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## Impact of design attributes and Neighbourhood externalities on an apartment's fair market value (FMV): A study of Noida

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### Abstract

Residential Apartments are a major part of housing infrastructure in urban areas, million-plus cities in India have witnessed a sharp rise in housing stock in the last decade. Apartment complexes are largely identified by the Design quality of the complex, the Builder's name, amenities, and the neighbourhood. These quality standards knit a built environment that ultimately led to a better quality of life in cities. Real-Estate firms have been using these attributes as the basis of the market price and as a USP for better sales. Time and again there have been discussions on the importance of Design Quality attributes and Neighbourhood factors in deciding the price of apartment complexes, however, their contribution and empirical quantification are seldom performed. Recent studies in property research have discussed the application of hedonic regression but there are criticisms about the sensitivity of such an approach particularly the functional discontinuity, non-linearity, data quality, etc. This article proposes an approach towards finding a correlation between quality attributes and the value of an apartment using the analytic hierarchy process (AHP). 25 experts were interviewed and a pairwise comparison was drawn between different attributes resulting in a weighted index called as Apartment Quality Index.

**Keywords:** Design, apartments, externalities, value, AHP

### 1. Introduction

The market value of an apartment is the function of the local property market and the quality attributes associated with it. Contemporary practices in property valuation are attempting to quantify such parameters to estimate the fair market value of the property. As per recent literature, property valuation through conventional approaches is not completely reliable and it is a potential risk for business decisions (Tezcan *et al.*, 2020) <sup>[59]</sup>. The conventional approaches of valuation are leading to over-valuations in some countries across Europe (Reinert, 2021) <sup>[50]</sup> it has been argued that existing practices of valuation need to be assisted with automated valuation models to cross-verify results (Tajani *et al.*, 2018) <sup>[58]</sup>. The authors have also emphasized the lack of studies conducted on understanding the dynamics of land values in semi-urban and rural areas (Binoy *et al.*, 2021) <sup>[13]</sup> which holds the outgrowth of cities by providing land for the development of housing stock. The most significant factor that speculators watch is the health of local economies (Nase *et al.*, 2016) <sup>[41]</sup>. Although many outside factors can ignite a boom in an area, such as the building of an auto plant or submitting the winning bid for the world cup of soccer, a strong local economy makes its own luck in attracting these outside factors and can greatly affect the price/value of a property. The price of the property reflects relative scarcity, and it serves as an indicator of economic activity. Empirical studies seeking to estimate property values typically approach the problem by estimating an econometric model based on land price theory and urban growth theory developed in urban economics. The result of these models is that other things being equal, within city limits (urban) property values increase as the distance to CBD decreases (due to location rents). Outside city limits, property values decrease with the distance from the city boundary (due to a decrease in development premium). A system of parcel-level land-price functions for selected land use classes is constructed. The dependent variable is the parcel-level real market value of a property. Market function plays an important role in deciding the value of an apartment, in accordance with the law of demand, as the demand for a commodity increases it has a positive impact on the price. As per the Task Force report by MOHUPA submitted in 2012, the current housing shortage in India stands at 18.78 million households.

