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Article

Can one measure architectural contextuality? A simple "building similarity indicator"

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ABSTRACT

Adaptation of a building to the environment – often referred as "contextuality" – is considered a key quality of architecture. The assessment of such contextual coherence is frequently attributed to the perception and expertise of architects. This is generally appropriate, as coherence depends on multiple factors such as form, color, materials, landscape, professional knowledge about ideas and historical contexts and an assessment of the *genius loci*, often described as atmosphere. Nevertheless, there is increasing interest in quantifying such aspects, particularly in the context of sustainability assessments like Social Life Cycle Assessment (sLCA).
This paper explores and discusses an approach to "quantifying the quality" of contextuality. It proposes a simple, image-based method for assessing contextual suitability using "Google Lens". The approach is as follows: Ten visually similar buildings are identified via "Google Lens" in relation to a specific reference building. The average distance between the physical locations of these search results and the location of the reference building is then calculated. This average distance serves as an indicator of whether comparable architectures are predominantly situated within the regional environment or dispersed over larger distances. The indicator is named the "Building Similarity Indicator" (BSI). The BSI was calculated for a dataset of 320 buildings. Data analysis shows significantly increasing BSI values depending on the estimated "modernity" of a building, representing a loss of geographical contextuality.
This highly oversimplified approach is ultimately discussed critically. It might offer no more than a quantifiable supplement to discussions on "contextuality." As such, it is suggested as appropriate for playing a role in quantitative storytelling for planners, architects, or sustainability scientists. Furthermore, integration into sLCA for buildings is suggested. Geographical contextuality can be seen as triggering identity and the conservation of (parts of the) perceived cultural history of a place. Therefore, it possesses social value.

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INTRODUCTION: WHY RATE THE "UNMEASURABLE"?

Technical optimization often comes at the cost of emotional richness in architecture. A loss of architectural quality is a global concern. It can be explained by increasingly uniform building styles. These are driven by the standardization and globalization of building materials, and by a growing, one-sided technical orientation in construction focused on goals such as energy efficiency, sound insulation, or fire protection. This results in a loss of cultural identity in architecture (Abel, 2012). Form follows engineering

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rationality, but it frequently does not follow individual or social meaning-making. Regional and familiar construction methods, materials, and forms are often completely disregarded.

In terms of industry and real estate business, we see a technically and economically determined approach to new buildings. In terms of architecture, we find an "object-centered" architectural language that is likewise detached from regional context. This is also how Swiss architect Gion A. Caminada described it in an interview: Caminada, who draws inspiration for his buildings from the vernacular architecture of Alpine villages in Switzerland, regards the ability of architecture to create *identity* and enable *spatial belonging* as essential. He therefore recommends that buildings incorporate many elements of their local context. He says: "It takes that quantum of near-sameness for identity enabling." (Schoper 2016)

This article picks up on that idea. It asks whether contextuality as a quality might not also be simply measurable — and discusses the advantages and limitations of such a quantitative approach. The contextual and spatial appropriateness of architecture is a central research topic in the field. Whether this appropriateness can be measured is a question that continues to engage scholars, as discussed by Yücel & Arabacıoğlu (2023) in *Megaron*.

Before proposing a simple indicator for measuring such appropriateness, this article begins with a propaedeutic observation: any attempt to "measure" a phenomenon as complex as appropriateness inevitably risks overreach. That could even evoke memorys of George Orwell's novel *1984*, where the state monitors citizens' satisfaction, reducing their emotions to standardized, quantifiable data. Especially in the age of artificial intelligence, scientists must be wary of such tendencies to quantify qualities of life that, in their "depth", can only be experienced personally and multimodally.

Is the attempt to quantify a quality an appropriate answer to a problem described as the loss of sensual and emotional values in planning and construction? Ironically, maybe. Yet it is not only technological possibilities but also the requirements set by the state or certification bodies like LEED, BREAM or DGNB that compel us to engage with such approaches. This text addresses such engagement using the example of assessing the local "appropriateness" of buildings, named contextuality or "contextual compatibility" (Groat, 2024). The endeavor to make a complex matter very simple deserves skepticism. It is a double-edged undertaking, but one with charm and precedents. A good example is the *Big Mac Index*: The price of a Big Mac in a given country serves as a useful indicator for assessing purchasing power parity between nations (Ong, 2003; Clements & Si, 2017; Akarsu et al., 2024). What is a dollar worth compared to a peso or a euro—how many Big Macs can you get for it? This simple indicator has proven effective and is scientifically recognized. But that pertains to economics. The research focuses on the appearance of cities and streetscapes, addressing the highly subjective phenomenon of how the spatial appropriateness (or "contextuality") of a building is perceived. Could there also be a quantifiable "simple approximation value" for this? Hardly, but this article suggests and critically discusses one.

Two research questions are addressed: First, is such a loss in regional contextuality over time measurable by the suggested simple visual indicator? Second: If so, could the indicator be useful for assessing social sustainability?

Personal Narrative on This Research

New buildings, as results of an increasingly technically and economically determined planning process, often feel "soulless" and devoid of character. This perception is shared by laypeople and architects. But it wasn't always like this. Since when do we perceive a loss of character (individuality, contextual appropriateness…) in the built environment? The 1960s? The 1970s?

As a researcher engaged in both sustainability quantification and cultural interpretation, I want to grasp and understand this phenomenon. This research started with an idea, inspired by the very simple "Big Mac Index" in economics. But the idea for a quantitative approach—capturing "contextuality" as "similarity" to what already exists in a region—could that really be a meaningful indicator of the phenomenon? Surely, only in strictly limited ways. But there are also see a connection to (social) sustainability, with its inherent demands for quantification.

The Social Sustainability Context

Urban planning and planning policies address functional aspects and the *appearance* of cities improving "urban quality" (Vanegas et al., 2010; Parfect & Power, 2014). Regulations concerning monument and ensemble protection, development plans, and land-use planning are among the most important instruments. Sustainability and the climate balance of urban functions are becoming central issues (Wheeler, 2016). The sustainability qualitys of buildings and architecture are significant in this context. The livability and quality of life in a city in the age of rising temperatures and water shortages in many regions depend largely on its building stock.

