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A Study of the Adaptive Reuse for School Land Use Strategy: An Application of the Analytic Network Process and Big Data

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***Abstract*—**In today's popularity and progress of information technology, the big data set and its analysis are no longer a major conundrum. Now, we could not only use the relevant big data to analysis and emulate the possible status of urban development in the near future, but also provide more comprehensive and reasonable policy implementation basis for government units or decision-makers via the analysis and emulation results as mentioned above. In this research, we set Taipei City as the research scope, and use the relevant big data variables (e.g., population, facility utilization and related social policy ratings) and Analytic Network Process (ANP) approach to implement in-depth research and discussion for the possible reduction of land use in primary and secondary schools of Taipei City. In addition to enhance the prosperous urban activities for the urban public facility utilization, the final results of this research could help improve the efficiency of urban land use in the future. Furthermore, the assessment model and research framework established in this research also provide a good reference for schools or other public facilities land use and adaptive reuse strategies in the future.

***Keywords*—**Adaptive reuse, analytic network process, big data, land use strategy.

I. Introduction

CHANGE in urban planning methods are mostly derived from technological innovation and changes in urban development patterns. Both information technology and urban development patterns have witnessed substantial changes from the past since the turn of 21st century, resulting in challenges in existing urban planning methods. The current urban development situations reveal that demographic change has become an imperative topic in urban planning. In addition, demographic change will affect both urban infrastructure plans and strategies. Therefore, how to formulate feasible coping strategy in response to demographic change has become a topic worth of academic attention.

Summarizing urban development issues and devising strategies require detailed data surveying and analytical techniques as the reference. In the past, surveying and analysis of the urban activities were mostly relied on manual operation, and the substantial resources such as required time, money, and labor costs spent in the planning process. However, the lack of comprehensive analysis and planning will lead to a major gap between the planning results and project objectives or civilian needs. With the current technological advance, data surveying and analysis are no longer a change. Because information technology has enabled urban planners to obtain diverse reference data for urban planning applications, the concept of data management has been conceived.

This study collected data from a multidimensional database to estimate and analyze various urban planning indicators, and the analytical results may serve as a reference for adaptive reuse planning strategies. The big data analysis may reflect the trends of urban activities and serve as a reference for decision making. Objective and scientific decision model should be applied during decision-making process to mitigate the drawbacks in past urban planning projects in which conformity to the leaders' or planners' ideas was prevalent. In addition, this study was carried out in response to the conflict between land use issues of public elementary and junior high schools and the social phenomena of aging and sub-replacement fertility in Taiwan. Under this agenda, both the central and local government agencies have begun to implement campus revitalization strategies and urban zoning reviews despite maintaining the existing planning methods. Therefore, this study focused on campus reuse strategies and reviewed the newer planning and decision models using big data and ANP before proposing a new operating procedure of urban planning.

II. Literature Review

Currently, adaptive reuse problems in Taiwan are mostly solved by classifying the target land first before reuse or revitalization strategies are devised. Scholars have proposed various definitions of adaptive reuse. For example, Langston et al. [1] argued that adaptive reuse strategies are a part of renovation process mainly to ameliorate economic, environmental, and social performance of a building. Bullen and Love [2] noted that adaptive reuse strategies transform disused or ineffective buildings into new buildings that can be used for a different purpose.

According to the aforementioned literature, adaptive reuse can be defined as "repurposing the economic, environmental, and social value of an existing building for the chance to be used again by occupants or exploit its value." The original purpose of zoning land lots for public facilities is to serve the general public. Therefore, adaptive reuse of public land not only repurposes the land, but also compensates the lack of public facilities in a community to improve the service functions of the community.