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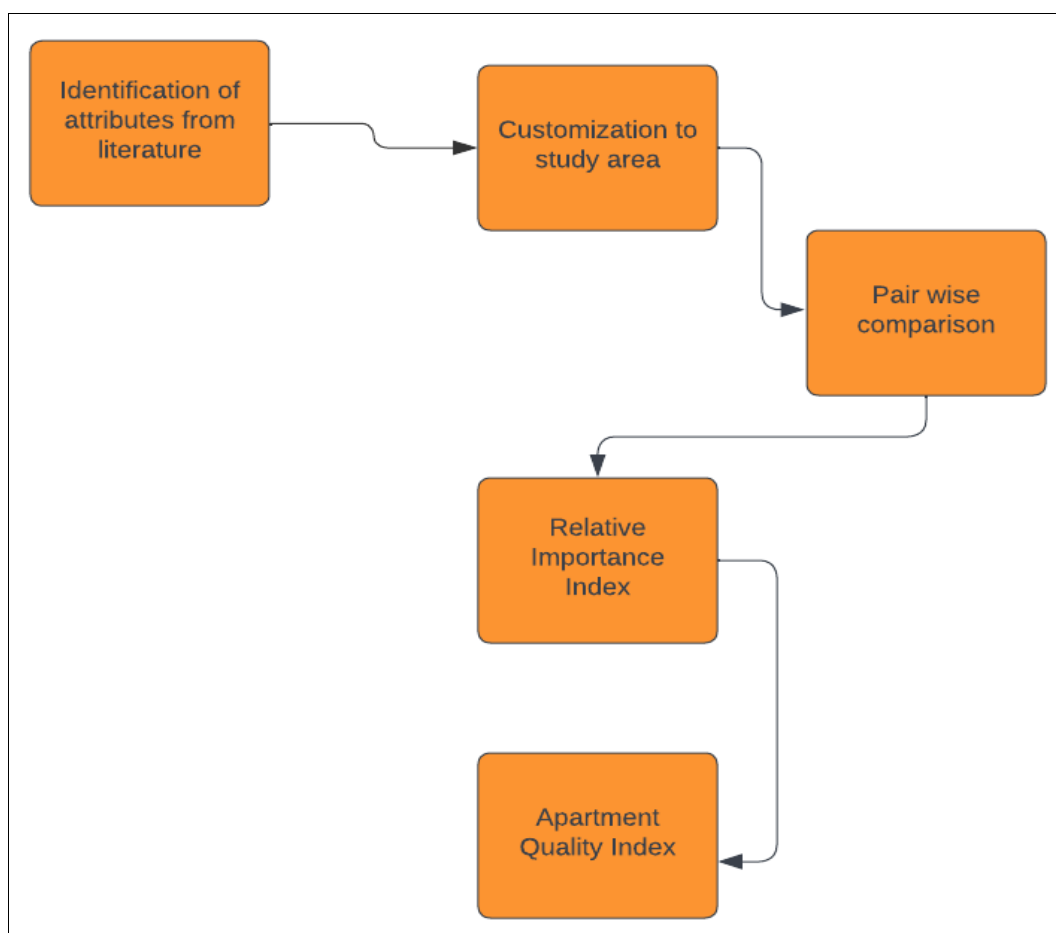
One in every 6 persons in urban areas doesn't have a house, such areas have become places of high concentration leading to poor housing stock, congestion, and obsolescence. Therefore, apart from the quantity of housing stock, the shortage also exists in terms of quality.

Studies have explored the possibility of design-quality-based value of the property where the Hedonic Price model was applied to find out the impact of physical attributes/design quality and its impact on the value of a residential property, (Nase *et al.*, 2016) [41]. Similar studies in Nigeria have indicated the use of Artificial Neural networks for predicting property values suggesting that it has better predictability as compared to traditional methods and can be used as a reliable tool for the valuation of the property (Boluwatife Abidoye & C Chan, 2017) [14]. Recent studies (Demetriou, 2018; Nase *et al.*, 2016; Tezcan *et al.*, 2020; Tomal, n.d.) [18, 41, 59, 60] have indicated the use of automated valuation methods such as the hedonic model, GIS land Quality index and ANN to assess the value of land during the process of land consolidation. There has been a continuous effort in finding new methods of valuation which can provide better results than existing methods.

Noida is one of the satellite towns adjoining New Delhi and it is envisaged to contain the future growth of the National Capital of Delhi in this context, Noida falls under the

National Capital Region (NCR). Noida has witnessed an upward demand for housing during the last two decades and consequently, the market price has shown a steep upward trend (Parashar *et al.*, 2020; Sinha, 2018; Tahsin & Sen, 2014) [46, 55, 57]. Noida authority also played a part by providing urban infrastructure like roads, nodes, civic amenities, etc thus making this place a perfect arena for housing development. Many private players participated during this boom to cater to the growing demand, multiple players proposed projects having unique Design quality and diverse neighbourhood features, and there were diverse asking pricing as well. New terms were coined by the Real-estate promoters to describe qualitative features of their project, such as PLC (Preferred location charges), Super Area, etc (Anarock, n.d., 2018; PLC Becoming a Standard Cost in Real Estate, n.d.; What Are Preferential Location Charges? | Housing News, n.d.) [43] and each investor or end-user were levied premium charges as deemed fit to the promoter. Considering two decades of exponential growth of housing, soaring property prices and availability of several apartment designs in varied locations make Noida a perfect case to study the impact of design quality and neighbourhood features on the fair market value of apartments. Further section of this article presents Methodology, Data, Results, Discussion and Conclusions.

