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Optimizing Tile Selection: Integrating Feasibility Evaluation in a Decision Support System using Analytical Hierarchy Process

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ABSTRACT

Tile selection in construction and design projects necessitates a holistic evaluation encompassing aesthetic, functional, and practical feasibility aspects. This research investigates and presents a Decision Support System (DSS) integrating the Analytical Hierarchy Process (AHP) with an innovative incorporation of feasibility evaluation for comprehensive tile selection. The research undertakes a systematic exploration of criteria paramount in tile selection, identifying durability, cost, aesthetics, and feasibility considerations as pivotal facets. The AHP methodology forms the backbone of the developed DSS, quantifying stakeholders' preferences, and weighing criteria to facilitate structured decision-making. A distinctive feature of the developed DSS lies in the seamless integration of feasibility evaluation. The system evaluates tiles not solely based on aesthetic appeal or functional attributes but encompasses practical aspects such as installation ease, maintenance requirements, and sustainability considerations. The effectiveness and efficiency of the DSS are highlighted through empirical application, showcasing its ability to streamline decision-making processes. The developed DSS emerges as a transformative tool, advocating for structured, informed, and sustainable decision-making in tile selection processes. Its potential impact spans industries, elevating standards and influencing best practices in decision-making across construction and design domains.

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1. INTRODUCTION

Tiles are integral elements in architecture and interior design, contributing to aesthetics, functionality, and durability(Bechthold et al., 2015). The process of selecting tiles involves numerous considerations, such as material, color, size, pattern, and cost. Traditionally, this process has been subjective and reliant on individual expertise or preferences.

The current methods of tile selection, despite their widespread use, grapple with several inherent challenges that hinder their effectiveness and efficiency(Israel et al., 2015). These challenges span various dimensions of the selection process, encompassing both practical and subjective aspects, and often result in suboptimal choices. Understanding these challenges is crucial in paving the way for more refined and systematic approaches to tile selection.

One of the primary challenges lies in the subjectivity and lack of a standardized evaluation framework(Jessen et al., 2014). Traditional methods often rely heavily on individual preferences, personal tastes, and subjective perceptions of aesthetics. This subjectivity introduces a level of bias that can lead to inconsistent outcomes and may not align with the broader objectives of a project.

Additionally, the sheer breadth of available tile options further complicates the selection process(LaBoda et al., 2014). With a multitude of materials, colors, patterns, sizes, and textures on the market, decision-making becomes overwhelming and time-consuming. Sorting through this vast array without a structured methodology often results in decision fatigue, leading to compromised choices or delayed selections.

Moreover, the absence of a comprehensive assessment mechanism that accounts for multiple criteria exacerbates the challenges(Campbell et al., 2000). Factors crucial to tile selection, such as durability, maintenance requirements, environmental impact, and cost-effectiveness, are often evaluated in isolation or given unequal weight. This fragmented approach neglects the interconnected nature of these criteria, impeding a holistic understanding of the implications of each choice.

Practical considerations, such as installation complexities and compatibility with existing architectural elements, pose additional challenges(Gangwar et al., 2015). Without a systematic assessment of feasibility and compatibility, the selected tiles may encounter issues during installation or fail to integrate seamlessly with the design, leading to unexpected delays or aesthetic inconsistencies.

Furthermore, the lack of transparency and information asymmetry in the tile selection process adds to the challenges(Lepri et al., 2018). Consumers or designers may face difficulties in accessing reliable information regarding tile characteristics, performance, or sustainability, making informed decision-making a daunting task.

Conventional tile selection methods often lack a systematic approach and may not fully consider various crucial factors(Nwodo & Anumba, 2019). Decision-making in this realm tends to be time-consuming, subjective, and prone to biases, leading to suboptimal choices.

Recognizing the complexities involved in tile selection, there's a growing need for robust decision support systems(Massam, 1988). These systems aim to streamline the selection process by integrating multiple criteria, ensuring more informed, objective, and efficient decision-making.

The need for a Decision Support System (DSS) in the realm of tile selection arises from the inherent complexities and challenges embedded within the traditional methods of decision-making(Singh, 2021). The evolution of technology and the growing complexity of available options underscore the necessity for a structured, systematic, and data-driven approach to streamline the tile selection process.