In addition to planning methods, sustainability requirements derived from building codes, building-related life cycle assessments (LCA), or certifiers' criteria play an increasing role. All this contributes to a significant increase in the complexity of creating sustainable cities. In addition to ecological life cycle assessments (LCA), social life cycle assessments (sLCA) are also conducted. The method has been internationally standardized by ISO

14075:2024. (ISO, 2024). Social LCA here is defined as "compilation and assessment of the socially relevant inputs and outputs and the potential social impacts of a product system throughout its life cycle". It must be related to a so called functional unit, as square meters of a building e. g. As social impact, "aspects relating to human well-being of interested parties" are mentioned in a very wide manner. Unlike standard LCA, qualitative data are accepted here beside quantitative. Since this industry standard is still new, certain qualitative dimensions remain underdeveloped. Aspects of architectural identity are not explicitly addressed, as the standard describes a general method applicable to all industrial and economic activities. Aesthetics are not directly addressed, as factors like labor conditions, human rights, community impacts, health and safety are focused. But in the given framework of governance and cultural heritage, architectural identities can be considered indirectly. For example, "access to immaterial resources" and the "protection of regional identities" may be reflected through governance measures like stakeholder participation, which ISO 14075 explicitly mentions as beneficial.

In such a framework, quantification gains importance. Aesthetics can be methodologically integrated. Social sustainability as mentioned in the academic literature includes criteria such as the quality of stay in neighborhoods, neighborhood conservation, and acceptance of urban design (Allam et al., 2024). This essay proposes a way to reduce the complexity of sustainable architectural (urban) planning in light of these circumstances.

Green Building and City Planning and the Need for KPIs

Quantification might be useful as both, a planning "tool" and a rating "instrument". A simple "visual proxy" for assessing the site-specific coherence and appropriateness (contextuality) of buildings is introduced and tested here, derived from visual comparisons of buildings. It has been designed to be very easy to calculate (see The BSI Indicator).

This attempt comes at a time when AI is becoming relevant in many areas of urban planning (Jiang et al., 2025). Other visual methods analyze urban streetscape attributes for planning and research. For example, computer vision techniques analyze urban streetscapes by processing geo-tagged street view images to extract detailed data on greenery, pavement materials, building facades, and urban furniture for urban researchers and planners—but their utility remains open (Liu & Sevtsuk, 2024). Personal reactions, so-called "emotional landscapes" or "emotional maps", have been created as indicators of human-building (architecture) interaction (Meenar et al., 2025).

Not only sustainability ratings rely on quantifiable, comparable values. Construction companies and other stakeholders require measurable key performance indicators (KPIs) to assess sustainability goals (Droutsa et al., 2023; Saradara et al., 2024). Durability – linked to perceived adequacy (Bergmeister & Taferner, 2023) – as well as the social qualities of "green buildings" are significant factors. Second, AI-based research requires purely visual criteria for comparison. Third, rating methods could serve as additional tools for professional agents, such as building authorities, in their decision-making processes.

Within this framework, simple and easy-to-understand tools like the BSI can serve as a communicative aid for architects. They can be seen as a form of quantitative storytelling—simplifying a complex phenomenon of perception into straightforward comparative data. Within the Green Building framework, where energy and cost efficiency dominate construction priorities, the role of atmospherically sensitive, critical architecture is increasingly sidelined. Emotional arguments are undermined (Pallasmaa, 2014; Grossarth, 2025). However, if atmospheric perception is as complex as it appears – and easily ignored in decision marking as "merely subjective" –, a purely efficiency-driven approach is insufficient. A more contextually appropriate architecture could also strengthen environmental concerns. This link is particularly evident in the preservation value and, consequently, the longevity of buildings – factors crucial to sustainability and life cycle assessments in the construction industry.

This study proposes a very simple – and admittedly too simple – method for quantifying architectural contextuality using AI-based visual comparisons. It might offer a quantifiable 'proxy' for a complex personal judgment that is based on emotional reactions, experience, culture and knowledge. The aim is to give the atmospheric and identity-forming qualities of architecture a "voice" within technically and economically dominated decision-making environments — one that can be recognized and understood even in those contexts.

BEYOND THE QUANTIFIABLE: PERCEPTUAL PHENOMENA OF URBAN "CONTEXTUAL ADEQUACY"

But how useful are image-based data-driven methods in adequately addressing complex, subjective and highly knowledge dependent phenomena such as judgments about appropriateness or similarity, coherence, or architectural quality?

Contextual Suitability is a big issue in architectural academics and urban planning practice (Vukmirović et al., 2015; van der Linden, 2021; Al-Hammadi & Grchev, 2023). On what terms can a building be appraised as "adequate" or "suitable" for its environment? Such a judgment is highly personal and subjective. Senses, feelings and experiences play key roles (Pallasmaa, 2024), but it is not purely subjective. The experience of "suitability" of architecture is intersubjectively sharable, as many results of empirical aesthetics show (Jacobsen, 2006; Jacobsen & Beudt, 2017; Vartanian et al., 2013). Many factors play a role, including proportions, colors, materials, and style. However, even (radical) changes in styles and patterns can be perceived as adequate, while others are dismissed as "eyesores" (German: *Bausünden*). In professional contexts, such judgments are made by architectural juries, where senses, experience, knowledge, and underlying narratives shape the decision-making process. A sense of adequacy or suitability (*Angemessenheit*) is often described as an affective intuition – essential not only in architecture but also in other fields such as even case law (Landweer, 2020). In this sense, feelings and sentiments play a crucial role. Wouldn`t any attempt to make such a phenomenon measurable be foolish? Maybe – but even a "foolish" indicator might address underrepresented interests of aesthetics in similary "foolish" environments. This is further discussed in this article later.

First, what exactly does the term contextuality describe? The contextual suitability of buildings within their environment has been discussed as a key quality feature of architecture for decades (Brolin, 1980), although this perspective appears to be fading into oblivion (Komez Daglioglu, 2015). Recent research, which includes quantitative and qualitative content analyses of academic publications on contextual architecture, has identified two main fields of interest: architecture in historic urban contexts and sustainable buildings (Yücel & Arabacioglu, 2023). Contextuality has been considered in physical, social, cultural, and local terms. Context matters not only for surrounding buildings but also for infrastructure and landscapes (Schmandt, 1999).

Contextual suitability is closely linked to the concept of atmospheres. Both are identifiable through personal perception and are hardly measurable. Locally working architects—especially those in heritage conservation—describe their profession as being sensitive to specific local craft traditions, the history of individual buildings, and the atmospheres they evoke like shown in field studies with house owners (Yarrow, 2019). Architectural atmospheres have been described in phenomenology as an in-between phenomenon that emerges from a given place, its spatial context, and the sensory impressions of the observer (Böhme et al., 2014). The perception of these atmospheres is, to a lesser extent, cognitive and more strongly "embodied" (Fuchs, 2017).