## 2. Methodology



**Fig 1:** Flow Chart

Seminal work published in the field of property value was systematically looked at in the Web of Science database using a well-defined set of keywords. Web of Science is one

of the largest databases indexing quality research articles from diverse fields and is widely accepted in academia. A set of keywords were formulated from the topic of research

and study of the first few articles published in the field of property valuation. A combination of the following keywords was used to formulate a search strategy:

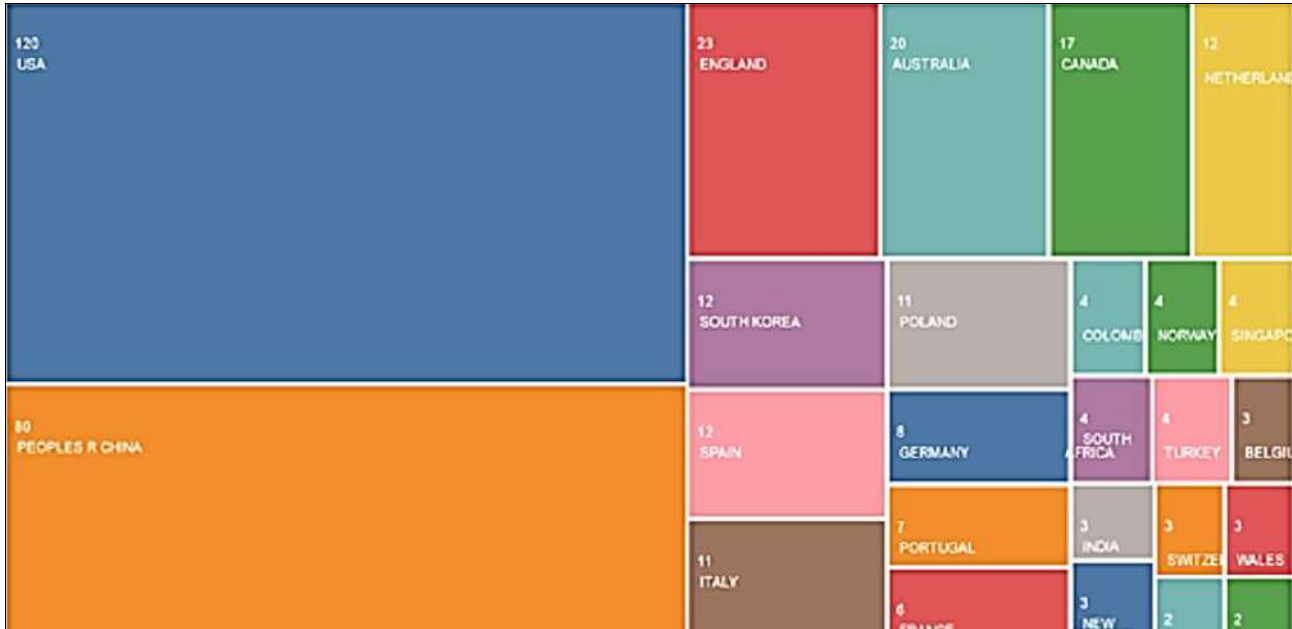
Apartment or Flat or Real-Estate or property (Title) and Externalities OR Planning interventions or Urban Planning or Town Planning or Value Determinants (Topic) and Valuation or Value or price or Appraisal or Mass Valuation or values (Title).

A review of the literature specified variables pertaining to design attributes and neighbourhoods that have an impact on the value of an apartment. All such variables were discussed with subject experts and professionals to draw pairwise comparisons. Experts were selected using a snowball

sampling technique. A structured interview method was adopted to record inputs from the selected experts; An Analytical Hierarchy Process approach was used to generate an apartment quality index based on the inputs from the interviews.