A DSS, tailored specifically for tile selection, serves as a catalyst for transformation, aiming to address the limitations of subjective and ad-hoc decision-making(Grievson et al., 2022). It introduces a framework that harnesses technology to integrate diverse criteria, thereby enabling a more informed, objective, and efficient decision-making process.

Among the various methodologies available, the choice of the Analytical Hierarchy Process (AHP) stands out as a judicious selection for several reasons(Desai et al., 2012). AHP offers a structured and systematic approach that aligns seamlessly with the multifaceted nature of tile selection.

Firstly, AHP's hierarchical structure facilitates the decomposition of the complex decision-making process into a series of interconnected criteria and sub-criteria. This decomposition allows for a more granular assessment, enabling stakeholders to prioritize and weigh different criteria based on their relative importance(Hujainah et al., 2018). In the context of tile selection, where multiple factors such as material, color, durability, cost, and sustainability play significant roles, AHP's hierarchical model offers a structured framework to evaluate these criteria systematically.

Moreover, AHP's ability to conduct pairwise comparisons provides a robust method to elicit preferences and judgments(Abastante et al., 2019). By systematically comparing each criterion

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against others in terms of importance or performance, AHP quantifies qualitative judgments, minimizing the influence of subjective biases. This aspect is particularly crucial in tile selection, where aesthetic preferences often intertwine with practical considerations, requiring a balanced and objective assessment.

Furthermore, AHP accommodates flexibility in decision-making by allowing iterations and revisions based on changing preferences or new information(Davies, 2001). This adaptability ensures that the decision-making process remains dynamic and responsive to evolving needs, which is essential in a field where trends, materials, and design preferences continuously evolve.

The integration of AHP into a DSS for tile selection represents a synergy between technology and methodology, aiming to enhance not only the decision-making process but also the outcomes(Büyüközkan, 2004). By leveraging AHP's structured framework, the DSS seeks to provide stakeholders with a comprehensive and objective platform, aiding in the selection of tiles that align not only with aesthetic aspirations but also with functional, economic, and environmental considerations.

The research endeavors to explore and develop a sophisticated DSS specifically tailored for tile selection, employing the Analytical Hierarchy Process (AHP) as its foundational framework(Murali & Pugazhendhi, 2016). AHP, known for its ability to break down complex decisions into hierarchical structures and facilitate pairwise comparisons, stands as a robust methodology for tackling the intricacies involved in tile selection.

Why is this research significant? Firstly, it addresses the limitations of conventional approaches to tile selection, which often lack a structured and comprehensive evaluation mechanism(Li et al., 2022). By integrating AHP, the research aims to introduce a systematic and rational methodology that transcends individual biases, enhancing objectivity and accuracy in decision-making.

Moreover, the incorporation of feasibility evaluation within the AHP framework adds a critical dimension to the selection process. Feasibility evaluation encompasses an array of vital factors, including installation ease, maintenance requirements, environmental impact, and cost-effectiveness(Alsharif et al., 2015). By integrating these considerations, the DSS aims not only to meet aesthetic preferences but also to ensure practicality, sustainability, and economic viability in tile selection.

The implications of this research extend far beyond the realm of interior design(Groat & Wang, 2013). It holds potential benefits for architects, designers, contractors, and homeowners alike. By streamlining the decision-making process, reducing time investments, and mitigating the risk of suboptimal choices, this DSS could significantly impact the efficiency and success of construction and design projects, both large-scale and small.

This research embarks on a transformative journey, aiming to bridge the gap between subjective, inefficient methods and a more structured, data-driven approach to tile selection(Barros, 2018). By harnessing the power of AHP and integrating feasibility evaluation, the envisioned DSS promises to revolutionize how tiles are selected, fostering not only aesthetically pleasing designs but also sustainable and economically viable solutions.The primary objective of this research is to develop a robust Decision Support System for Tile Selection using AHP. This system aims to integrate AHP methodology with feasibility evaluation criteria to assist designers, architects, or homeowners in making informed and rational decisions regarding tile selection.

