0.47 | 0.98 | 0.57 | 0.70 | 0.49 |
| laundry              | 0.59 | 0.75 | 0.57 | 0.87 | 0.43 | 0.61 | 0.31 |
| physician's or dentist's office | 0.44 | 0.82 | 0.36 | 0.56 | 0.62 | 0.52 | 0.70 | 0.34 |
| drug store, cosmetic shop | 0.80 | 0.80 | 0.87 | 0.39 | 0.72 | 0.50 | 0.61 | 0.45 |
| cram school, culture school | 0.54 | 0.81 | 1.00 | 0.58 | 0.42 | 0.46 | 0.55 | 0.41 |
| general store, stationary shop | 0.57 | 0.80 | 1.00 | 0.53 | 0.81 | 0.33 | 0.64 | 0.34 |
| grocery store        | 0.62 | 0.71 | 0.95 | 0.53 | 0.93 | 0.41 | 0.77 | 0.40 |
| clothing shop        | 0.58 | 0.59 | 1.00 | 0.55 | 0.91 | 0.31 | 0.60 | 0.35 |
| book store, record shop | 0.48 | 0.72 | 1.00 | 0.54 | 0.91 | 0.59 | 0.67 | 0.46 |
| other offices         | 0.66 | 0.88 | 0.95 | 0.51 | 0.43 | 0.51 | 0.70 | 0.43 |
| other facilities      | 0.68 | 0.73 | 0.88 | 0.53 | 0.83 | 0.45 | 0.63 | 0.42 |

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**Fig. 10. Distribution of populations in Seishin-Minami New Town**

![Fig. 10. Distribution of populations in Seishin-Minami New Town](image)

**Fig. 11. Prediction of developments of facilities**

![Fig. 11. Prediction of developments of facilities](image)
derived by the assumption in the prediction that the Seishi-Minami New Town was developed by the land readjustment project, which has no regulations on the location of facilities, while the actual development is under the auspices of the new residential town development project, where regulations were lessened only in the residential districts of low-rise housing established by the district plan. In addition, the fact that there was not enough time to locate shops also seems to cause the differences.

2) Summary of methods of supplying facilities

Finally, we tried to summarize our ideas concerning methods of supplying community facilities in Fig.12. Many built-up areas have facilities developed with small regulations, while most new towns have facilities planned strictly in advance. We propose a third method “preparatory development”, which means leaving space available in advance for the development of facilities.

The methods adopted in Seishin-Minami New Town are summarized as follows:

a. Planned invitation:
   This is a method of supplying community facilities by planned invitation. By this method, some shops on the low floors of multi-dwelling houses and clinics in residential areas have been developed. It has a planned mixed-use.

b. Preparatory development:
   This method requires the district plan to lessen regulations prohibiting facilities to be built along main streets in the new residential town project, and allows facilities to be built only in residential areas with detached houses. This method concerns both planned and unplanned development in that some space is reserved at the beginning of the new town’s development, which keeps open the possibility of extra facilities being built by the property owner. This is expected to result in a mixed-use community.

c. Unplanned development:
   This method leaves the development of facilities completely up to the property owners with no regulation involved. Some shops are built in residential areas and within the multi-dwelling houses in Seishin-Minami New Town. Such unplanned building can be seen in various new towns developed by the new residential town project and it might be considered a non-desirable mixed-use practice.

Conclusion

1) The development of community facilities in the surveyed new towns was analyzed using the theory of quantification. It was found that the four factors used in the analysis; the surrounding population, land-use zones, distances from the town center and the relation to the main streets, can explain how facilities are developed. In particular, zoning is one of the factors that have more influence on the development generation of facilities than any other factor.

2) The model used by the theory of quantification presented in this report proved to be useful as an explanation model by comparing the number of facilities estimated by the model with that of the facilities observed in the surveyed new towns.

3) Through comparative study of the number of facilities predicted in advance before development and that of the observed facilities in Shishin-Minami New Town, it was clear that the model can predict the location of the community facilities generated spontaneously. In addition, it was also found that many kinds of facilities would be built on reserved sites and along main streets.

4) Finally, we tried to summarize our ideas of methods for supplying community facilities. In addition to two existing methods, “Planned Invitation” and “Unplanned Development”, we proposed the third method named “Preparatory Development”, which means leaving desired space open in advance for facilities.

Needless to say, in order to understand the process of development, it is essential to analyze it from diverse points of view including geographic, social and economic. As an initial step in this study, we discussed the fluctuations of both the numbers of generated facilities and their spatial distributions.

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Notes
1. Jane Jacobs is famous for her insistence on the need for diversity in town (Jacobs, 1961). The essence of Peter Blake’s criticism on New Towns and zoning (Blake, 1977), and of Richard Senatt’s The Use of Disorder (Senatt, 1970) is criticism on over calculated planning of towns and cities.
2. The model expressed by the theory of quantification 1 is as follows:

\[ Y_m = C + CA_1 \cdot X_{1m} + \ldots + CA_n \cdot X_{nm} \]

Where
- \( Y_m \): estimated number of facilities in divided area \( m \) (dependent variable)
- \( C \): weighted mean of \( Y_m \)
- \( CA_n \): category weight of category \( n \)
- \( X_{nm} \): \( =1 \), if \( m \) belongs to category \( n \)
- \( =0 \), if \( m \) does not belong to category \( n \)

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