**3. Data**

Initial search keywords were returned with 308 articles, search results were further refined for the English language resulting in 304 articles published from various geographical locations with the USA contributing most of them followed by China, England, Australia, and so on shown in figure-2 below.



**Fig 2:** Highest publications from different countries.

Analysis of results based on disciplines and initial screening of titles and abstracts indicated that articles cover a wider spectrum highlighting the impact of many determinants including environment, taxation, planning, market, ecology, transport, etc, however, this study was about the impact of design attributes and neighbourhood factors on the value of apartments, therefore, the results were further screened with scoping review method and A total of 91 Articles, initiating discussions on apartment value, neighbourhood factors, externalities, valuation practices, mass appraisals, tools, etc. Also, there were articles discussing the classical theories of

Von Thunen, Haig, and William Alonso (Alonso, 1960; Goldberg, 1970; Haig, 1926) [4, 24, 26] and public lectures by Raymond Unwin (Unwin, 1914) [63] about the relationship between Town Planning and land values.

**3.1 Literature Review:** The list of attributes and neighbourhood variables extracted through the review of the literature was further vetted by experts in the field and the final list of design attributes and externalities is presented below:

**Table 1:** List of Attributes & Externalities

Attributes	Sub-Attributes	Description	References
Apartment Design (A)	Carpet Area	Carpet Area of the apartment	(Aydinoglu <i>et al.</i> , 2021; Janssen, 2003; Mazikana, n.d.; Millhouse, 2005a, 2005b; Nase <i>et al.</i> , 2016; O’Connell & Keller, 2002; Rittenbruch <i>et al.</i> , n.d.; Rong <i>et al.</i> , 2020; Tomal, n.d.) [7, 30, 35, 36, 41, 44, 51, 60]
	Light and ventilation	Availability of natural light and air ventilation in all rooms	
	Balconies	Number and size of balconies	
	Room sizes	Space available in rooms for furniture layout	
Preferred Location (PL)	Floor	Level of the floor w.r.t ground (First floor or second floor or any other)	(Acosta-Gonzalez <i>et al.</i> , 2021; Ahlfeldt & McMillen, 2018; Barnard, 1976; Bello <i>et al.</i> , 2020; Bencure <i>et al.</i> , 2019; Engstrom & Gren, 2017; Fadaei <i>et al.</i> , 2015; Gnat, 2021; Li <i>et al.</i> , 2015; Munneke & Slawson, 1999; International Valuation Standards, 2020; UDOEKANEM Nigerian Journal of Construction Technology and Management, n.d.; Son <i>et al.</i> , 2012; Ustaoglu & Aydinoglu, 2020; Xu <i>et al.</i> , 2021; X. R. Zhang <i>et al.</i> , 2013; Zin <i>et al.</i> , 2019) [1, 3, 8, 9, 10, 20, 22, 23, 32, 39, 47, 62, 56, 65, 67, 70, 71]
	Park view	View of the dedicated park from the rooms	
	Orientation	Orientation of the apartment w.r.t cardinal direction, like east or north facing, etc.	
	construction Quality	Perceived quality of construction w.r.t technology used and visible example if any.	
Project (Pr)	Location	Distance from City centre or from Major node	(Acosta-Gonzalez <i>et al.</i> , 2021; Alonso, 1964; Arentze & Timmermans, 2007; Bello <i>et al.</i> , 2020; Bertaud & Renaud, 1995;
	Image of	Reputation enjoyed by the builder by virtue of its	

	Builder	past projects. (Public perception)	Burnell, 1985; <i>Challenging the Tides: Indian Real Estate</i> , 2015; "Models of Urban Geography and Settlement Location," 2020; Epstein, 2018; Fadaei <i>et al.</i> , 2015; Helbing <i>et al.</i> , 2017; Hoesli, 2006; Jackson, 2001; Martinez & Araya, 2000; Munneke & Slawson, 1999; Murphy, 2012; Navarro-Azorin & Artal-Tur, 2016; Orford, 2002; Tripathi & Kumar, 2017) [1, 5, 6, 9, 12, 15, 16, 38, 21, 22, 27, 28, 29, 34, 39, 40, 42, 45]
	Park area	Availability and size of central park in the project	
	Amenities	Club and other amenities provided.	