The atmospheric and thus identity-related value of contextuality applies not only to neighboring buildings but also to the broader area, even extending to the city as a whole. Relevant categories include building materials, colors, architectural styles, window shapes, doorway arches, roof forms, and the specific history of a building in terms of its usage and construction evolution. While architecture situates its designs within historical contexts, it also evolves them further. Stylistic inconsistencies and deliberate breaks with building traditions have long been part of modern architectural expression. By contrast, industrial housing construction in rapidly expanding cities is often characterized as dreary, monotonous, or part of a "cool technopolis" (Sennett, 2018). The new construction of office and multi-story residential buildings is frequently perceived as arbitrary—suggesting that such structures could exist anywhere in the world. This phenomenon is particularly evident in industrialized countries, where mass-produced building materials are widely available at low cost and where construction is heavily influenced by standardization and legal regulations. These regulations may pertain, for example, to fire safety or energy efficiency requirements for facades. As an unintended result, architectural qualities such as the situational appropriateness of a building are often lost.

THE BSI INDICATOR

The indicator is called "BSI", the "Building Similarity Indicator". BSI is modeled as follows:

It is suggested to simply paste a photo of a building into "Google Lens" (former *Google Reverse Image Search*) and calculate an average value based on the distances of the search results. As examples, visually similar results for a historical building and a "modern" commercial single-family house are shown here (Figure 1a).

The following specifications were established: The first 10 search results were located. If the reverse image search identified the exact same building, the result was ignored, as only comparisons between different buildings were considered meaningful. The next closest matches were then analyzed. In some cases, localization was unclear. Stock photos without a specified location were ignored. The handling of construction companies' websites, which showcase examples of their work without clear localization, remains a matter of debate. Generally, results were included if the construction companies operated regionally, while those from large national companies were excluded. In the case of regional firms, the location of their headquarters was used for index calculation.

Google Lens searches for "visual matches". The first 10 search results were quantified by measuring the distance between Point A, the location where the initial image was taken, and Point B, the location where the building visible in the search result is located. If a search result shows the building from the initial image or no building at all, the search result is skipped, and the next one is taken. This process continues until 10 distances could be measured. As mentioned before, buildings that are photographed too often, such as the Eiffel Tower, are excluded from the analysis, because it is very rare to find anything other than this exact building in the search

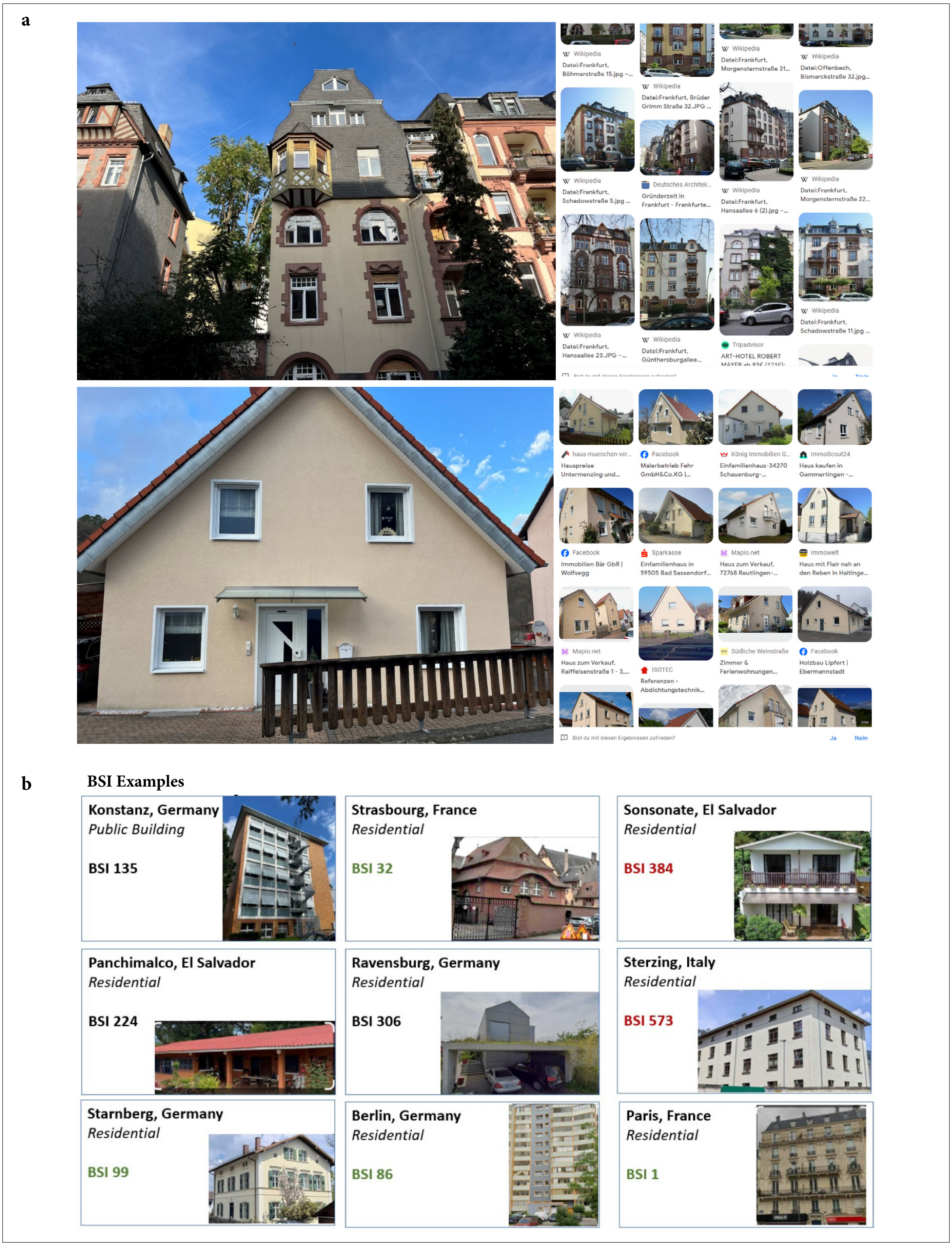

Figure 1. **(a)** Similar results for a historical building and a "modern" commercial single-family house. **(b)** Some of the BSI value examples.

results. If the search result shows a prefabricated house, the location of the prefabricated house company is used. If the result refers to a social media page, an attempt is made to find information about the location of the building there; otherwise, the location of the recipient is used (in our case, usually a craft business or construction company).

Using the ten distance values between the studied building and the search results, an average distance was calculated. To give statistical weight to buildings with many visually similar counterparts located within a relatively close range (under 100 km), some datasets were mathematically adjusted. The index value is based on the number of distance values below 100 km. If 0–2 of the ten distances were below 100 km, the index value equals the unadjusted average of all ten distances. If 3–5 distances were below 100 km, the average was reduced by one-third; if more than six distances were below 100 km, the average was reduced by half to determine the final index value.

BUILDINGS` BSIS: SOME EXAMPLES

Some examples for house images and their BSI values are listed in Figure 1b. One can, for example, see that the BSI does not increase with more recent construction years in any case. A residential building in East Berlin, for instance, has a low BSI value of 86. The typical GDR prefabricated slab building (1950s-1970s) is modern, yet regionally specific as BSI indicates. It's a striking irony: the absence of regional adaptation was a deliberate choice by GDR architects. While the same models were deployed across the GDR—making them regionally specific to socialist Eastern Europe—they were not locally adapted in architectural terms.

