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Research on the Development of Building Age Indicators Using Building Register Data

송유미 Song, Yumi
조영진 Cho, Youngjin
안의순 Ahn, Euisoon

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SUMMARY

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Song, Yumi
Cho, Youngjin
Ahn, Euisoon

Buildings are an integral part of our daily lives, and the construction and distribution of buildings for various purposes reflect the status of a region and can reveal the unique characteristics of that region. This information on building distribution and performance serves as supporting data for regional policies and project implementations. In particular, for aging buildings, their condition is closely related to the safety of residents, making it a crucial factor in selecting many policies and projects. Therefore, an intuitive understanding of information on the status of aging buildings is crucial for policy decision-making.

However, the current information on aging buildings is provided in a fragmented manner based on specific points in time regarding their level of deterioration, making it difficult to forecast future trends in policy implementation targets. Therefore, in order to support the establishment of data-driven architectural policies, there is a need for intuitive and objective data that can identify the medium- and long-term deterioration and characteristics of buildings. In addition, for the implementation of medium- and long-term policies, it is necessary to develop methods to track changes in buildings and predict future trends.

This study aims to develop indicators that can identify the aging characteristics of buildings in a region by using building administration data. To convey the developed indicators effectively, the study also proposes visualized data, explores correlations with regional characteristics through clustering and analysis in conjunction with other statistical indicators, and seeks ways to use these indicators to assist in regional policy implementation.

Information relating to the elapsed years of buildings is confirmed to be comprehensively collected through the SEUMTER (national administration for houses & buildings). The data on building age by elapsed years, which can identify building age, are provided only as supplementary materials in press releases or public metadata. These data are presented as simple figures regarding the total number of buildings or total floor area, which limits users' ability to comprehend and use the information quickly. Using building age data, which are national core data, requires users to possess proficiency in spatial data programs and data analysis. According to legal standards, the age and service life of buildings are verified to determine the number of aged buildings. The primary data used to assess the aging of a building are its date of approval for use (or the date of inspection for use) or its completion date. The level of the deterioration of buildings is used as a supporting data for implementing policies and projects, primarily relying on figures published in press releases and statistics. In particular, the elapsed service life and aging status of housing have been found to be used in construction and urban planning, indicating that there is a greater focus on residential buildings, which directly impact daily life and quality of life.

It has been observed that there is considerable public interest in the aging of buildings, and building age can serve as a key indicator for analyzing various social phenomena such as the real estate market and energy usage. Therefore, it is deemed necessary to provide intuitive and highly reliable information on building age to facilitate its application in policymaking and project implementation.

Therefore, this study aims to produce information relating to building age that can be used in institutional and project initiatives. The term "building age" used in this study refers to the physical elapsed service life, serving as data to assess the aging and deterioration of buildings.

The analysis of building age data is based on the December 2023 building registry data.

The usage of buildings is categorized into residential types, which serve as places for people's living, and non-residential types, which are used for various economic, social, and cultural activities. The status of buildings is aggregated based on area rather than the number of buildings. Buildings without a recorded date of approval for use in the building register are excluded from the analysis, as their age cannot be estimated. In buildings where there are errors in the recorded types of approval dates for use, the year is estimated based on the specific circumstances. If estimation is not possible, those buildings are also excluded from the analysis. Outlier data exhibiting abnormal distributions undergo data cleansing to process them into an analyzable format.

Descriptive statistical analysis can be conducted by using data extracted from building registers regarding the age of building areas by their usage. The average total floor area refers to the average value of the total floor area per floor for buildings in a given area. By analyzing the average total floor area, the general size of buildings in the area can be estimated. The average age refers to the mean value calculated based on the total floor area of buildings according to their year of approval for use. Unlike the conventional percentage of aging buildings, the average age can provide new insights into the level of deterioration of buildings in the area. The median age refers to the value obtained by converting the year of approval for use of the building that is positioned in the middle when all buildings are arranged according to their approval dates. Unlike average age, the median age is not influenced by total floor area. The aging acceleration indicates the rate at which the aging of buildings progresses, whether quickly or slowly. It is calculated based on the slope value of the trend line for the floor area distribution of buildings aged from 0 to 30 years.

A building age pyramid chart was created to represent visually the age structure of buildings in local municipalities, based on extracted building age data. As the building age pyramid varies in the numerical values of floor area by age, depending on the range of the expressed regions, a graph representing the distribution ratio of floor area by age was created to facilitate intuitive comparisons of the structural composition. A higher-level regional graph is placed in the background, allowing for a quick overview of the relative age distribution of the regions. The data on the left side are categorized as non-residential buildings, while the right side represents residential buildings. In addition, relevant data such as average age, median age, and aging acceleration are displayed for easy viewing at a glance, along with numerical data.