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Currently, studies on adaptive reuse of school land in Taiwan have mostly focused on repurposing vacant space rather than comprehensive replanning and construction of the entire tract of land lot [3]. However, despite the dearth of literature on adaptive reuse of school land, the planning and review process of school land reuse in Taiwan can be further explored. In addition, the Construction and Planning Agency of the Ministry of the Interior (CPAMI) in Taiwan published [4] A Study on Principle for Over All Criticism of School Facilities in Aged Society in 2000 in response to future surplus of school land caused by change in demographic structure. The report stated that school land usage in Taiwan may adopt the practice in Japan, which integrated school reuse with local communities by combining aspects of continuing education, open campus space, and multipurpose campus facilities. Therefore, the discussion of school land reuse strategies must review the zoning plan aspects. Ultimately, revitalization strategies for vacant land and space, regardless for commercial, industrial, tourism, education, or social welfare purposes, are intended to enhance, update, or repurpose the buildings in question through the transformation of land or space usage. The assessment of overall community and urban development needs is required in functionality reviews to prevent vacant facilities in the future.

In Taiwan, the Ministry of Education (MOE) is the central government agency in charge of merging schools, whereas the CAPMI is responsible for reviewing the facilities and land usage. Currently, the principles of school land revitalization strategies in Taiwan are mainly based on the *Implementation Plan of Campus Space Diversification* issued by the MOE. According to the plan, local government agencies (e.g., city and county levels) may propose their own revitalization strategies for vacant junior high and elementary school space within their subdivision. The principles of the central government and the regional revitalization strategies devised by local government units are summarized in this section. The MOE proposed a three-year master plan for campus space revitalization between 2007 and 2010. Under this program, the MOE proposed five projects as follows: (a) repurposing vacant campus space as community learning centers, (b) establishing leisure sports facilities in primary and secondary schools, (c) expanding digital opportunity centers in rural schools, (d) revitalizing vacant space as innovative bases for sustainability and energy conservation, and (e) implementing campus revitalization plans for public junior high and elementary schools and developing specialty schools. With these five projects, the MOE aimed to achieve five goals as follows: (a) revitalizing idle campus space and maximizing its usage, (b) creating new educational value by integrating local resources and demand, (c) accomplishing universal access of learning and diversifying educational functions, (d) establishing excellent interactions between schools and local communities, and (e) implementing sustainable education. The MOE vows to provide a firm direction for sustainable usage of campus resources. Currently, the *National Primary and Secondary School Equipment Standard* published by the MOE determines the lot size of junior high and elementary school land in Taiwan. Generally, vacant land is defined as the economically inefficient land attributed to decreased users, improper use, limitation by building codes, disrepair, and insufficient maintenance funds [5]. Since the promulgation of the Implementation Plan of Campus Space Diversification, county and city governments have employed this policy to devise principles of relevant works or develop plans according to the need within the administrative subdivision. However, the implementation plan does not explicitly enforce that campus space revitalization strategies are solely employed to meet the agenda of the central government, and county and city government agencies may promulgate revitalization provisions specific within their administrative subdivision under the guidance of the implementation plan devised by the MOE. The present study summarized the purposes of converted school space according to the published campus space revitalization plans by local government units, including early childhood education, elderly social welfare facilities, social education facilities, arts institutions, educational resource centers, after-school counseling, education for the underprivileged, youth entrepreneurship centers, public housing, and other public projects [6].

The above reviewed literature revealed that to avoid inefficient usage and vacancy of facilities, local development must be considered carefully during the facility planning process as well as remained the function of the facilities. However, reviews of project revision or multifunctional usage of public facilities require a rigorous and prudent assessment. A comprehensive data analysis enables the planning content to meet the development needs. As the existing analytical methods have shifted towards big data applications, the present study employed the features of big data to conduct research and analysis on revitalization strategies for vacant school space in Taiwan.