Another example shows accuracy of the BSI: The Parisian architectural style of the 19th century, with its cream-colored limestone and characteristic balconies, is highly specific and shows the lowest value, with a BSI of 1. A small townhouse in Alsace, France, is also strongly rooted in its regional context and ranks at BSI=32. This historic building likely dates from the late 19th or early 20th century and features a steep, multi-angled hipped roof, arched windows, and a red plaster façade, as typical of *Heimatstil* with *Jugendstil* influences, common in southern Germany or Alsace.

A post-war modernist building in Konstanz, Germany, shows numerous matches in the region—southern Germany—where floating window bands, the use of brick in the façade, and the flat roof are typical. This five-story building, likely from the 1950s or 1960s, is typical for West German postwar modernism in administrative or educational buildings. A modern exposed concrete villa, by contrast, shows little regional specificity; its value exceeds 300. Very high BSI values—and thus very low regional appropriateness—are seen in a multi-storey white-plastered building in Sterzing, Italy (BSI=573) – a solid, typical worker housing from the early 20th century in the broader alpine region – and in El Salvador (BSI=384), where similar climate-adapted styles —designed for cross-ventilation, sun protection, and outdoor living – appear in many Central American holiday home developments.

EMPIRICAL RESULTS

As some aspects on the "Google Lens" tool and the exact data collection procedure are described in the Appendix, this section presents the data characteristics and identifies statistical patterns.

Descriptive Statistics

The "BSI indicator" can accurately be interpreted as follows:

The higher the indicator value, the greater the spatial dispersion of the ten most visually similar comparison buildings. (*formal definition*)

Or, more freely interpreted:

The higher the indicator value for a building, the lower its similarity to other local buildings based on visual criteria and publicly available data on the internet. (semantic interpretation)

What do the data reveal? Are there any notable patterns in the statistical distribution? Yes, there are (Figure 2).

Age

The index value consistently increases with the building age categories. Newer buildings, with estimated construction years from 2011 onward, exhibit the highest index values. This can be seen as evidence of an international and national standardization of architectural styles, driven by the industrialization of building materials, the professionalization of project planning, and possibly also the harmonization of sustainability and construction standards, such as ISO norms. Thus, research question 1 ("Is such a loss in regional contextuality over time measurable by the suggested simple visual indicator?") can clearly be answered with "yes".

Country

Looking at the country-level distribution, different patterns emerge. Among the countries with larger datasets, the United Kingdom, Denmark, Czechia, Switzerland and France show lower index values. This can be interpreted as an overall greater local appropriateness of construction across architectural periods and building types. In the case of the United Kingdom, for example, this pattern aligns with findings that self-building or craft-based renovation is more common, while commercially organized new construction plays a lesser role. It is possible that different heritage protection standards also play a role, though

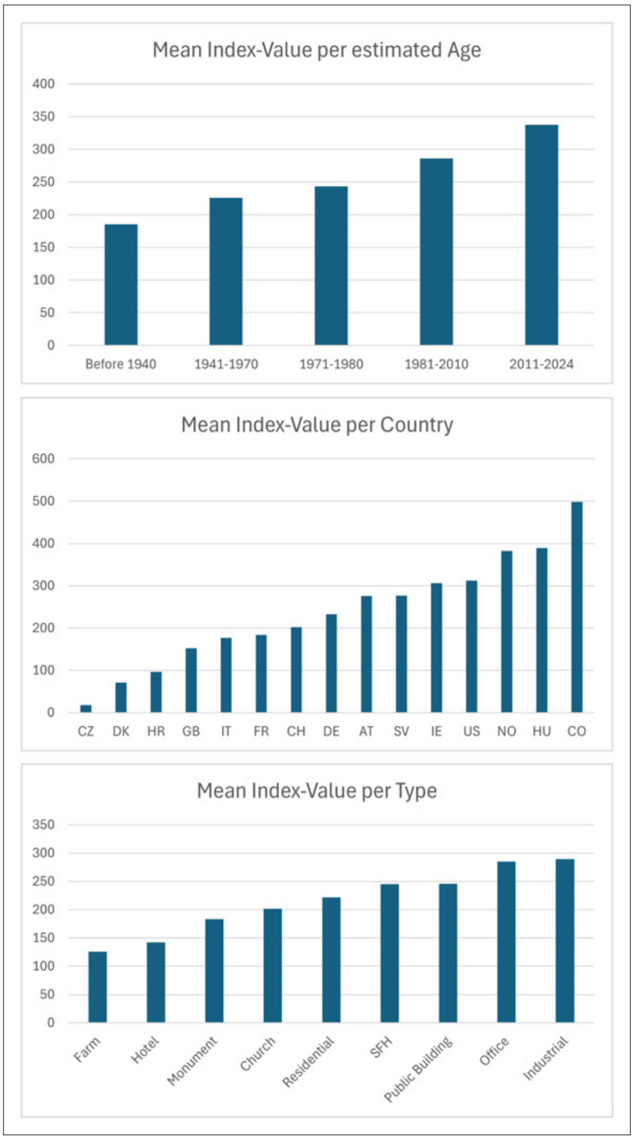

Figure 2. Descriptive statistics.

this remains speculative and would require further investigation.

Countries with particularly high index values include Austria, Germany, Hungary, Slovenia and Norway, as well as Colombia as an "outlier". One possible explanation for this could be a broader prevalence of industrially standardized building types and architectural styles.

Building Types

Differences also emerge regarding building types. Monumental buildings and agricultural structures exhibit greater local appropriateness compared to the overall average index value. Residential buildings fall into a middle range, while office and industrial buildings show the highest spatial dispersions of the ten most visually similar comparison buildings.

Remarks on Data Availability

Some aspects must be mentioned critically. In addition to statistical limitations of the explanatory regression models, there are also content-related limitations — this concerns, for example, the sources that “feed” Google Lens. Distortions are likely in this context. Sources from tourism and real estate sectors are often overrepresented in image archives, especially in regions with high tourism activity and extensive construction and real estate transactions. Representative and historically significant buildings are frequently photographed and can be accurately recognized by AI. If a region has little tourist appeal, there are, for example, fewer photos available as reference points. It is unclear what consequences this has for the explanatory power of the BSI. However, given the enormous flood of images on social media and the internet, it can be assumed that the data basis in industrialized countries is already very large and widespread by the mid-2020s. Therefore, the BSI is not significantly affected on the number of available comparison photos.

