



THE IRPA NAVIGATOR MODEL FOR MULTI-CRITERIA ASSESSMENT OF PUBLIC CATERING FACILITIES IN TASHKENT

*The IRPA Navigator Model for Multi-Criteria Assessment of Public
Catering Facilities in Tashkent*

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Abstract. This article proposes a method for assessing public catering facilities not as isolated commercial points, but as an urban service system connected with transport and pedestrian links, public spaces, temporal dynamics, and urban development. The aim of the study is to substantiate an eight-component IRPA Navigator model for comparing the territorial potential of the twelve districts of Tashkent and to interpret the results of its preliminary testing. The model normalizes the indices of territorial functional compatibility, accessibility, public-space integration, gastronomic activity, urban development dynamics, seasonal-spatial adaptability, temporal flow, and regeneration potential to a 0–1 scale and produces the K IRPA coefficient through weighted aggregation. In the preliminary calculation, district coefficients ranged from 0.48 to 0.84, with a mean of 0.687, a median of 0.705, and a standard deviation of 0.113. Two districts were classified as very high, four as high, three as medium, two as low, and one as a regeneration reserve. The result is not intended to convert the ranking into a simple “good–bad” assessment; rather, it demonstrates the need to differentiate intervention intensity, facility format, and pre-design verification. The advantage of the model is that, together with the integral score, it reveals dominant and deficit factors; its limitation is that district-level results cannot substitute for site-specific approval.

Keywords. public catering, architecture, urban planning, GIS, multi-criteria assessment, IRPA Navigator, walkability, public space, Tashkent.



1 Introduction

The public catering network integrates the city's everyday service infrastructure, street activity, and tourism economy. The performance of restaurants, cafés, canteens, teahouses, food courts, food halls, and mobile formats depends not only on internal layout or seating capacity, but also on area function, transport and pedestrian access, the quality of public space, temporal flows, microclimate, and service logistics. Studies on walkability link pedestrian accessibility with health, livability, and sustainability [1]; research on the urban food environment likewise shows that the mere presence of facilities is insufficient, and that access quality and social context are also important [2].

In location-planning problems, GIS and multi-criteria decision analysis make it possible to integrate indicators measured in different units into a single decision framework [3]. However, a single integral score may conceal why an area receives a high or low result. Therefore, the interpretability of the result—namely, identifying which factor is strong and which is deficient—is more important for pre-design decision-making than the ranking itself.

In Tashkent, gastronomic concentration in central districts, shortages of everyday services in newly developed residential areas, queues and safety issues at transport hubs, seasonality in recreational areas, and opportunities for adaptive reuse in industrial zones occur simultaneously. Applying the same facility type to all of these situations is not justified from an urban-planning perspective. The research question is therefore: how can territorial indicators of different types be combined into a reproducible and interpretable coefficient and then translated into architectural and urban-planning recommendations?

The aim of the article is to substantiate the structure, normalization, and aggregation algorithm of the eight-component IRPA Navigator model, statistically describe the preliminary testing results for the twelve districts of Tashkent, and define the limits of the model's practical application.



2 Materials and Methods

2.1 Study Area and Database

The study area covered the twelve administrative districts of Tashkent. The empirical database was formed from official demographic and economic statistics, open GIS and POI layers, public transport stops and routes, the pedestrian network, public spaces, educational, commercial, tourism, and recreational facilities, as well as field observation and photographic documentation protocols. Local assessments were designed to record separately a 250–500 m service zone, pedestrian flow in at least three time periods, active frontage, open space, loading operations, and waste logistics.

Because the data were aggregated at district level, the results serve the purpose of strategic screening. A decision concerning a specific site is not derived automatically from the district score; it must be re-checked using micro-location, sanitary, fire-safety, environmental, heritage, engineering, and transport-safety filters.

2.2 Index System

Cod	Index name	Wei	Assessment content
HF	Territorial functional compatibility	0.18	Compatibility of population, jobs, education, commerce, and everyday needs with the functional profile of the area
QQI	Accessibility	0.17	Metro, bus, pedestrian network, intersections, and access
JMI	Public-space integration	0.15	Connection with squares, parks, active frontage, streets, and open passage spaces



Cod	Index name	Wei	Assessment content
GFI	Gastronomic y	0.14	Existing catering facilities, tourism, evening y, and diversity of formats
UR	Urban development ics	0.12	New construction, population growth, nent, and new functions
MM	Seasonal-spatial bility	0.09	Shade, canopies, ventilation, open–closed rmation, and year-round operation
VB	Temporal flow	0.08	Demand in the morning, at lunchtime, in the g, on weekends, and by season
RSI	Regeneration al	0.07	Vacant buildings, underused areas, industrial e, and opportunities for adaptive reuse

Table 1. IRPA Navigator indices and preliminary weights

The indices were selected not to repeatedly count the number of facilities, but to represent complementary urban-planning dimensions. HFM measures the functional basis of demand; QQI measures accessibility; JMI measures the facility's relationship with streets and public space; GFI measures the existing gastronomic ecosystem; URD measures future change; MMM measures climatic and seasonal adaptability; VBO measures temporal dynamics; and RSI measures regeneration potential.