The present study aimed to use various urban activity data to predict the usage of various facilities and demographic statistics at various time points in the future, which are required in urban planning operations. Kitchin [7] stated that big data may provide raw materials for urban governance and develop a feasible, sustainable, and highly transparent city management strategy. Neirotti [8] argued that the data variables generated under the development of smart cities may serve as a reference for policy makers and city managers. Rathore et al. [9] asserted that a smart city management plan based on the Internet of things favors efficient urban activities and city governance. These studies have revealed that the primary data application in urban management is mainly to provide a reference for policy making or governance policy, which is the concept of evidence-based government. Under this philosophy, big data will become the basis of urban governance and strongly support policy implementation and promotion.

Currently, how to utilize data for urban governance planning is still hotly debated, but temporal and spatial records on movement of people and objects remain the primary source for data analysis. These data are continuously updated and accumulated in every minute and second. Therefore, the

temporal and spatial records of human activities in a city can be employed to investigate the characteristics and spatial distribution of human activities and serve as a reference of urban planners. However, big data can be applied in policy making via useful and helpful raw data as well as spatial information such as personal household registration information, public facilities usage, and medical information. Collecting and presenting these spatial data also facilitate spatial planning. In addition to hotspot analysis, the voluminous data may be used to estimate the amount of urban activities, enhancing the accuracy of big data-based analytical results.

III. Research Design

This study primarily used the time series and ANP methods to conduct the research and obtain the reference data suitable for the empirical area. These two methods accomplished two primary objectives as follows: (a) predicting the future information of the empirical area and (b) providing an objective decision-making appraisal. The research steps and procedure are presented in the following figures:

Step1. Propose a land reuse plan for the future need in the empirical area.
Step2. List the indicators required for the reuse plan and collect the relevant data.
Step3. After sorting and classifying the obtained data, estimate each indicator using the time series method.
Step4. Utilizing ANP approach to develop and analyze the expert questionnaire.
Step5. Devise a feasible reuse strategy according to the ANP results and the need in the empirical area.

The flowchart of research steps is shown in Fig. 1.

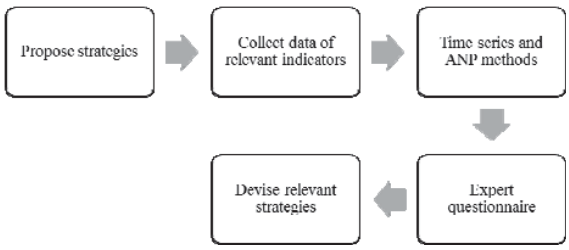

Fig. 1 Flowchart of research steps

IV. Empirical Study and Analysis

A. Definition and Scope of Empirical Research Subject

Although the objective of this study was to investigate school land reuse strategies, school land can be classified according to its usage (e.g., college, high school, junior high school, and elementary school). Because only junior high and elementary school lands are subject to urban planning laws in Taiwan, this study focused on these two types of school land as the empirical subjects. Given the constraint of data acquisition, this study limited to the schools in Taipei City as the empirical scope.

B. Indicators for School Land Reuse Strategies and Scheme Construction

The indicators and scheme construction for land reuse strategies are closely related in this study. The indicators and schemes were established through a literature review. Because this study aimed to provide a reference for land reuse planning through big data analysis, a series of quantifiable indicators were constructed. Therefore, to achieve the principle of serving the general public, efficient facility usage, and social fairness, this study summarized three indicators through a literature review comprising demographics, facility usage, and social welfare policy assessment.

According to the aforementioned literatures, demographic analysis in urban planning should shift the focus from historical and estimated total population to the composition of population. Therefore, to account for the composition of population, this study divided the demographic indicator into youth, adolescent and adult, and senior population. In addition, the efficiency of facility usage should be accounted for during the planning reviews to avoid a surplus of identical facilities and reoccurrence of vacancy. For this reason, this study divided the facility types into three categories consisting of facilities for children, senior citizens, and vocational training. Consequently, the indicators of facility efficiency comprised the usage of the three aforementioned categories.