Further Examples of Intuitively (Non-) Valid BSI Indications

A historic urban villa in Vienna, with a mansard roof, Art Nouveau elements, and ornate façade detailing, might be considered highly place-specific. But the BSI value of 454 is high, as most visual matches are located in Munich (Figure 3). This could be due to the frequent use of yellow façade color in Munich. Here, the influence of color is likely overemphasized by the BSI. By contrast, a BSI of 1 for a grand corner building from the late 19th-century Viennese Gründerzeit period is intuitively convincing.

A Vienna residential building with BSI=693 represents contemporary minimalist architecture that prioritizes abstraction over regional references or contextual integration. Likewise, a BSI of 904 for an urban residential building with an angular, fragmented form, striped façade, and narrow balconies—typical of globalized contemporary architecture that emphasizes visual complexity over regional ties—also seems justified.

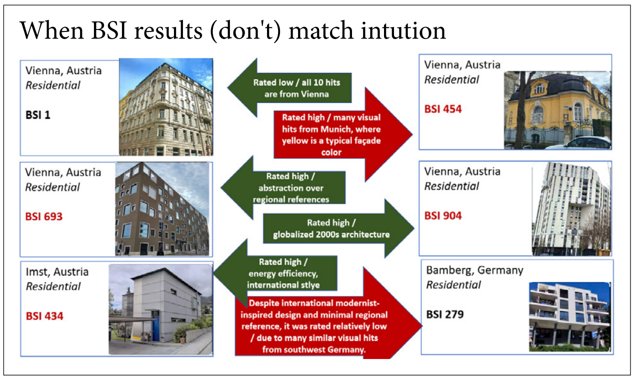

Figure 3. Visual matches that are located in Munich.

Regression Analysis and Interpretation

How about causality as statistically demonstrable? A simple statistical regression is used to examine which factors significantly influence the BSI value. However, since all explanatory variables—building type, construction age, and country—are binary-coded, the explanatory power of the results is limited. This section provides the rationale and discusses these limitations.

While different statistical distributions do not inherently indicate causality in terms of a explanatory power of "age", "country" or "type" for the BSI index value, an OLS regression models relationships between variables, which may be interpreted causally under certain assumptions (Wooldridge, 2016). In multivariate regression analyses, multiple explanatory variables are related to a dependent variable. We have included all binary-coded variables in an OLS model to explain the similarity indicator value (problems linked to this model are discussed later). The regression can be represented as follows:

BSI index= $\alpha+\beta_1$ *Type*$1+\beta_2$ *Type*$2+[\ldots]+\beta_n$ *Type* $n+\gamma_1$ Age$1+\gamma_2$ *Age*$2+[\ldots]+\gamma_n$ *Age* $n+\partial_1$ *Country*$1+\partial_2$ *Country2*$+[\ldots]+\partial_n$ *Countryn*,

where *BSI index* is the building similarity index, α is the intercept, β_n are the OLS regression coefficients for n building Types, γ_n for building age classes, ∂_n for countries, and where all explaining variables are binary coded.

The model must be interpreted with very great caution due to more than one reason. If there are interactions between building type, age and country that are not explicitly modeled, the estimates might be biased or incomplete (see also discussion). The overall explanatory power of the multivariate model is relatively low (Figure 4). The residual standard error is 165.3, which represents the average deviation of the observed values from the predicted values. A lower value would indicate a better model fit. The R^2 coefficient of determination is 0.1934, meaning that only 19.34% of the variation in the dependent variable is explained by this model. R^2 is relatively low what suggests that important explanatory variables may be missing or that the data exhibit high variability. The adjusted R^2 value is 0.1188, which accounts for the number of predictors. Since this value is lower than R^2, it indicates that some variables may not significantly improve the model. Overall, the model is statistically significant, meaning that at least one independent variable has an explanatory influence on the dependent variable (F-statistic: 2.592, p=5.017e-05). The intercept value (220.846, p=0.0769) suggests that if all explanatory variables were set to zero, the dependent variable would be approximately 220.8. However, this value is not highly significant (p>0.05) but is close to the threshold.

```
Residuals:
    Min      1Q  Median      3Q     Max
-320.05 -112.33  -41.61   95.70  473.29

Coefficients: (2 not defined because of singularities)
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)           220.846    124.397   1.775 0.076885 .
Type_SFH              -54.811     55.814  -0.982 0.326895
Type_Farm            -114.980     79.727  -1.442 0.150324
Type_Residential      -69.763     53.743  -1.298 0.195283
Type_Industrial        37.810     72.073   0.525 0.600251
Type_Office           -65.895     92.454  -0.713 0.476579
Type_Public.Building  -62.985     60.116  -1.048 0.295625
Type_Monument           9.471     67.764   0.140 0.888942
Type_Hotel           -151.385     69.929  -2.165 0.031209 *
Type_Church                NA         NA      NA       NA
Age_Before.1940        52.628     55.890   0.942 0.347155
Age_1941.1970          99.978     58.262   1.716 0.087220 .
Age_1971.1980         120.740     61.528   1.962 0.050669 .
Age_1981.2010         164.140     61.065   2.688 0.007601 **
Age_2011.2024         206.188     59.957   3.439 0.000669 ***
Country_GB           -119.696    109.796  -1.090 0.276537
Country_FR            -30.290    113.740  -0.266 0.790186
Country_AT              7.782    101.466   0.077 0.938916
Country_CH            -78.782    112.395  -0.701 0.483901
Country_DE            -20.128    100.130  -0.201 0.840826
Country_CO            125.777    193.458   0.650 0.516106
Country_CZ            -51.461    201.681  -0.255 0.798778
Country_DK           -180.061    156.240  -1.152 0.250075
Country_HR           -179.785    118.440  -1.518 0.130113
Country_HU            131.161    197.490   0.664 0.507123
Country_IE             54.238    111.063   0.488 0.625664
Country_IT            -77.868    102.366  -0.761 0.447462
Country_NO             91.144    153.929   0.592 0.554230
Country_SV            -26.804    136.463  -0.196 0.844420
Country_US                 NA         NA      NA       NA
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 165.3 on 292 degrees of freedom
Multiple R-squared:  0.1934,    Adjusted R-squared:  0.1188
F-statistic: 2.592 on 27 and 292 DF,  p-value: 5.017e-05
```

Figure 4. OLS regression.

The strongest and most significant relationships are observed in relation to the construction years of the buildings: The newer a building, the higher the value of the BSI. This - in line with the results of the descriptive statistic – suggests an increasing standardization or homogenization of modern buildings. Buildings from the most recent period, with estimated construction years from 2011 onward, show the highest positive and highly significant effect on BSI (206.188, p=0.000669, p<0.001). Buildings estimated to have been constructed between 1981 and 2010 exhibit a strong positive and significant effect on BSI (184.140, p=0.0076). Buildings from the 1971–1980 period also show a positive but only marginally significant effect. All older building age classes have positive but no longer significant effects, with those built between 1941 and 1970 coming close to the threshold for statistical significance. The significance levels remain comparable even when the explanatory variable classes Age and Country are omitted, which also helps reduce multicollinearity issues (see Appendix).