2.3 Normalization and Aggregation

Indicators measured in different units were converted to a 0–1 scale. For a positively oriented indicator, $x' = (x - x_{\min}) / (x_{\max} - x_{\min})$; for a negatively oriented indicator, $x' = (x_{\max} - x) / (x_{\max} - x_{\min})$. Values approaching 1 indicate stronger territorial suitability, whereas values approaching 0 indicate a constraint or deficit. When threshold values are selected, the influence of extreme observations and the consistency of the data sources in terms of time period are checked.



$$K \text{ IRPA} = 0.18\text{HFM} + 0.17\text{QQI} + 0.15\text{JMI} + 0.14\text{GFI} + 0.12\text{URD} + 0.09\text{MMM} + 0.08\text{VBO} + 0.07\text{RSI}$$

The sum of the weights equals 1.00. The preliminary weights were formed on the basis of theoretical analysis, urban-planning logic, and expert discussion; they should be regarded not as absolute constants, but as methodological parameters that can be recalibrated through pilot monitoring and sensitivity analysis. The pairwise-comparison logic proposed by Saaty can be used to verify expert weights, while GIS-MCDA can serve as a methodological basis for spatial integration of layers [3, 4].

The weighted contribution of each index is calculated as $D_i = w_i \times I_i$. The largest D_i indicates the dominant factor, while the smallest D_i indicates the deficit factor. If the difference between the two largest contributions is less than 10 percent, the result is interpreted as “mixed dominance.” This rule links the integral score to its causal composition.

Potential levels were defined as follows: $K \text{ IRPA} \geq 0.80$ — very high; 0.70–0.79 — high; 0.60–0.69 — medium; 0.50–0.59 — low; $K \text{ IRPA} < 0.50$ — regeneration reserve. These thresholds constitute a preliminary classification and should be verified using an independent sample and real pilot results.

2.4 Reliability and Control of Limitations

Data sufficiency is controlled by the coefficient $K_d = n_{\text{available}}/n_{\text{required}}$. If K_d is below 0.80, the result is treated not as a final design decision but as a preliminary assessment requiring additional data. Varying the weights by ± 10 percent, testing the stability of district rankings, comparing POI layers with field inventories, and repeating measurements in different seasons were adopted as subsequent verification stages.



3 Results

3.1 Integral Indicators of Tashkent Districts

Rank	District	K IRPA	Level
1	Yunusobod	0.84	Very high
2	Mirobod	0.82	Very high
3	Mirzo Ulugbek	0.79	High
4	Shaykhontohur	0.78	High
5	Chilonzor	0.74	High
6	Yakkasaroy	0.73	High
7	Yashnobod	0.68	Medium
8	Olmazor	0.66	Medium
9	Sergeli	0.61	Medium
10	Uchtepa	0.59	Low
11	Yangihayot	0.52	Low
12	Bektemir	0.48	Reserve