**4. Results**

The panel of experts selected for structure interviews comprises of Consultant Architects, Real-Estate professionals, Projects Management Consultants, and Property Valuers. These experts were selected through a non-probabilistic snowball sampling technique, such technique is extensively used in conducting qualitative research. All the experts selected for the interview were highly qualified, and adequately experienced that their inputs can be considered. The average experience of experts on the panel was 22.72 years. Below is the pie chart showing the composition of an expert panel. A total of 25 interviews were conducted through a questionnaire-based survey to arrive at pair-wise comparisons of each of the attributes deduced through an extensive literature review. The analytical hierarchy process commonly known as AHP is a multi-criteria decision-making process proposed by Saaty to help take decisions making in a complex scenario (Saaty, 1987) [53]. This method has multiple applications and is commonly used to process information and generate results. The section below will have a pair-wise comparison matrix in line with Saaty's AHP approach and the results are discussed in the further section. There are three main criteria and four sub-criteria within each of the main criteria. Three main criteria were compared first followed by comparison among sub-criteria within each main criterion Comparison tables and matrix are shown below.

Work Domain	No. of Interviews
Real Estate	7
Project management	4
Architecture	9
valuation	5
Total	25

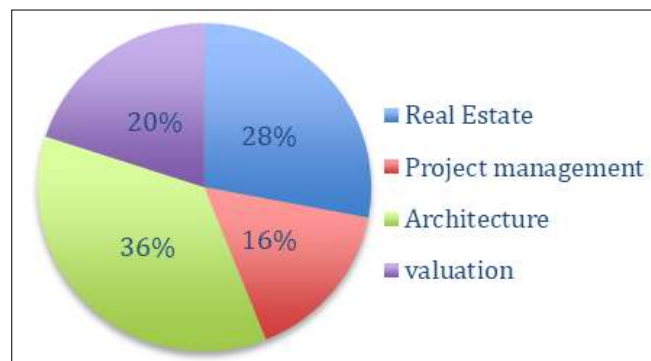


Fig 4: Composition of Panel of Experts

**4.1 AHP-Based Comparison Matrix of Attributes as per the list:**

**4.1.1 Main Criteria comparison matrix (A)**

	A	PL	Pr
A	1	2/3	7/9
PL	1 1/2	1	5/6
Pr	1 2/7	1 2/9	1
	3.74	2.90	2.61

**Normalized matrix**

	A	PL	Pr	W	AW	Lamda	CI	RI	CR
A	0.27	0.24	0.30	0.27	0.805864	3.00966	0.006041	0.58	0.01
PL	0.39	0.35	0.32	0.35	1.056572	3.012873			
Pr	0.34	0.42	0.38	0.38	1.149898	3.013714			
				1.00		3.012083			

**4.1.2 Sub-Criteria Matrix - Apartment Design**

	CA	LV	B	R
CA	1	6/7	2 1/7	4/5
LV	1 1/6	1	2 3/5	1
B	1/2	3/8	1	1/2
R	1 2/9	1	2 1/7	1
	3.87	3.30	7.88	3.22

**Normalized matrix**

	CA	LV	B	R	Weights	AW	Lamda	CI	RI	CR
CA	0.26	0.26	0.27	0.25	0.26	1.042892	4.00779	0	0.9	0.003
LV	0.30	0.30	0.33	0.29	0.31	1.23131	4.008033			
B	0.12	0.12	0.13	0.14	0.13	0.509508	4.003625			
R	0.32	0.32	0.27	0.31	0.31	1.223586	4.007663			
					1.00		4.006778			