On the other hand, the only statistically significant explanatory variable among building types is the hotel category. Single-family houses show a negative but not significant effect (-54.811, p=0.327), while farms also exhibit a negative but not significant effect (-114.980, p=0.150). Similarly, residential buildings have a negative but not significant effect (-69.763, p=0.195). Industrial buildings, on the other hand, show a positive but not significant effect on BSI (37.810, p=0.600). Office buildings (-65.895, p=0.477) and public buildings (-62.985, p=0.296) also display negative but not significant effects. Heritage buildings have only a very small and non-significant effect (9.471, p=0.889). It is worth noting that the regression does not return values for churches (NA), which suggests that this category was excluded due to multicollinearity. Hotels, however, exhibit a significantly negative effect ($p<0.05$), meaning that these buildings have significantly lower values for the dependent variable (-151.385, p=0.031). In other words, if a building is classified as a hotel, its architecture is significantly more similar across all observations.

Also, the country comparison in the OLS model is not very informative. No country shows a highly significant deviation. However, there is a tendency for some countries with less standardized construction methods, such as Denmark and the United Kingdom, to have negative values.

A key issue affecting the overall model fit is likely the exclusive use of binary explanatory variables (Frazis & Löwenstein, 2003). A model with only binary predictors in many cases has the deficit that the coefficient only reflects the average difference between groups (e.g., houses in Germany versus all countries) and cannot truly be interpreted as a "causal" effect in the strict sense. Since all explanatory variables are binary, each coefficient represents the expected difference in the BSI index when the variable is 1 compared to the reference category (which is implicitly set to 0). However, this does not necessarily imply a causal effect unless endogeneity issues (e.g., omitted variables, selection bias) are addressed. In particular, the binary structure of the "explanatory" variables proves to be a methodological problem. An improved model with additional explanatory variables could help improve the model`s quality. A deeper analysis of construction years could reveal patterns explaining why newer buildings have higher index values. The non-significant country effects could be further investigated with additional data, e. g. regional.

Personal Reflection on This Work

The result is interesting: It conveys something meaningful. But actually, this isn't primarily about the "BSI indicator value" itself. It's more about the combination with the image results from Google – and what they reveal. In combination, BSI value and interpretation yield a "quantitative storytelling" about similarity and adequacy. What is needed now is a follow-up study asking: Do the buildings with a low BSI score correspond more closely to your aesthetic preferences than the others? Because the original idea was to use similarity to geographically nearby buildings as a kind of proxy for appropriateness – and ultimately, that's about aesthetic perception.

CONCLUSION

In the 2020s, construction experts often build in ways that no longer fit the surrounding place. This article addressed this as a serious concern. While the method may seem somewhat playful, also the suggested approach has it`s technocratic side. Quantifying contextual adequacy – seriously? The aim, however, was to enable a quantification of the phenomenon of architectural appropriateness in the professional areas, where quantification is needed. This research did this in order to allow the usage of BSI for a subsequent, meaning-generating interpretation.

With the BSI, a simple similarity indicator was proposed and tested using 320 data sets. It reflects similarity to architectural styles based on the geographical proximity of a building. This was proposed as an approximation of the more complex phenomenon of appropriateness in architecture.

The BSI index has significant weaknesses. What does such an indicator based on geographical proximity not represent?

- It defines geographic contextuality rigidly in terms of distance in kilometers. But in post-postmodern times and cities, given a high variety and architecturally "salad bowl" character of streets, neighbourhoods and city quarters, BSI can hardly be seen as an appropriate single measure. What in a specific street or backyard situation might be seen as "appropriate" by architectural experts or by majorities of laypeaople, might be not in the next. In such urbanized contexts, the BSI easily fails.
- BSI is not suitable for evaluating exceptional architecture that does not aspire to regional similarity, but achieves a sense of appropriateness through stylistic ruptures, modernity, and breaking out of the expected framework.
- The indicator can strongly overemphasize a single aspect of similarity — such as a material or color (see sec. 4) — even when the "trained human eye" would still judge a building as highly appropriate to its local context.
- In other specific cases, the indicator can also fail significantly. For instance, there is a geographic boundary where traditional stone and half-timbered construction meet. Here, a comparison value like "500 km" tells us little—certainly, a half-timbered house is more "similar" to another half-timbered house 500 kilometers away than to a natural stone house just 10 kilometers away.
- The indicator also exhibits other distortions. The more widely a historical building style or material is geographically distributed, the more the BSI shows upward bias. The honey-colored sandstone of the British Cotswolds, for example, is a highly region-specific material—very low values are "naturaly" to be expected here. In contrast, traditional Asian bamboo construction is spread over thousands of kilometers.

However, the indicator also shows strengths:

- It identifies and "acknowledged" highly complex weightings of forms, colors, materials, and façade elements in many cases.
- In many cases, the BSI does provide a reasonable indication of geographical contextuality. For mass housing or single-family homes, this criterion often aligns with the needs of the users on-site, though it is increasingly disregarded. For these areas, the BSI appears to be a not entirely pointless quantitative "tool" for supplementary evaluation, but a meaningfully interpretable representation of social values.
- In the case of individual projects or plans, the BSI is only meaningful when combined with a qualitative interpretation of the visual results. (Only in the case of large-scale comparisons, its value can carry significance on its own).

In summary, the BSI has some charm – but won`t heal the sufferings of socially unsustainablle construction. The indicator was deliberately kept simple. It provides results that are intuitively understandable. The houses exhibit comprehensible similarities regarding facade materials, the number and placement of windows and doors, and the colors and shapes used. The BSI provides a certain statement about the appropriateness in terms of a visual overall impression.

Descriptive data of 320 datasets and statistical tests demonstrate that newer buildings are increasingly arbitrary in their design. With regard to the first research question, this means that the BSI, as a quantifiable measure, reliably indicates regional contextuality based on diverse visual criteria (Figure 5). Furthermore, by linking contextuality to cultural values and the protection of cultural identities, the BSI could potentially be integrated into sustainability evaluations such as social life cycle assessment (sLCA). However, as a quantifiable indicator, it should also be viewed in that context as complementary to participatory approaches such as stakeholder dialogues, which may be more suitable for capturing personal experiences of contextuality and identity-related aspects of architecture.