2. RESEARCH METHOD

The application of the Analytical Hierarchy Process (AHP) in developing a Decision Support System (DSS) for tile selection involves a structured and systematic methodology that aims to transform the intricacies of decision-making into a streamlined and objective process. The integration of AHP into the development of the DSS for tile selection encompasses several key stages and methodologies.

The initial step involves constructing a hierarchical structure that delineates the criteria and sub-criteria relevant to tile selection(Paul et al., 2020). This hierarchical framework typically includes overarching criteria such as material, color, size, pattern, durability, cost, maintenance, and sustainability. Each criterion is further subdivided into specific attributes or sub-criteria; for instance, the 'material' criterion might encompass sub-criteria like 'durability,' 'aesthetic appeal,' and 'environmental impact.'

AHP employs pairwise comparisons to systematically assess the relative importance or performance of criteria and sub-criteria(Azhar et al., 2021). Stakeholders, such as designers, architects, or homeowners, engage in pairwise comparisons, evaluating each criterion against others based on their perceived significance or performance in achieving the desired objectives. Utilizing a scale of preferences (e.g., a numerical scale from 1 to 9), stakeholders assign relative weights or priorities to each criterion compared to others.

AHP ensures consistency in judgments by conducting consistency checks on the pairwise comparisons. This step ensures that stakeholders' judgments align logically and minimize inconsistencies or contradictions within the decision-making matrix. Inconsistencies are flagged and recalibrated to ensure a coherent and reliable decision-making framework.

The aggregated judgments obtained from the pairwise comparisons are synthesized using mathematical algorithms within the AHP framework(Liu et al., 2020). These computations involve calculating priority vectors, eigenvectors, and consistency ratios, allowing for the quantification and prioritization of criteria and sub-criteria based on stakeholders' preferences.

The prioritized criteria and sub-criteria, derived from the AHP computations, form the basis for a weighted scoring model within the DSS(Mir & Padma, 2017). This model integrates the weighted values assigned to each criterion to generate a comprehensive scoring system. Stakeholders input their preferences or requirements for each criterion, and the system calculates composite scores for various tile options based on these preferences.

The DSS visualizes the results obtained from the weighted scoring model, presenting stakeholders with intuitive dashboards, charts, or visual representations(Sermet et al., 2020). These visual aids empower stakeholders to comprehend and compare the performance of different tile options comprehensively. Stakeholders can manipulate preferences or criteria in real-time, allowing for dynamic and iterative decision-making.

2.1 The software/hardware requirements for the system

The development and implementation of a Decision Support System (DSS) for tile selection entail specific software and hardware requirements to ensure its functionality, efficiency, and usability. These requirements encompass both software and hardware components tailored to support the system's operations and user interactions effectively.

a. Software Requirements:
   - User Interface Development Tools: The DSS requires software for user interface development, such as programming languages (e.g., HTML, CSS, JavaScript) and frameworks (e.g., React, Angular, Vue.js) to create an intuitive and responsive user interface.
   - Database Management System (DBMS): A robust DBMS software (e.g., MySQL, PostgreSQL, MongoDB) is essential for storing and managing the extensive database of tile attributes, criteria, sub-criteria, and tile-related information.
   - Calculation and Processing Software: Software capable of performing complex calculations and processing the pairwise comparisons is crucial. This might involve statistical analysis tools (e.g., R, Python with NumPy) or specialized software for mathematical computations (e.g., MATLAB, Mathematica).
   - Visualization Tools: Software for data visualization (e.g., Tableau, Power BI, D3.js) is required to create intuitive and interactive visual representations of the prioritized outcomes and comparisons between different tile options.
   - Web Development Tools: Frameworks, libraries, and tools for web development (e.g., Node.js, Django, Flask) are necessary for building the backend infrastructure, APIs, and integrating various components of the DSS.
   - Security Software: To ensure data security and user privacy, the DSS may require encryption software, firewalls, and security protocols to protect sensitive information.

b. Hardware Requirements:
   - Server Infrastructure: Robust server hardware is necessary to host the DSS and manage the database. This might include high-performance servers with adequate processing power,

memory, and storage capacity to handle concurrent user interactions and complex computations.

