An Empirical Analysis on the Structure of Facility Accumulations by Comparison of 8 Cities

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Many city centers decline and become homogenized because of depopulation, an aging population combined with a diminishing number of children, and uniform urban development. In these situations, generally, attempts are made to reinvigorate city centers by changing and extending the use of existing buildings, e.g., for community development and renovations;however, there are many cases in which such changes do not last or have a lasting impact around the facility. These well-intentioned activities do not often function well because we do not clarify the mechanism of facility accumulation as what is gathered together by individual facilities; thus, we cannot introduce facilities and policies that generate an overall improved livelihood. Present city centers already comprise various facilities. Given large- or small-scale developments in a city center, we must attempt to create or extend facilities in existing facility groups. The mechanism behind facility accumulation focused on individual facilities is useful knowledge for efficiently revitalizing a city center that does not generate a strong enough livelihood from individual facilities but shares a livelihood with surrounding facilities.

In this paper, we attempt to empirically clarify the latent attributes that can explain the mechanism of facility accumulation based on facility co-occurrence information in city centers and find common latent attributes and structure of facility accumulation by comparing properties of latent attributes and co-occurrence relations between them of each city center.

We express facility accumulation as the facility co-occurrence network that consists of nodes representing facilities and links representing co-occurrence information between such facilities; we solve the inverse problem by estimating latent attributes of facilities that generate a facility co-occurrence network. This approach is workable by applying a framework based on the stochastic block model proposed by Nowicki and Snijder[**?**] to the facility co-occurrence network generated only by location information of facilities. This approach enables us to classify latent attributes that generate facility accumulation into several types. The discovery of a new facility classification axis enables us to grasp quantitative properties of facility accumulation, i.e., (1) properties of latent attributes, (2) co-occurrence relations between attributes, we estimate latent attributes of facilities that generate facility accumulation and empirically clarify the quantitative and qualitative properties of the mechanism of facility accumulation as a case study in city centers of Japan.

We clarified that (1) Regarding the latent attribute, each such attribute quantitatively has properties in terms of characteristic business types. Further, each latent attribute can be interpreted by these quantitative properties. (2) Regarding the relation between latent attributes, facility accumulation can be expressed by the co-occurrence relation between latent attribute, enabling us to grasp a latent structure of facility accumulation that eliminates positional information from co-occurrence information between facilities. (3) There are common latent attributes and latent structures of facility accumulation.

References

[1] Nowicki, K. and Snijders, T. A. B. :Estimation and prediction for stochastic blockstructures, *American Statistical Association Journal of the American Statistical Association*, Vol.96, No.455, pp.1077-1087, 2001.