In further research, the BSI:

- could be generated automatically or calculated using Artificial Intelligence (AI) tools, allowing for the analysis of even larger datasets.
- is also relevant for further cross-country comparisons or more precise analyses of construction years, particularly when based on actual rather than estimated building dates.
- could be tested against empirical studies on aesthetic perception to examine whether buildings with lower BSI scores are perceived as more appropriate—thus validating the indicator's underlying hypothesis.
- should be further integrated into sLCA and other social sustainability assessment frameworks, with detailed methodological development.

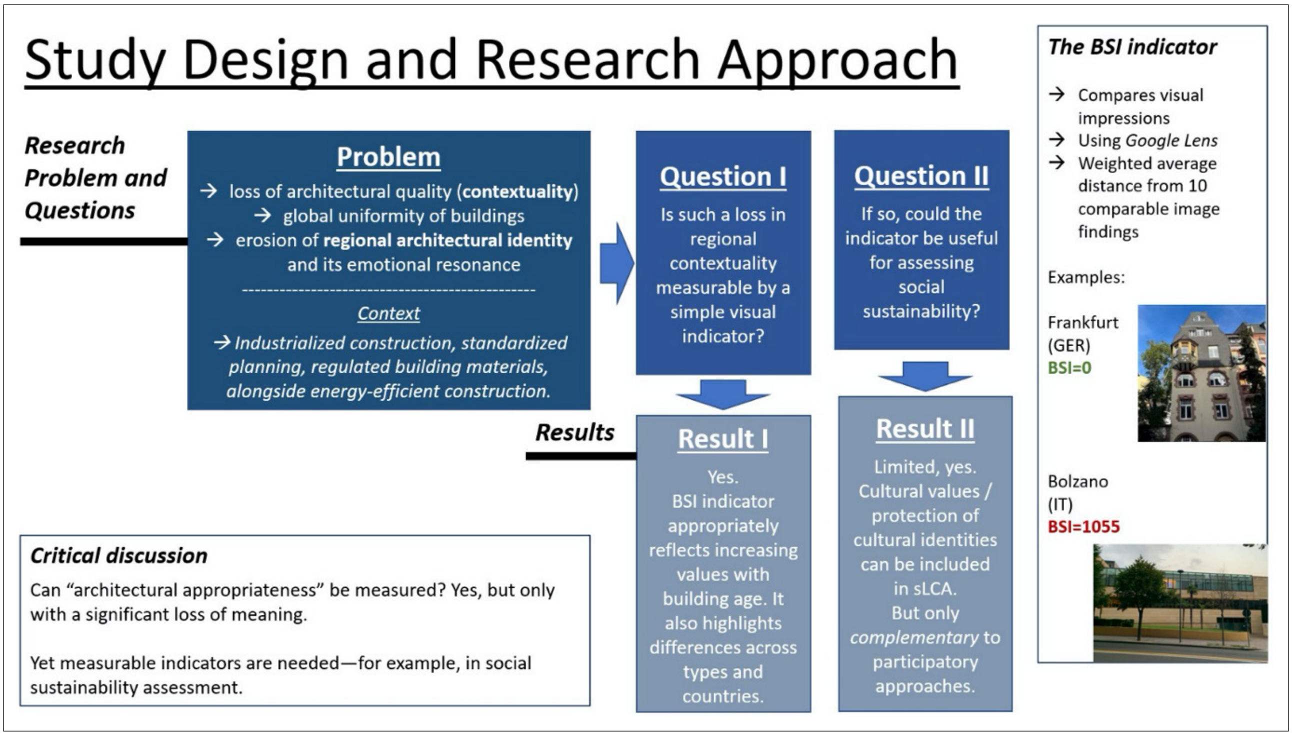

Figure 5. Approach of this study.

The true qualities of architecture surpass what can be expressed in numbers and metrics. The sense of appropriateness of a building to its location requires knowledge, a trained eye, and a multimodal perception of the surroundings. However, the attempt to measure the "immeasurable"—even if somewhat playful in intent—is not without interest. The results demonstrate high plausibility and primarily reflect the increasing arbitrariness of architecture throughout the 20th century. Ironically, a formal quantitative indicator – while largely simplifying an experimental phenomenon – could contribute to re-focus on the socio-material richness of buildings. Quantification is the language of industrial engineering. But social sustainability, as Lucius Burckhardt (2022) put it, means "minimal intervention" based on local awareness — and thus the preservation of regional anchors of identity.

Appendices: https://jag.journalagent.com/megaron/abs_files/MEGARON-12316/MEGARON-12316_(3)_MEGARON-12316_Appendices.pdf

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REFERENCES

Abel, C. (2012). *Architecture and identity*. Routledge. https://doi.org/10.4324/9780080939018

Akarsu, M. Z., Gharehgozli, O., & Atal, V. (2024). Big Mac affordability and income inequality across the European Union. *Journal of Economic Studies, 52(6), 1189–208*. https://doi.org/10.1108/JES-06-2024-0421

Al-Hammadi, N. A., & Grchev, K. (2023). Aspects of contextual architecture regarding traditional/contemporary architecture, physical/cultural and place identity: A systematic literature review. *Open House International, 48*(1), 119–40. https://doi.org/10.1108/OHI-01-2022-0007

Allam, Z., Sharma, A., & Cheshmehzangi, A. (2024). Life in the city: Behavioural changes can drive urban sustainability goals. *Cities, 151*, 105163. https://doi.org/10.1016/j.cities.2024.105163

Bergmeister, K., & Taferner, J. (2023). The beauty of simplicity and recyclability. In *International Symposium of the International Federation for Structural Concrete* (pp. 13–26). Springer. https://doi.org/10.1007/978-3-031-32519-9_2

Bitirim, Y. (2022). Retrieval effectiveness of Google on reverse image search. *JJournal of Imaging Science & Technology, 66*, 010505-1. https://doi.org/10.2352/J.ImagingSci.Technol.2022.66.1.010505

Böhme, G., Borch, C., Elíasson, Ó., & Pallasmaa, J. (2014). *Architectural atmospheres: On the experience and politics of architecture*. Birkhäuser. https://doi.org/10.1515/9783038211785

Brolin, B. C. (1980). *Architecture in context: Fitting new buildings with old*. Van Nostrand Reinhold.

Burckhardt, L. (2022). *The minimal intervention*. Birkhäuser.