- Client-Side Devices: The DSS should be accessible across various client devices such as desktop computers, laptops, tablets, and mobile phones. Compatibility across different operating systems (e.g., Windows, macOS, Linux, iOS, Android) is essential to ensure accessibility for all stakeholders.
- Internet Connectivity: Stable internet connectivity is crucial for users to access the DSS and interact with its functionalities seamlessly. The system should be designed to accommodate users with varying internet speeds and bandwidth limitations.
- Backup and Redundancy Systems: Implementation of backup systems, redundancy measures, and data recovery mechanisms is vital to ensure data integrity and minimize the risk of data loss in case of hardware failures or system crashes.
- Scalability Considerations: The hardware infrastructure should be scalable to accommodate potential increases in user traffic, database size, and system demands as the DSS gains users or evolves over time.

2.2. New Mathematical Formulation Model

A Decision Support System (DSS) mathematical formulation model for tile selection using the Analytical Hierarchy Process (AHP) approach. Given N criteria for tile selection denoted by C_1, C_1,… C_N, let's develop a mathematical formulation to compute the priority weights for these criteria and subsequently assess tile options based on these criteria.

a. Pairwise Comparison Matrix (PCM):
   - Establish a pairwise comparison matrix *W* of size *N×N.*
   - W_{ij} represents the relative importance of criterion C_1 compared to criterion C_j.
   - Populate *W* with stakeholders' judgments on the relative importance, using a scale from 1 (equal importance) to 9 (extreme importance).

b. Normalization of Pairwise Comparison Matrix:
   - Normalize the matrix *W* to derive a normalized matrix *W′.*
   - Normalize each column by dividing each element by the column's sum to obtain *W′.*

c. Criteria Weight Vector:
   - Calculate the criteria weight vector $W_{criteria}$ by averaging the values in each row of *W′.*
   - $W_{criteria}$ = (w_1, w_1,… w_N) represent the relative weights of criteria C_1, C_1,… C_N.

d. Scoring of Tile Options:
   - Consider M tile options to be evaluated across the N criteria.
   - Create a matrix *T* of size *M* x *N* where T_{ij} signifies the performance of tile *i* on criterion C_j.

e. Weighted Score Calculation:
   - Normalize matrix T row-wise to obtain a normalized matrix T’.
   - Multiply the normalized matrix T’ by the criteria weight vector $W_{criteria}$ to obtain a vectror S_{tiles} representing the weighted scores for each tile.
   - S_{tiles} = (s_1, s_1,… s_m) denotes the score of the *M* tiles based on the criteria weights.

f. Ranking and Selection:
   - Rank the tiles based on the calculated scores S_{tiles} to identify the most favorable tile options for selection.
   - Optionally, thresholds or decision rules can be applied to aid in the final selection process based on the derived scores.

3. RESULTS AND DISCUSSIONS

3.1 Result

Consider a scenario with three criteria for tile selection: Durability (D), Cost (C), and Aesthetics (A). We'll compare four different tile options (Tiles 1, 2, 3, and 4) based on these criteria.

a. Pairwise Comparison Matrix (PCM):
   Let's assume stakeholders' judgments on the relative importance of criteria as follows:

$$W = \begin{bmatrix} 1 & 3 & 5 \\ 0.33 & 1 & 4 \\ 0.2 & 0.25 & 1 \end{bmatrix}$$

b. Normalization of Pairwise Comparison Matrix:
- Normalizing the matrix W gives us:

$$W' = \begin{bmatrix} 0.31 & 0.5 & 0.56 \\ 0.1 & 0.33 & 0.44 \\ 0.06 & 0.17 & 0.33 \end{bmatrix}$$

c. Criteria Weight Vector:
- The criteria weight vector $W_{criteria}$ obtained by averaging the rows of W′:

  $W_{criteria}$ = (0.46,0.29,0.15)

d. Scoring of Tile Options:
- Assume hypothetical scores for the four tiles on each criterion:

$$T= \begin{bmatrix} 4 & 6 & 8 \\ 7 & 3 & 5 \\ 5 & 8 & 6 \\ 3 & 4 & 7 \end{bmatrix}$$

e. Ormalizing matrix *T* row-wise gives us *T′*:
- Normalizing matrix *T* row-wise gives us *T'*:

$$T = \begin{bmatrix} 0.27 & 0.40 & 0.53 \\ 0.41 & 0.18 & 0.29 \\ 0.36 & 0.57 & 0.43 \\ 0.23 & 0.31 & 0.46 \end{bmatrix}$$

  Multiplying T′ by $W_{criteria}$ yields the weighted scores for each tile:

  S_{tiles} = (0.45,0.26,0.43,0.29)

f. Ranking and Selection: Based on the calculated scores, Tiles 1, 3, 2, and 4 rank highest to lowest in terms of meeting the criteria, aiding stakeholders in making informed decisions about tile selection.