Because the construction and allocation of public facilities need to be adjusted according to the public policies promoted by the government, low-income household, unemployment rate, and rental population are extremely crucial indicators of social welfare policies. Therefore, to meet the principle of social fairness, this study employed these three indicators to examine the social welfare dimension in the subsequent analysis. Finally, through the literature review and deduction, this study summarized the indicators into three dimensions consisting of demographics, facility usage, and social welfare, which were further divided into various indicators to accommodate various considerations, as shown in Table I.

C. Assessment of School Land Reuse Strategies

The reuse strategies investigated in this study were established after existing laws and policies in Taiwan were reviewed. Empirical studies have demonstrated that vacant campus space utilization in Taipei City has been regulated in a principled approach. Therefore, this study devised alternative reuse strategies under the principle of meeting the Taipei City Government's agenda on major policies, social development, and community needs. According to the public facility and campus reuse strategies developed by municipal governments, existing examples of campus revitalization, and policies that the government intended to promote, the reuse plans within the empirical area in this study can be classified as: (a) early childhood education and after-school care facilities, (b) community health care facilities (c) vocational training institutions, and (d) public housing.

TABLE I
DESCRIPTIONS OF INDICATORS

Dimension	Indicator	Description
A. Demographics	A-1. Youth	Youth population is the population between age 0 and 14 and is subject to the provision of the Protection of Children and Youths Welfare and Rights Act.
	A-2.Adolescent and adult	Adolescent and adult population is the population between age 15 and 64 and is the primary human resource of the society.
	A-3.Senior citizen	Senior citizen is the population aged ≥65 years and is subject to the provision of the Senior Citizens Welfare Act.
B. Facility usage	B-1. Facilities for children	This indicator measures the usage of preschool education facilities such as kindergarten and child care centers on the basis of the number of enrollment.
	B-2. Facilities for senior citizen	This indicator measures the number of people served by senior home services, day care services, and senior service centers (both public and private).
	B-3. Facilities for vocational training	Vocational training facilities can be either public or private, and the private institutions mostly focus on after-school or short-term education. This indicator measures the enrollment of the Taipei City Vocational Development Institute, which is the only public vocational training facility in Taipei City.
C. Social welfare	C-1. Low-income household	Low-income household refers to the household with an average monthly income per person lower than the minimum living expenses and a household asset (including real estate) lower than the announced standard during the year in question. This indicator measures the proportion of underprivileged group in Taipei City.
	C-2. Unemployment rate	Unemployment rate shows the unemployment situation among the urban population. This indicator not only measures the economic development of the city, but also is a crucial basic indicator for labor and employment policy making and assessment.
	C-3. Rental population	Rental population measures the rental demand of the urban area in question and is one of the key indicators of residential policy planning in Taiwan. Current housing policies aim to achieve "housing justice" in response to urban development issues caused by rapid growth of urban tenants and rent spike. This indicator is also one of the key references for housing policy making.

After reviewing and summarizing the urban planning, social welfare, and labor policies promulgated by the central and Taipei City Government, this study generated four strategic plans for vacant campus reuse. Meanwhile, a comprehensive review and discussion of school land reuse was conducted during the 684th City Planning Commission sponsored by the Department of Urban Development of Taipei City Government on April 7, 2016. The city government's primary objective was to convert vacant campus space into public uses health care, parks, public housing, and government offices. The four options proposed in this study were formulated in response to the discussion during the aforementioned conference and focused on three major categories comprising health care, public office space, and public housing. Finally, this study constructed a framework for campus land reuse plan evaluation after selecting the indicators and establishing reuse options. The evaluation model is expected to facilitate subsequent appraisal process and analysis.