**4.1.3 Sub Criteria Matrix- Preferred Location**

	F	PV	O	CQ
F	1	5/9	1/2	2/7
PV	1 5/6	1	6/7	1/3
O	2 1/7	1 1/6	1	1/2
CQ	3 3/5	3	2 1/5	1
	8.56	5.68	4.52	2.07

**Normalized matrix**

	F	PV	O	CQ	W	AW	Lamda	CI	RI	CR
F	0.12	0.10	0.10	0.13	0.11	0.451974	4.008349	0.01	0.9	0.006
PV	0.21	0.18	0.19	0.16	0.19	0.74373	4.014092			
O	0.25	0.21	0.22	0.22	0.22	0.900832	4.012357			
CQ	0.42	0.52	0.49	0.48	0.48	1.923849	4.029443			
					1.00		4.01606			

**4.1.4 Sub Criteria Matrix-Projects**

	L	IB	PA	Am
L	1	1 5/7	3 1/2	2
IB	4/7	1	2 1/4	1 1/2
PA	2/7	4/9	1	2/3
Am	1/2	2/3	1 4/7	1
	2.38	3.84	8.33	5.07

**Normalized matrix**

	L	IB	PA	Am	W	AW	Lamda	CI	RI	CR
L	0.42	0.45	0.42	0.38	0.42	1.677871	4.010737	0	0.9	0.002
IB	0.24	0.26	0.27	0.29	0.27	1.070301	4.00588			
PA	0.12	0.11	0.12	0.13	0.12	0.481577	4.005716			
Am	0.22	0.18	0.19	0.20	0.19	0.777817	4.004205			
							4.006635			

A consistency index of all the matrixes from 4.1.1 to 4.1.4 as listed above are in the acceptable range hence all the results are dependable and can be considered further for generation of relative weightages. The following table indicates the weightages of each sub-criteria matrix.

#### 4.2 Weightages of all the sub-variables

Table 2: Weightage

A	Weightages	PL	Weightages	Pr	Weightages
CA	0.2602163	F	0.112758	L	0.418345
LV	0.3072105	PV	0.18528	IB	0.267183
B	0.1272617	O	0.224514	PA	0.120223
R	0.3053115	CQ	0.477448	Am	0.19425

Variables	Weightages	Variable Description
CA	0.07	Carpet Area
LV	0.08	Light Ventilation
B	0.03	Balconies
R	0.08	Room Sizes
F	0.04	Floor
PV	0.06	Park View
O	0.08	Orientation
CQ	0.17	Construction Quality
L	0.16	Location
IB	0.10	Image of the builder
PA	0.05	Park Area
Am	0.07	Amenities
Total	1.0	

Based on the weightages calculated from each sub-criteria matrix the cumulative weightages are calculated and shown in the following table to generate an apartment quality index.

#### 5. Discussion

Variables identified through the literature review were presented to experts during structured interviews and pair-wise comparison was drawn using Multi Criteria Decision Making (MCDM) Guidelines prescribed under Analytical Hierarchical Process (AHP). There were 21 questions presented to 25 experts individually, these experts were selected through a snowball sampling technique. Each expert was to draw a comparison between two variables on a seven-pointer scale. The comparison matrix was tested for consistency and only after the desired consistency, inputs of the experts were taken. Similarly, inputs of all the experts were tabled in a final matrix and relative weightages were calculated. These weightages indicate the variables' influence on the fair market value (FMV) of the apartments. The experts also shared their opinion about "Location" as the most influential parameter and how it is seen in the context of contemporary urban planning.

The systematic Literature review identified three major attributes affecting the value of apartments namely Apartment Design, Preferred Location, and Project attributes. Apartment design includes all the qualitative design-related parameters such as carpet area, light and ventilation, number and sizes of balconies, and space distribution between the rooms to provide for furniture layout. Preferred Location includes all the attributes related to the position of the apartment in the housing complex such as the floor level with reference to the ground floor, View of central park from the rooms of the apartment, orientation of the apartment with reference to the cardinal direction for