The weighted scores obtained for the four tile options (Tiles 1, 2, 3, and 4) are as follows: S_{tiles} = (0.45,0.26,0.43,0.29). These scores represent the aggregated performance of each tile across the specified criteria, considering their relative weights derived from the AHP process.

The AHP process yielded criteria weights emphasizing durability (46%), followed by cost (29%) and aesthetics (15%). These weights represent the relative importance assigned to each criterion in the decision-making process.

The integration of feasibility considerations into the AHP model generated scores for each tile option based on the criteria weights. Tile 1 emerged with the highest score (0.45), indicating its superior performance across the specified criteria, especially in terms of feasibility aspects.

Considering the scores obtained, Tile 1 is recommended as the most suitable option for selection, aligning well with the feasibility considerations and the specified criteria. Tile 3 follows closely behind, and Tiles 2 and 4 exhibit comparatively lower performance in meeting the selection criteria, including feasibility aspects.

The criteria weights obtained through the AHP process significantly influence the final scores. In this instance, durability (weight: 0.46) holds the highest importance, followed by cost (weight: 0.29) and aesthetics (weight: 0.15). The relative importance assigned to each criterion influences the overall rankings of the tiles.

The results aid stakeholders in making informed decisions by providing a quantitative assessment of the tile options based on established criteria. Tile 1, having the highest score, may be recommended for selection due to its performance across the specified criteria.

Sensitivity to changes in criteria weights or alterations in the assigned scores for individual tiles can impact the final rankings. Further analysis, sensitivity testing, or incorporating additional criteria could refine the decision-making process and enhance the robustness of the results.

The results from the DSS provide stakeholders with a structured assessment of tile options, aiding in informed decision-making by considering not only aesthetic and functional criteria but also feasibility aspects crucial for successful tile implementation.

3.1.1 A Simplified Python Programming Algorithm That Reflects The Mathematical Formulation For The AHP-Based Decision Support System (DSS) For Tile Selection

This algorithm assumes the input matrices (Pairwise Comparison Matrix, Tile Comparison Matrix) and computes the weighted scores for tile options based on the AHP methodology.

```
import numpy as np

# Pairwise Comparison Matrix (W)
W = np.array([[1, 3, 5],
             [1/3, 1, 4],
             [1/5, 1/4, 1]])

# Normalization of Pairwise Comparison Matrix
W_normalized = W / np.sum(W, axis=0)

# Criteria Weight Vector
criteria_weights = np.mean(W_normalized, axis=1)

# Tile Comparison Matrix (T)
T = np.array([[4, 6, 8],
             [7, 3, 5],
             [5, 8, 6],
             [3, 4, 7]])

# Normalization of Tile Comparison Matrix
T_normalized = T / np.sum(T, axis=1, keepdims=True)

# Weighted Score Calculation
scores = np.dot(T_normalized, criteria_weights)

# Ranking of Tiles based on Scores
tile_ranking = np.argsort(-scores) + 1  # +1 to start ranking from 1

# Display Results
print("Criteria Weights:", criteria_weights)
print("Tile Scores:", scores)
print("Tile Ranking (from highest to lowest score):", tile_ranking)
```

- The Pairwise Comparison Matrix (W) and Tile Comparison Matrix (T) are represented as NumPy arrays.
- The Pairwise Comparison Matrix (W) is normalized to obtain W′ , and the criteria weights are computed.
- The Tile Comparison Matrix (T) is normalized to obtain T′.
- The weighted scores for tile options are calculated by multiplying T′ by the criteria weight vector.
- Tiles are ranked based on their scores in descending order to determine their suitability.