D. Analysis of Evaluation Indicators

This study first classified the perspective school land for reuse before collecting quantifiable indicators of various facilities which would serve as a reference for subsequent decision-making operations. After devising the reuse options for appraisal, this study listed the evaluation indicators according to facility usage and the principle of social fairness. To facilitate a smooth selection process, this study only selected attainable data with connotations similar to the ideal evaluation indicators. To account for computational and forecasting consistency in subsequent research, this study used monthly data as the primary temporal unit during the time series analysis. However, interpolation was required to convert the inconsistent time frequency of the collected data into a uniform unit. In addition, the collected data had varying starting periods because of factors such as statistical regulations and varying policy implementation time. To facilitate a consistent data analysis, this study set the data collection interval between January 2000 and December 2015. Each indicator was estimated individually through the time series method to obtain the volatility of the indicator in question.

E. Empirical Procedure of ANP

The empirical procedure of ANP can be divided into three steps: First, conduct pairwise comparisons to measure the relative weight and obtain the weight of each indicator (W_1, without considering the interdependence); second, perform pairwise comparisons between indicators with inner dependence to obtain the weight of dependency for each indicator (W_2); third, use the pairwise comparison matrix to solve the weight of the subsequent indicator (W_c) by multiplying the current indicator by its weighted vector, thereby obtaining the weights of various reuse plans. In addition, this study aimed to assist weighting designation in future school reuse strategies through the operation of ANP, and the weights derived from various reuse purposes may serve as a reference for municipal affair planning and strategy formulation in the future. The estimated urban development dynamics and demand for various facilities obtained during the operational process of ANP may provide experts with a reference for follow-up decision making. The interdependence between the benchmarks must be clarified during ANP.

Because this study primarily used ANP for data analysis, the weights of the alternative options were obtained according to experts' questionnaire response. ANP enabled the planning evaluation model proposed in this study method similar to those used by various government agencies and enhanced its practicality. This study selected one representative from the academic, industrial, and government circles to conduct personal interviews. The presence of our research staff during the interviews not only assisted the respondents to fill the

questionnaire but also increased the response rate. Evidently, a total of three expert questionnaires were distributed with a 100% response rate.

F. Computational Process of ANP

This section uses one of the expert responses to demonstrate Steps 1–7 of the computational and analytical process of obtaining the final weight value of each alternative option in the questionnaire. This study ultimately used arithmetic means to determine the order of priority weights, which were used in the finalized proposal of school land reuse strategies. The steps of analytical process of the expert questionnaire are detailed as:

Step 1: Pairwise Comparison Weights of Each Benchmark

The pairwise comparison between benchmarks obtained the weights of each benchmark's influence on the objective (denoted as W_1). During the computational process, the linear value of 1 in the matrix indicated equal importance of two benchmarks. In addition, when verifying the questionnaire results, the consistency index and ratio must pass the consistency test. This study also conducted the consistency test on the pairwise comparison matrices of W_1 and W_3. In the sample questionnaire, the weights W_1 are listed from A-1 to C-3 as:

(0.017, 0.03, 0.044, 0.027, 0.052, 0.35, 0.19, 0.087, and 0.202)

Step 2: Pairwise Comparison Weights of Each Alternative Option

This step conducts the pairwise comparisons of the relative importance of each benchmark on each alternative option (denoted as W_2). The results demonstrate the relative importance of each alternative option under each benchmark. For example, the weights listed in Row 1 (A1, youth population) show the comparison of the score of each alternative option when A1 is taken under consideration.

Step 3: Pairwise Comparison Weights of Inner Dependence between Indicators

Step 3 is the pairwise comparisons of inner dependence between benchmarks, which compare the weight of mutual influence between each benchmark. The actual weight of each benchmark on the objective is denoted as W_3.

$$W_3 = (W_{31}, W_{32}, W_{33}, W_{34}, W_{35}, W_{36}, W_{37}, W_{38}, W_{39}).$$

Step 4: Priority Weights of Inner Dependence

To obtain the pairwise comparison weights of inner dependence of benchmarks (denoted as W_c), the W_3 in the inner dependence matrix is multiplied by W_1 in Step 4 (i.e., $W_c = W_3 \times W_1$). The calculated W_c are listed from A-1 to C-3 as:

(0.02625, 0.088609, 0.052706, 0.01775, 0.076474, 0.228002, 0.191998, 0.052377, and 0.265308).