Clements, K. W., & Si, J. (2017). Simplifying the Big Mac Index. *Journal of International Financial Management & Accounting, 28*(1), 86–99. https://doi.org/10.1111/jifm.12058

Droutsa, K. G., Balaras, C. A., Dascalaki, E. G., Kontoyiannidis, S., Moro, A., & Bazzan, E. (2023). Key performance indicators for sustainable Mediterranean buildings and cities. *IOP Conference Series: Earth and Environmental Science, 1196*(1), 012076. https://doi.org/10.1088/1755-1315/1196/1/012076

Frazis, H., & Löwenstein, M. A. (2003). Estimating linear regressions with mismeasured, possibly endogenous, binary explanatory variables. *Journal of Econometrics, 117*(1), 151–78. https://doi.org/10.1016/S0304-4076(03)00121-0

Fuchs, T. (2017). Embodiment – Verkörperung, Gefühl und Leibgedächtnis [Embodiment, feeling, and body memory]. *Psychoanalyse im Widerspruch, 29*(1), 9–28. https://doi.org/10.30820/0941-5378-2017-1-9

Groat, L. N. (2024). Contextual compatibility in architecture. In *Environmental Perspectives* (pp. 215–32). Routledge. https://doi.org/10.4324/9781003500582-17

Grossarth, J. (2025). *Bioeconomy of buildings: From resource flows to meanings*. Springer. https://doi.org/10.1007/978-3-031-84014-2

ISO. (2024). *Principles and framework for social life cycle assessment*. ISO 14075:2024

Jacobsen, T. (2006). Bridging the arts and sciences: A framework for the psychology of aesthetics. *Leonardo, 39*(2), 155–62. https://doi.org/10.1162/leon.2006.39.2.155

Jacobsen, T., & Beudt, S. (2017). Stability and variability in aesthetic experience: A review. *Frontiers in Psycholo-*

gy, 8, 143. https://doi.org/10.3389/fpsyg.2017.00143

Jiang, H., Li, M., Witte, P., Geertman, S., & Pan, H. (2025). Urban chatter: Exploring the potential of ChatGPT-like and generative AI in enhancing planning support. *Cities, 158*, 105701. https://doi.org/10.1016/j.cities.2025.105701

Komez Daglioglu, E. (2015). The context debate: An archaeology. *Architectural Theory Review, 20*(2), 266–79. https://doi.org/10.1080/13264826.2016.1170058

Landweer, H. (2020). Warum Normen allein nicht reichen. Sinn für Angemessenheit und Rechtsgefühl in rechtsästhetischer Perspektive [Why standards alone are not enough. A sense of appropriateness and legal feeling from a legal aesthetic perspective]. In *Rechtsästhetik in rechtsphilosophischer Absicht* [Legal aesthetics with philosophical intention] (pp. 61–84). Nomos Verlagsgesellschaft. https://doi.org/10.5771/9783748908784-61

Liu, L., & Sevtsuk, A. (2024). Clarity or confusion: A review of computer vision street attributes in urban studies and planning. *Cities, 150*, 105022. https://doi.org/10.1016/j.cities.2024.105022

Meenar, M., Pánek, J., Kitson, J., & York, A. (2025). Mapping the emotional landscapes of parks in post-industrial communities enduring environmental injustices: Potential implications for biophilic city planning. *Cities, 158*, 105692. https://doi.org/10.1016/j.cities.2024.105692

Ong, L. (2003). *The Big Mac Index: Applications of purchasing power parity*. Springer. https://doi.org/10.1057/9780230512412

Pallasmaa, J. (2014). Space, place and atmosphere: Emotion and peripheral perception in architectural experience. In Borch, C., ed. *Architectural Atmospheres: On the Experience and Politics of Architecture, Birkhäuser, 2014*, pp. 18-41. https://doi.org/10.1515/9783038211785.18

Pallasmaa, J. (2024). *The eyes of the skin: Architecture and the senses*. John Wiley & Sons. https://doi.org/10.1002/9781394200702

Parfect, M., & Power, G. (2014). *Planning for urban quality: Urban design in towns and cities*. Routledge. https://doi.org/10.4324/9780203754467

Saradara, S. M., Lara, J. C., Swarnakar, V., Rauf, A., Qureshi, R., Fadel, M., & Khalfan, M. M. (2024). Construction and demolition waste management in the United Arab Emirates through the 3R principle. *Engineering, Construction and Architectural Management, 31*(13), 430–54. https://doi.org/10.1108/ECAM-06-2024-0810

Schmandt, M. J. (1999). The importance of history and context in the postmodern urban landscape. *Landscape J, 18*(2), 157–65. https://doi.org/10.3368/lj.18.2.157

Schoper, T. (2016). *Ein Haus: Werk-Ding-Zeug?: Gespräche mit Gion A. Caminada, Hermann Czech, Tom Emerson, Hans Kollhoff, Valerio Olgiati [A House: Work-Thing-Tool?: Conversations with Gion A. Caminada, Hermann Czech, Tom Emerson, Hans Kollhoff, Valerio Olgiati]*. Passagen Verlag.

Sennett, R. (2018). *Building and dwelling: Ethics for the city*. Farrar, Straus and Giroux.

Van der Linden, M. (2021). *Architecture: Changing spatial transitions between context, construction and human activities*. Springer Nature. https://doi.org/10.1007/978-981-33-4658-1

Vanegas, C. A., Aliaga, D. G., Wonka, P., Müller, P., Waddell, P., & Watson, B. (2010). Modelling the appearance and behaviour of urban spaces. *Computer Graphics Forum, 29*(1), 25–42. https://doi.org/10.1111/j.1467-8659.2009.01535.x

Vartanian, O., Navarrete, G., Chatterjee, A., Fich, L. B., Leder, H., Modroño, C., Nadal, M., Rostrup, N., & Skov, M. (2013). Impact of contour on aesthetic judgments and approach-avoidance decisions in architecture. *Proceedings of the National Academy of Sciences of the United States of America, 110*(Suppl. 2), 10446–53. https://doi.org/10.1073/pnas.1301227110

Vukmirović, M., Vaništa Lazarević, E., & Marić, J. (2015). A new tool for assessment of contextuality of architecture. In *REAL CORP 2015. Plan Together–Right Now–Overall. From Vision to Reality for Vibrant Cities and Regions: Proceedings of the 20th International Conference on Urban Planning, Regional Development and Information Society* (pp. 39–48). Schwechat: CORP-Competence Center of Urban and Regional Planning.

Wheeler, S. M. (2016). Sustainability planning as paradigm change. *Urban Planning, 1*(3), 55–8. https://doi.org/10.17645/up.v1i3.740

Wooldridge, J. M. (2016). *Introductory econometrics: A modern approach* (6th ed.). Cengage Learning.

Yarrow, T. (2019). How conservation matters: Ethnographic explorations of historic building renovation. *Journal of Material Culture, 24*(1), 3–21. https://doi.org/10.1177/1359183518769111

Yuan, S., & Wu, X. (2021). Deep learning for insider threat detection: Review, challenges and opportunities. *Computers & Security, 104*, 102221. https://doi.org/10.1016/j.cose.2021.102221

Yücel, R. K., & Arabacıoğlu, F. P. (2023). “Context" knowledge in architecture: A systematic literature review. *Megaron, 18*(3), 366–86. https://doi.org/10.14744/megaron.2023.81594