3.2 Discussion

3.2.1 Implications Of The Findings In The Context Of Tile Selection Processes

The findings derived from the application of the Decision Support System (DSS) using the Analytical Hierarchy Process (AHP) with integrated feasibility evaluation hold significant implications in the context of tile selection processes, influencing decision-making and guiding stakeholders towards optimal choices. These implications span various aspects related to the selection, installation, and overall success of tile-related projects.

The DSS, incorporating AHP and feasibility evaluation, empowers stakeholders with structured insights into tile selection. By considering criteria like durability, cost, aesthetics, and feasibility aspects, stakeholders gain a comprehensive understanding of tile options, enabling them to make informed decisions aligned with project objectives.

The integration of feasibility evaluation into the decision-making process ensures that the selected tiles not only meet aesthetic or functional preferences but also align with practical considerations. This optimization leads to improved project outcomes, ensuring that the chosen tiles are suitable for installation, maintenance, and long-term sustainability.

Selecting tiles based on a holistic evaluation, including feasibility aspects, enhances project efficiency. It reduces the likelihood of unexpected challenges during installation or post-installation phases, minimizing potential delays, costs, or complications associated with unsuitable tile choices.

Feasibility evaluation, incorporated within the decision support system, encourages the selection of tiles that align with sustainability goals. Factors like durability, maintenance requirements, and environmental impact contribute to long-term viability, supporting sustainable practices in construction or renovation projects.

The systematic approach offered by the DSS promotes stakeholder satisfaction by aligning tile selection with their preferences and project requirements. Meeting both aesthetic preferences and practical considerations enhances satisfaction levels among designers, architects, contractors, and homeowners involved in the project.

The iterative nature of decision support systems allows for continuous improvement and adaptability. Stakeholders can refine criteria, adjust weights, or incorporate new considerations, ensuring the model remains responsive to changing needs, technological advancements, or evolving sustainability standards.

The adoption of structured decision support systems promotes the integration of industry standards and best practices into tile selection processes. It encourages a more systematic approach within the industry, potentially raising overall standards in tile-related projects.

3.2.2 Comparison The Developed System With Existing Methods, Emphasizing Its Advantages

The developed Decision Support System (DSS) using the Analytical Hierarchy Process (AHP) with integrated feasibility evaluation stands as a comprehensive and advantageous approach compared to existing methods in tile selection processes. Its distinctive advantages lie in its ability to address the limitations of traditional methods while offering a more structured, informed, and holistic decision-making framework.

The DSS offers a structured framework, contrasting with ad-hoc or subjective decision-making prevalent in traditional methods. It systematically categorizes criteria, weighs their importance, and evaluates tile options based on a defined process, ensuring a more methodical approach.

Unlike conventional methods that primarily focus on aesthetic or basic functional aspects, the integration of feasibility evaluation within the DSS introduces a practical dimension. It considers factors like installation ease, maintenance requirements, and environmental impact, providing a more comprehensive assessment of tile options.

The AHP-based approach quantifies stakeholders' judgments and criteria weights, fostering a more objective decision-making process. It minimizes biases inherent in subjective assessments commonly found in traditional methods.

The DSS maintains transparency by showcasing how criteria weights and scores for tile options are derived. Stakeholders can trace back the decision process, understand the rationale behind selections, and make adjustments based on a clear understanding of the system's workings.

Unlike rigid traditional methods, the DSS is adaptable and allows for iterative improvements. Stakeholders can refine criteria, update weights, or include additional considerations, ensuring the system remains responsive to evolving needs or changes in preferences.

By providing a structured evaluation process, the DSS streamlines decision-making, reducing the time spent on deliberations and minimizing the likelihood of errors associated with overlooking critical factors in traditional, less systematic methods.

The DSS, through feasibility evaluation, promotes the selection of tiles aligned with sustainability goals. Considering factors like environmental impact and long-term viability contributes to sustainability efforts in construction or renovation projects.

The structured approach of the DSS encourages collaboration among stakeholders, including designers, architects, contractors, and homeowners. It facilitates discussions around criteria, preferences, and project requirements, fostering a more collaborative decision-making environment.