Step 5: Pairwise Comparison Weights of Inner Dependence between Alternative Options

Step 5 obtains the weight of the inner dependence between alternative options under different benchmarks (denoted as W_4), and the values of W_4 corresponding to each benchmark are listed as:

$$W_4 = (W_{41}, W_{42}, W_{43}, W_{44}, W_{45}, W_{46}, W_{47}, W_{48}, W_{49}).$$

Here we show the pairwise comparisons of alternative options corresponding to the low-income population according to the scholarly respondent. The response reflected that this expert evaluated equal effects of low-income population on all alternative options (i.e., no significant difference among the alternative options).

Step 6: Actual Weights of Each Alternative Option Affected by Indicators

To obtain the actual weight of each alternative option (denoted as W_p), W_4 is multiplied by W_2, which can be related as:

$$W_p = W_{4\,i} \times W_2 = (W_{p1}, W_{p2}, W_{p3}, W_{p4}, W_{p5}, W_{p6}, W_{p7}, W_{p8}, W_{p9})$$

Step 7: Actual Priority Weights of Each Alternative Option

To obtain the actual priority weight of each alternative option (denoted as W_A), W_p is multiplied by W_c, which can be related as:

$$W_A = W_P \times W_C$$

V. Results and Discussion

The computational and analytical results from Steps 1–7 are the appraisal outcomes from the three expert questionnaires, including the final priority weights of the alternative options calculated objectively. This study generated the weight value of each alternative option W_A using the arithmetic means of the three expert questionnaires from the industrial, government, and academic circles. The alternative options are listed by priority in a descending order as: Early childhood education and after-school care facilities (Option 1), public housing (Option 4), community health care facilities (Option 2), and vocational training facilities (Option 3).

The appraisal results were compared with the indicators predicted by data mining method used in this study. The comparison demonstrated that youth population is expected to see a 44% decrease from the 2001 data, whereas the usage of youth welfare facilities is expected a 52% growth during the same period. The appraisal results also prioritized on youth welfare facilities, reflecting the preference of and attention garnered by Option 1 in future urban development. In addition, the usage growth of youth welfare facilities indicated that this type of facilities has a steadily growing demand.

The academic and industrial appraisals ranked public housing (Option 4) fourth and third, respectively, whereas the governmental appraisal ranked it first, resulting a final ranking at No. 2. This may be attributed to the arithmetic means approach to obtain the final weight values, and the government's emphasis on public housing led to the improved

rank of Option 4. The government is a key promoter and leader of public housing policy, which is one of the key services provided by the Department of Urban Development of Taipei City Government. Therefore, the relative high weight on Option 4 reflected the considerable attention on public housing from the government's viewpoint.

Community health facilities provide the service capacity of long-term care for senior citizens. Option 2 garnered considerable attention from both the academic and industrial respondents. However, the final ranking of Option 2 was affected by the low weight value appraised by the governmental respondent. The weight rankings revealed that both the academic and industrial experts' emphasis on senior citizen welfare facility usage and the growing population of senior citizens. The low weight on Option 2 ranked by the governmental respondent does not necessarily mean the low importance of senior citizen welfare facilities from the governmental perspective. The variance may simply be attributed to the business focus of the department in question.

Option 3 provides civilians with vocational training facilities. There is currently only one vocational training facility in our empirical study area, Taipei City. Although the indicators showed a slightly decreased usage of the vocational training facility, unemployment rate, a key indicator of labor and vocational training policy making, showed an increasing trend. The description of the aforementioned campus reuse options mentioned that vocational training facilities not only provide services of technology transfer and talent cultivation, but also are imperative to industrial and employment policies in municipal planning.