Vaastu or climatic compliance, Assurance of Construction quality of the complex like use of modern technology, contractor's reputation, etc. Project related attribute includes all the qualitative attributes related to the housing project like Location/distance from major node or city centre, Reputation enjoyed by the builder by virtue of past performance, green areas & amenities available in the project like the club, indoor games, swimming pool, jogging & cycling track, outdoor games, etc. The pair-wise comparison was first drawn between three major attributes and the results show that the project and preferred location contribute significantly (35% & 38%) and the design lead parameters contribute about ¼ (27%) to the fair market value of the apartment indicating a poor sensitivity towards quality design parameters. This further emphasises that expenditure towards design-related parameters may not yield as many returns from an investor's point of view. These results also contradict trends in many developed countries like the UK where design quality lead parameters contribute significantly to the value and affordable housing tend to be poorer in design quality (Nase *et al.*, 2016) [41]. Further, pair-wise comparison included all the sub-attributes and the results indicated in table-2 highlight that sub-criteria Light & Ventilation, Construction Quality, and Location contribute the highest (30%, 47% & 41% respectively) within their domain. The final weightages of each of these parameters are placed in Table 3 indicating that Construction quality and location are the highest contributors to the fair market value of the apartment, together they add around 1/3<sup>rd</sup> followed by the image of the builder, this result is in line with the market prices of the renowned builders like Godrej properties, ATS, Mahagun Group, etc.

Table 3: Contribution to Fair Market Value (FMV)

Variables	Ranks	Contribution to FMV
Construction Quality	1	17%
Location	2	16%
Image of the builder	3	10%
Light Ventilation	4	8%
Room Sizes	5	8%
Orientation	6	8%
Amenities	7	7%
Carpet Area	8	7%
Park View	9	6%
Park Area	10	5%
Floor	11	4%
Balconies	12	3%

In addition to pair-wise comparison, the experts emphasized the location parameter in detail, Location is referred to the relative position of a housing complex within the urban system, it also signifies the availability of neighbourhood amenities, connectivity, and distance to the city centre, therefore, making it an abstract identity to measure. In economic terms, location refers to the distance from the city centre and the associated cost of transportation, communication, and other services (Colwell & Sirmans, 1978; Goldberg, 1970; Kang, 2015; Seyfried, 1970) [17, 24, 31, 54]. However, modern town planning practices have been advocating a decentralized approach there by creating multiple subcentres in a city. Furthermore, there is a lot of emphasis on sustainable practices therefore concepts like walkability, 15-minute city, and new urbanism have gained

importance recently (Adhikari, 2016; Bertaud, 2022; Kang, 2015; "Urbanization beyond Municipal Boundaries," 2013) [2, 11, 31]. With the advancement in technology and augmentation of transportation infrastructure distance from the city centre is now measured in time (Dziauddin, 2019; Guzman *et al.*, 2021; Lindsey & Santos, 2020; Yuwei & Pengfei, 2013; M. Zhang & Wang, 2013) [19, 25, 33, 68, 69]. Most of the real-estate promoters and builders using time as the measure of proximity. From the above, it is understood that the location parameter is a bundle of various sub-attributes, and it is responsive to time, technology and planning practices.

## 6. Conclusion

This article aims to quantify the impact of apartment design attributes and project-related externalities on the overall value of an apartment. Real-Estate promoters market their projects by highlighting design and amenities-based USPs. As an investor/end-user, the value of each such amenity and design quality is rarely known, most of the experiences players sail through easily but novices find difficulties in decision-making and are bound to believe the promoters. A number of attributes were identified with the help of literature, these attributes were later discussed with experts and a pair-wise comparison was drawn to generate an index. Results from the survey indicate that construction quality is also an important USP of any residential project contrary to the general belief that only location matters. In addition, it also explained the rise of market prices of apartment complexes in the adjacent land parcel having modern construction technology like cast-in-situ. The image of the builder is also important as it is the quality assurance of the apartment complex. With a tool like the apartment quality index, the value impact of such attributes can be quantified, it will further build confidence among builders and buyers. It is largely believed that these variables shall be universally applicable in all locations but one should be very conscious in comparing properties in different districts as there can be some geographical or social priorities therefore generalization of these results shall be made with caution. It is also important to mention that location parameters need detailed deliberation to understand multidimensionality. It is important to mention that the contemporary planning practices advocate a multi-nuclei approach thereby generating multiple similar locations if distance from the city centre is the only parameter to measure location.

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