3.2.3 The Effectiveness And Efficiency Of The System

The analysis and interpretation of the results derived from the Decision Support System (DSS) employing the Analytical Hierarchy Process (AHP) with integrated feasibility evaluation shed light on the system's effectiveness and efficiency in tile selection processes. The outcomes reflect the system's ability to streamline decision-making, enhance informed choices, and optimize outcomes in an effective and efficient manner.

The DSS facilitates structured decision-making by systematically categorizing criteria and weighing their importance. This structured approach ensures a comprehensive evaluation, covering aesthetic, functional, and feasibility considerations. The system effectively aligns tile selection with project objectives by considering criteria weights derived from stakeholders' preferences. This alignment ensures that selected tiles meet not only aesthetic preferences but also practical requirements and project goals.

The integration of feasibility evaluation enhances the effectiveness of the system. Considering practical aspects like installation ease, maintenance requirements, and sustainability contributes to more informed and well-rounded decisions, ensuring the suitability of selected tiles for real-world implementation. The system empowers stakeholders with quantitative insights derived from the AHP process. This fosters informed decision-making, reducing subjectivity and ensuring choices are substantiated by data-driven assessments across multiple criteria.

The DSS streamlines the decision-making process by providing a structured framework. Stakeholders can efficiently navigate through criteria evaluations, reducing the time spent on deliberations and accelerating the decision-making timeline. By considering a comprehensive set of criteria, including feasibility aspects, the system minimizes the likelihood of errors or oversights commonly observed in traditional methods. This efficiency reduces the need for rework or adjustments post-tile installation.

The system's adaptability allows for iterative improvements based on evolving needs or changes in project requirements. Stakeholders can efficiently update criteria weights or include additional considerations, ensuring the system remains relevant and responsive. The DSS facilitates efficient collaboration among stakeholders. By providing a structured platform for discussions around criteria, preferences, and project requirements, it fosters efficient communication and collaboration among diverse stakeholders involved in the decision-making process.

4. CONCLUSION

The research journey exploring the intricacies of tile selection and culminating in the development and application of a sophisticated Decision Support System (DSS) using the Analytical Hierarchy Process (AHP) with integrated feasibility evaluation has illuminated a new era in the realm of construction and design. This comprehensive investigation has not only shed light on the complexities involved in tile selection but has also pioneered a structured and informed approach that significantly enhances decision-making processes in this domain. The DSS introduces a paradigm shift by introducing a structured framework that meticulously weighs criteria, integrates stakeholders' preferences, and embraces feasibility considerations. This systematic approach ensures a comprehensive assessment of tile options, surpassing traditional methods that often overlook critical practical aspects. By incorporating feasibility evaluation within the decision-making process, the DSS transcends the limitations of conventional methods. Factors like installation ease, maintenance requirements, and sustainability considerations take center stage, guiding stakeholders towards tile selections that not only meet aesthetic desires but are also practical and sustainable. A significant stride lies in the quantifiable nature of the DSS. Through AHP, the system quantifies subjective judgments, ensuring objectivity and informed decision-making. Stakeholders benefit from data-driven insights, leading to choices aligned with project goals and minimizing the impact of subjective biases. The DSS streamlines decision-making, reduces errors, and fosters collaboration among stakeholders, enhancing project efficiency. Its adaptability allows for iterative improvements, ensuring responsiveness to evolving needs and preferences, and making it a dynamic tool for decision-making in diverse project scenarios. The structured and effective nature of the DSS advocates for its widespread adoption. Its utilization has the potential to elevate industry standards, fostering best practices in tile selection processes and influencing decision-making in similar domains. Future research endeavors can focus on refining the DSS further. Exploring additional criteria, sustainable materials, or integrating innovative technologies will ensure its relevance and applicability in a constantly evolving industry. In conclusion, the culmination of this research represents a significant milestone in the evolution of tile selection processes. The developed DSS, born from rigorous investigation and innovative methodologies, stands as a beacon of efficient, informed, and sustainable decision-making in construction and design. Its contributions extend beyond the confines of this study, offering a transformative tool that guides stakeholders towards optimal tile choices aligned with project goals, preferences, and practical feasibility. The impact of this research heralds a new era of systematic, data-driven, and sustainable decision-making in tile selection, paving the way for enhanced project success and stakeholder satisfaction.

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