The comparison between the experts' appraisals and the trends of various indicators revealed that the usage growth of facilities affected the ultimate assessment results. This finding echoed the fact that usage of the same facility type is a crucial factor of overall facility reviews, as mentioned earlier in this article. However, facility usage does not singlehandedly determine the survival of the facility type in question. For example, proposals for vocational training facilities must account for both the regional unemployment rate and the demand for implementation of relevant policies. If this phenomenon occurs, the management plan of the facility in question should be reviewed rather than directly assessing the sustainability of the facility. Therefore, the aforementioned appraisal results mainly serve as the reference for various aspects of campus reuse strategies in the empirical area rather than determining the necessity of the existence of the facility type in question.

VI. Conclusion

A. Establishing an Objective Planning Process

Since the advent of digital age, data recording has become increasingly convenient, fast, and realistic, resulting in substantial influence on urban planning. In the past, urban planners had to rely on traditional data compiled by the government annually (e.g., census data of population, industry, and commerce) for reference and estimation. These data were mostly recorded in long frequency cycles (e.g., yearly or longer) and were inadequate to reflect the rapidly changing dynamics of social and urban development. The advent of information society has revolutionized how government agencies register data and manage those data in order to facilitate real- time, rapid, and realistic documentation. Big data features real- time, fast, and realistic characteristics, which can be used to analyze government data and enhance the accuracy of information for urban planning. In addition, the proposal of multiple-criteria decision-making (MCDM) method may change future decision-making models. Therefore, this study employed the "accurate" and "objective" aspects in big data and MCDM methods to establish the planning procedure.

Previous studies have selected various indicators to propose suitable solutions, but this approach cannot effectively mitigate the decision-making shortcomings in practice. Currently, the early drafts of urban planning are mainly carried out by the will of those in charge, as mentioned previously. Regardless of whether these early works will be finalized and executed, relevant feasibility reviews may cost considerably and result in waste of resources. Therefore, this study proposed a planning procedure that utilizes the information possessed by the government. In addition, this study collaborated with government units and its professional committee for MCDM appraisal to provide a direction for policy making. Urban planners may effectively evaluate the priority of their municipal planning options using the proposed procedure. This section details each step of the proposed procedure for future reference.

Step1. Propose alternative options: Propose response measures to improve current urban development challenges or accomplish the political opinions proposed by the ruling party.

Step2. Construct evaluation indicators: Propose quantifiable indicators to facilitate objective evaluation.

Step3. Collect data of each indicator: Data collection can provide a realistic and comprehensive representation of urban activity.

Step4. Analyze and estimate each indicator: Big data applications and analysis have become a key reference for policy making. However, these approaches have mostly employed mature statistical models previously proposed, and the computational process has mostly relied on manual power, prohibiting voluminous data analysis. The mature information technology at present facilitates fast and accurate data computation.

Step5. MCDM operation: MCDM enables objective evaluation on proposals or the weights a benchmark in relation to other benchmarks. The weight values may serve as a reference for administrators or decision makers. The main objective of MCDM is to eliminate the conflict among the ruling party, the committee members, advisors of the ruling party, and professionals, thereby achieving objective appraisals.

Step6. Select the optimal option: This step ranks the priority of

decision-making or proposal planning and prevents inefficient implementation caused by resource dispersion.

B. Constructing Reuse Strategies for School Land in Taipei City

Constructing the reuse strategies for school land can not only improve the land values, but also meet the daily demands of local residents. To enhance the feasibility of overall implementation, this study proposed suggestions for prioritizing alternative options and added the concept of multifunctional facility to further reduce the likelihood of vacancy. The proposed suggestions are described as follows:

1. Suggested Priority of Alternative Options

This study assessed the weights of each alternative option evaluated by the academic, governmental and industrial experts through a questionnaire. The priority of alternative options for school land reuse strategies are ranked in a descending order as follows: Early childhood education and after-school care facilities (Option 1), public housing (Option 4), community health care facilities (Option 2), and vocational training facilities (Option 3).