Table 2. Preliminary IRPA testing by district in Tashkent

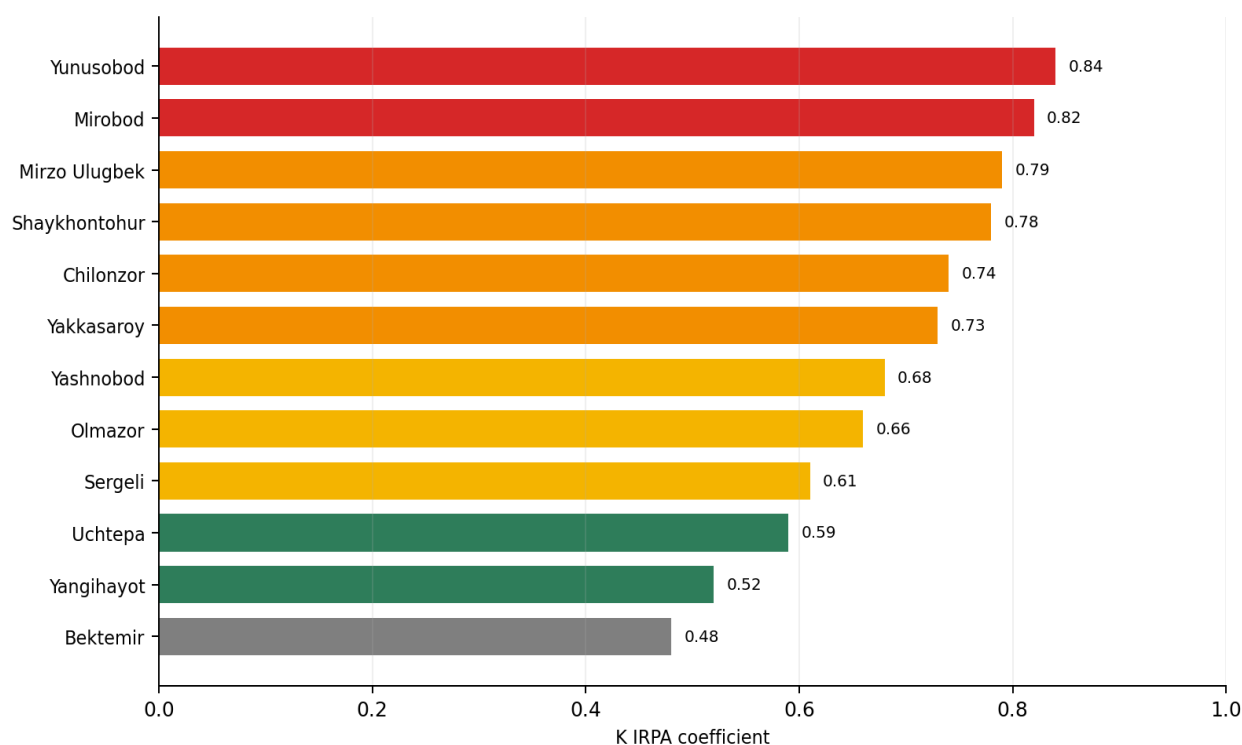


Figure 1. K IRPA coefficients by district in Tashkent

The calculated values ranged from 0.48 to 0.84. The mean was 0.687, the median 0.705, the population standard deviation 0.113, the coefficient of variation 16.4 percent, and the range 0.36. The first quartile was 0.605 and the third quartile 0.783, indicating that the differences among districts are not merely random minor fluctuations but represent sufficient territorial variation to justify differentiated intervention strategies.

The very-high group included Yunusobod and Mirobod; the high group included Mirzo Ulugbek, Shaykhontohur, Chilonzor, and Yakkasaroy. The medium group comprised Yashnobod, Olmazor, and Sergeli; the low group comprised Uchtepa and Yangihayot. Bektemir, with a coefficient of 0.48, was classified in the “reserve” group. The shares of the groups were 16.7, 33.3, 25.0, 16.7, and 8.3 percent, respectively.



3.2 Architectural and Urban-Planning Interpretation of the Results

Level	Main strategy	Boundary between incorrect and appropriate interpretation
Very high	Quality management	Do not automatically increase the number of new facilities; manage the pedestrian environment, active frontage, logistics, and excessive concentration
High	Specialized format	Select a restaurant, café, youth-oriented, or tourism-oriented format that matches the area's dominant function and user profile
Medium	Balancing	Strengthen everyday services and eliminate deficits in public space or transport connectivity
Low	Phased service	Begin with a small module, neighborhood service, family café, or low-risk pilot
Reserve	Regeneration pilot	Workers' canteen, food market, adaptive reuse, and phased revitalization of the area

Table 3. Transition from IRPA level to intervention strategy

A high score does not mean “build more restaurants.” In a central or highly active area, the number of facilities may already be sufficient while problems related to pedestrian paths, waste, loading, ventilation, or evening noise remain significant. Conversely, a low score does not imply abandoning the area; it indicates the need to begin with a small format, low-cost pilot, everyday service, or regeneration initiative.

4 Discussion

The results confirm the main advantage of the GIS-MCDA approach: rather than explaining an urban area through a single indicator—for example, population density or the number of restaurants—demand, accessibility, public space, time, and



development factors are considered together. As Malczewski has shown, GIS and multi-criteria analysis systematize spatial decisions, although the choice of criteria and weights can significantly influence the result [3]. For this reason, IRPA Navigator is not a “black box”: the index value, weight, and contribution are visible separately.

Treating walkability and public-space indices as separate components is consistent with studies of urban life. Montgomery links urban vitality to diversity of activities, transactions, and spatial quality [5]. Ewing and Cervero demonstrated that characteristics of the built environment such as density, diversity, design, destination accessibility, and distance to transit jointly influence travel choice [6]. Thus, the success of a public catering facility depends not only on commercial demand, but also on its position within the street and transport system.