The age structure of buildings shows variations in area distribution across different local governments, depending on the policies or projects being implemented in those regions. Metropolitan and provincial areas tend to exhibit building area distributions that closely resemble the national pattern, as they are less influenced by local factors compared to smaller administrative units, such as cities, counties, and districts.

As such, the building age structure shows variations by region, and these differences become more apparent as the resolution of the regions increases. This indicates that the age structure can be considered one of the characteristics used to understand the regions.

Therefore, this study proposes the building age indicator as a policy indicator that can be used in architectural and urban policies. This indicator can be applied during the stages of policy development and the analysis of issues relating to urban, social, and economic phenomena.

This study proposes the average age of buildings as the building age indicator. The building age indicator provides information on the age status of buildings in a specific area or city, and the average service life is calculated by using statistics based on the total floor area of buildings categorized by their usage and date of approval for use in that region. This indicator can be used as a diagnostic tool for assessing the aging of local buildings and urban areas. Also, it can be used as a diagnostic tool for building safety and management by linking the degree of aging of buildings with their characteristics, such as structure and usage, through the analysis of the indicator.

When examining the age structure of buildings, some local governments exhibit similar patterns. Therefore, this study explores the potential of using building age structures for understanding the characteristics of cities, counties, and districts through clustering-based categorization.

The hierarchical cluster analysis method was conducted to cluster the building age structures by region. When classifying the local governments for residential and non-residential buildings, four clusters of residential buildings and four clusters of non-residential buildings were formed. When combining the residential and non-residential clusters, a total of 13 combinations of building age structure distribution clusters were identified.

Comparative statistics were collected by adding statistical tables from KOSIS (Korean statistical information service), which provides data at the city, county, and district levels, along with processed data used in the comprehensive (quantitative) indicator for areas experiencing population decline, designed to facilitate inter-regional comparisons.

The population-related characteristics among regional statistics were associated with the classification of residential building clusters, and economic characteristics also appeared to have some relevance. Regarding economic characteristics, they seem to be somewhat influenced by the clusters of non-residential buildings.

While clustering by region is possible for the building age structure, due to the strong influence of each area's unique characteristics, it is difficult to classify the distribution graphs of building floor areas across the regions perfectly. Many areas with similar policy targets, such as newly developed cities and regions experiencing population decline, are often grouped into specific clusters, but some are classified into different clusters. Therefore, it may not be appropriate to generalize these findings hastily. Although the age-related patterns of buildings can provide a brief overview of the population structure and economic conditions of the area, it is essential to interpret the meaning of this distribution by including additional analytical work, such as changes in the surrounding circumstances.

This study aims to present the building age indicator, a new analytical resource relating to the aging of buildings, as part of the regional characteristics data. The building age indicator represents the average age of regional buildings, which is calculated by applying weight to the floor area in relation to their service life. Furthermore, by providing supplementary data relating to building age, such as median age and aging acceleration, this indicator enables a more detailed understanding of the annual distribution status of buildings. The status of age distribution of buildings is presented in an intuitive format, similar to a population pyramid, allowing information users to grasp the data easily. This approach goes beyond merely identifying the quantity of aged buildings, enabling a multidimensional interpretation of the extent of building aging.

The building age structure can provide a basis for inferring the status of a region, serving as supplementary material for gaining a brief overview of the population and economic conditions. However, to assess the situation in a region accurately, it is essential to examine the social environment, policy directions, and other specific factors in detail.

The produced building age indicator and various age-related data can be used during the analysis phase of status assessments for the construction and implementation of urban projects, such as regional architectural master plans, as well as for policy formulation. Also, it can be useful in the process of selecting locations for the establishment of regional building safety centers by providing a multifaceted view of the state of aging buildings.

In addition, the process of identifying the aging status of local buildings should consider not only the number of buildings but also their area-based status. To ensure the ongoing quality management of building data and to produce relevant statistics along with meaningful interpretations, it is essential to establish or designate an organization or personnel capable of performing these tasks professionally, such as the Building Statistics Center (tentative name).

This study is significant in that it presents objective new metrics by using publicly available data and national statistics to identify the aging status of local buildings. However, it has certain limitations due to the quality of the raw data and the lack of available information. First, this study has restricted the classification of building use to residential and non-residential categories. Next, the analysis point is fixed at the end of December 2023. Third, there were limitations in the collection of statistical data for regional characteristics analysis. Finally, the methodologies used for outlier detection and clustering were limited. Future attempts to apply various methods could help enhance the quality of the building age indicators.

Keywords :

Policy indicators, Building statistics, Building age