The rankings demonstrated that early childhood education and after-school care facilities ranked first among reuse strategies for school land in Taipei City. Although the ranking contradicted with the decreased youth population, the increased double-income families reflected to the increased parental demand on child care services. Junior high and elementary schools are mostly community centers with excellent transportation access, favorable environment, and plentiful space for youth activity. Repurposing this type of school land enables the government to provide child care services and mitigate the parents' burdens and reduce the governmental expense on subsidized child care. In addition, converting school land into child care or after-school care facilities may effectively reduce construction or renovation expenses because of similar facility layout between schools and child care facilities.

Public housing ranked second in the appraisal conducted by this study. Taipei is a city that attracts abundant labor force from the rest of Taiwan. The increased labor force reflects the increased rental demand within Taipei. Once the rental supply and demand are no longer in equilibrium, the imbalance may derive to challenges in social development. Therefore, public housing is also listed as a crucial urban planning aspect in foreign metropolitan areas with this characteristic. Although the emergence of public housing or affordable apartments does not completely satisfy the rental demand in urban areas, the overall housing market is healthier with their presence. In addition, public-owned apartments can also be allocated to underprivileged for interim housing options.

The primary function of community health care facilities is to provide long-term care locally in response to aging-in-place policies. However, long-term care requires considerable space and comprehensive planning to facilitate excellent long-term care quality. Constructing community health care facilities promotes cooperation between public and private sectors to reduce the required developmental cost. The reduced cost of land acquisition or rental can be transferred to health care equipment or human resource expenses, further improving the overall health care quality. Ultimately, senior citizens may benefit from affordable and quality long-term services.

Labor policy is a pivotal part of employment policy. Vocational training facilities are constructed to assist unemployed human resources in obtaining job skills. In addition, these facilities provide services in job matching and entrepreneurship assistance to supplement the employment policies. Vocational training services that meet the local needs can effectively supply the human resource need specific to the region.

2. Multifunctional Reused Facilities

The literature review on school land reuse revealed that residents express the need of open space for public use within repurposed facilities. School land has served as a community center for resident activities in addition to its intended educational purpose. The open space in school also serves other roles in a community level. For example, the green space reserved during the planning process has the function of regulating the urban microclimate, and both the open space and green space in school land serve the disaster prevention function. Therefore, facility revitalization planning should account for these elements so that these functions do not vanish from daily life as school facilities no longer exist. The green space per capita in Taipei is merely 5 m^2, far lower than the standard 8 m^2 suggested by the World Health Organization in 1990 [10]. Moreover, increasing green space enhances the environmental friendliness of an urban area. Urban planners have incorporated the concept of urban disaster prevention in their periodic reviews. The playground and open spaces in schools have long served as shelters for evacuation. Under the trend of increased urbanization and intensive development, urban open space has become increasingly difficult to obtain. Therefore, reuse strategies should also reserve open space as community shelters.

Facility reuse strategies should account for multifunctionality in addition to green space and open space zoning. This study suggests that urban planners should integrate other public facilities to the primary facilities as long as the usage of the primary facilities is not interfered. For example, parking lots are the most common multifunctional facilities in urban areas. Although the public transit network in Taipei has gradually matured, parking remains the most difficult transportation challenge in the city. Therefore, incorporating parking facilities in school land reuse strategies may simultaneously mitigate the externality caused by urbanization.

Finally, the planning method proposed in this study enables the implementation of the finalized strategy to be consistent with future urban development, thereby enhancing the feasibility of the reuse strategy. Incorporating multifunctional

facilities not only reduces the likelihood of vacancy but also achieves compact urban development in growth management. Therefore, this study incorporated the concept of growth management in the proposed reuse strategies to meet the contemporary urban planning philosophy.

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