The novelty of the IRPA model lies not in the new name of the index itself, but in combining three operations into a single decision chain: measuring territorial potential, explaining the reason for the score through dominant and deficit factors, and then deriving an appropriate typology and project requirement for the area. This feature distinguishes it from a simple ranking table.

At the same time, the study has several limitations. First, spatial heterogeneity within a district is hidden by average values. Second, POI data may contain errors related to facilities that have closed or recently opened. Third, expert weights must be re-checked using an independent expert group and real usage data. Fourth, the model does not fully account for economic profitability; rent, investment, average check, and operating costs are assessed separately in a business plan. Fifth, proving causal effects requires before-and-after monitoring of pilot facilities.

5 Conclusion

As a result of the study, an eight-component, interpretable, and recalibratable IRPA Navigator model was developed for locating public catering facilities in Tashkent. The model integrates the HFM, QQI, JMI, GFI, URD, MMM, VBO, and



RSI indices on a 0–1 scale and shows both the integral K IRPA coefficient and the causal composition of the result.

Preliminary testing revealed a 0.36-point difference among districts. This difference is used not to label districts as “best–worst,” but to select the type and sequence of intervention. In high-scoring areas, quality, the pedestrian environment, and logistics are priorities; in medium-scoring areas, balancing measures are prioritized; in low-scoring areas, everyday services and small pilots are emphasized; and in reserve areas, regeneration becomes the priority.

Three conditions are mandatory for practical application: confirming the district-level result through a 250–500 m micro-site assessment; separately checking compliance with SHNQ requirements and sanitary, fire-safety, environmental, and heritage regulations; and recalibrating weights and thresholds on the basis of real flow data, expert AHP, sensitivity analysis, and 3-, 6-, and 12-month pilot monitoring. Under these conditions, IRPA Navigator serves as an analytical bridge between the master plan, district-level programs, and pre-design screening.

REFERENCES

1. Baobeid A., Koç M., Al-Ghamdi S.G. Walkability and Its Relationships With Health, Sustainability, and Livability. *Frontiers in Built Environment*. 2021. Vol. 7. Article 721218. <https://doi.org/10.3389/fbuil.2021.721218>
2. Chandrabose M. et al. Neighbourhood walkability and dietary attributes: effect modification by area-level socio-economic status. *Public Health Nutrition*. 2022. 25(9). P. 2593–2600. <https://doi.org/10.1017/S1368980022001197>
3. Malczewski J. GIS-based multicriteria decision analysis: a survey of the literature. *International Journal of Geographical Information Science*. 2006. 20(7). P. 703–726. <https://doi.org/10.1080/13658810600661508>
4. Saaty T.L. Decision making with the analytic hierarchy process. *International Journal of Services Sciences*. 2008. 1(1). P. 83–98. <https://doi.org/10.1504/IJSSCI.2008.017590>



5. Montgomery J. Making a city: urbanity, vitality and urban design. Journal of Urban Design. 1998. 3(1). P. 93–116. <https://doi.org/10.1080/13574809808724418>
6. Ewing R., Cervero R. Travel and the Built Environment: A Meta-Analysis. Journal of the American Planning Association. 2010. 76(3). P. 265–294. <https://doi.org/10.1080/01944361003766766>
7. Giles-Corti B. et al. City planning and population health: a global challenge. The Lancet. 2016. 388(10062). P. 2912–2924. [https://doi.org/10.1016/S0140-6736\(16\)30066-6](https://doi.org/10.1016/S0140-6736(16)30066-6)
8. UN-Habitat. City-Wide Public Space Strategies: A Guidebook for City Leaders. Nairobi, 2020. <https://unhabitat.org/city-wide-public-space-strategies-a-guidebook-for-city-leaders>
9. FAO. FAO Framework for the Urban Food Agenda. Rome, 2019. <https://openknowledge.fao.org/>
10. National Statistics Committee of the Republic of Uzbekistan. Official Statistics Portal. <https://stat.uz/><https://stat.uz/>
11. OpenStreetMap contributors. Open geospatial data. <https://www.openstreetmap.org/>
12. Ministry of Construction of the Republic of Uzbekistan. SHNQ 2.07.01-23 Urban Planning: Planning the Development and Construction of Urban and Rural Settlements. <https://mc.uz/><https://mc.uz/>
13. Farxatova Z.X. Preliminary IRPA Navigator testing data for the 12 districts of Tashkent. Author's dissertation research, 2026.