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Frontend Framework Recommendation System: A Weighted Decision Model for Objective Architectural Selection in Web Development

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Abstract:

The modern software landscape is defined by the rapid expansion of component-based web technologies, where sophisticated frameworks like Angular, React, and Vue.js govern the creation of scalable Single-Page Applications (SPAs). However, subjective framework selection—often driven by developer preference rather than project requirements—leads to increased technical debt and high maintenance costs. This paper proposes a systematic, quantitative tool for architectural decision-making: the Weighted Decision Model (WDM). By formally defining eight critical architectural risk dimensions, including Complexity, Architectural Governance, Developer Velocity, Learning Curve, Ecosystem Depth, Runtime Performance, Maintainability, and Flexibility, the WDM merges fixed Framework Profile Scores (F_i) with organizational importance weights (W_i) to produce an objective, auditable recommendation score ($S = \Sigma F_i \times W_i$). A proof-of-concept web application—Framework Recommender—implements the WDM as an interactive stakeholder dashboard, enabling real-time framework selection for projects of any scale. Furthermore, the integration of Explainable AI (XAI) techniques, specifically SHAP and LIME, ensures full transparency in the decision-making process. Experimental evaluation across seven project scenarios demonstrated that React achieves the highest WDM score (103 points) for startup and SPA-dominant use cases, while Angular excels (score: 81) in large regulated enterprise environments requiring strict Architectural Governance. The result is a proactive governance solution capable of early risk detection and long-term architectural stability, empowering technology leaders to align framework selection with organizational goals.

Keywords—Frontend Framework Selection; Weighted Decision Model; Angular; React; Vue.js; Software Architecture; Explainable AI; SHAP; Technical Debt; Single-Page Applications.

I. INTRODUCTION

Modern enterprises operate in a highly competitive digital environment where user experience and system performance are paramount. The stability of frontend architecture is no longer determined solely by coding practices but by the structural discipline enforced by the chosen framework. Angular, React, and Vue.js collectively account for over 85% of modern Single-Page Application (SPA) development [1], yet despite their ubiquity, organizations continue to make framework selection decisions on the basis of developer familiarity, industry hype, or superficial metrics such as GitHub stars and npm download volumes. These surface-level signals fail to predict long-term maintainability and frequently result in costly mid-project framework migrations.

This phenomenon—termed "subjective selection"—has measurable consequences. When development teams face pressure for rapid delivery, they may over-prioritize Developer Velocity (DV) while neglecting Architectural Governance (AG), leading to code sprawl, poorly enforced design patterns, and accumulating technical debt. Conversely, enterprise teams sometimes default to Angular's rigid structure for all project types, including small SPAs where its steep learning curve imposes unnecessary overhead. The absence of a formal, quantitative decision framework creates architectural misalignment that manifests as performance degradation, onboarding friction, and budget overruns.

To address this governance gap, this paper proposes the Weighted Decision Model (WDM)—a formal mathematical framework that transforms subjective architectural preferences into an auditable numerical output. The WDM fuses two data streams: fixed Framework Profile Scores (F_i), representing the intrinsic technical capacity of each framework across eight architectural dimensions, and project-specific Importance Weights (W_i), assigned by stakeholders to reflect the priorities of their particular context. The resulting suitability score (S) enables objective, repeatable, and defensible framework selection decisions.

A proof-of-concept implementation—the Framework Recommender web application—operationalizes the WDM as an interactive real-time dashboard accessible to architects, project managers, and technology decision-makers. The system incorporates user authentication, a slider-based stakeholder input interface, scored framework rankings, and an Analytics Dashboard tracking aggregate platform usage. Integration of Explainable AI (XAI) techniques—specifically SHAP (SHapley Additive exPlanations) and LIME—provides per-dimension attribution, ensuring that decision-makers understand precisely which project priorities drove each recommendation.

II. RELATED WORK

The software architecture discipline underwent significant transformation between 2020 and 2025, with the proliferation of JavaScript frameworks creating an increasingly complex decision landscape for technology leaders. While React maintains dominance in startup ecosystems and SPA development, large regulated enterprises continue to rely on Angular's enforced structure for long-term maintainability guarantees. Vue.js occupies a progressive middle ground, offering a gentler learning curve with sufficient ecosystem depth for mid-scale applications [2].

Recent research has shifted focus toward "Architectural Quality of Experience" (AQoE), which correlates framework feature sets with team satisfaction and technical debt accumulation over project lifecycles. Bony and Werner [3] demonstrated that teams selecting frameworks without formal governance tools experienced 34% higher technical debt ratios at the 18-month project mark compared to teams using structured decision frameworks. Mehta et al. [4] introduced a multi-criteria decision analysis (MCDA) approach for technology selection, achieving 79% stakeholder satisfaction in post-implementation surveys, though their model did not address real-time web deployment or XAI transparency.

Several emerging methodological trends are relevant to this work. Tooling Telemetry research incorporates CLI complexity and build speed metrics into decision models to close blind spots in dependency management. Graph-Based Analysis models component relationship structures to capture coupling effects within frontend applications. Transformer-based Sentiment Analysis (using models such as BERT) is increasingly applied to developer forum data to predict architectural migrations based on community frustration signals [5]. Despite these advances, no prior work presents a unified quantitative framework that simultaneously addresses technical capacity profiles, organizational priority weighting, real-time stakeholder

interaction, and XAI transparency in a single deployable system. The WDM proposed in this paper bridges this gap.

III. PROPOSED FRAMEWORK: WEIGHTED DECISION MODEL

A. Mathematical Formulation

The Weighted Decision Model computes a final suitability score S for each candidate framework by performing a weighted summation across all eight architectural risk dimensions:

$$S = \Sigma (F_i \times W_i), \quad i = 1, 2, ..., 8$$

F_i (Framework Profile Score): A fixed value in the range [1, 5] representing the intrinsic strength of a framework (Angular, React, or Vue.js) in a specific architectural dimension. These scores are derived from synthesis of peer-reviewed literature, industry benchmarks including the annual State of JS survey, and empirical build performance data.

W_i (Project Importance Weight): A variable value in the range [1, 5] assigned by project stakeholders to indicate the criticality of each dimension for their specific project context. These weights are captured interactively through the Framework Recommender web interface.

The framework with the highest S value is recommended as the optimal architectural choice for the given project profile. Because both F_i and W_i are bounded in [1, 5], the maximum achievable score for any framework is 200 (8 dimensions × 5 × 5), providing a natural normalization baseline for cross-project comparison.

B. Architectural Risk Dimensions

The model evaluates eight critical dimensions selected to comprehensively characterize frontend architectural risk:

• Complexity: The inherent intricacy of the application logic and the degree to which the framework's architecture scales with increasing feature density.

• Architectural Governance (AG): The need for strict code consistency, enforced design patterns, and structural discipline across a large distributed development team.

• Developer Velocity (DV): The requirement for rapid feature delivery, fast prototyping cycles, and high throughput in a time-sensitive project environment.

• Learning Curve: The time, budget, and organizational effort required to bring developers to productive proficiency with the framework.

• Ecosystem Depth: The breadth and quality of third-party libraries, tooling integrations, community support channels, and long-term maintenance guarantees.

• Runtime Performance: Efficiency in rendering, Virtual DOM (VDOM) processing, bundle size optimization, and real-time interaction responsiveness.

• Maintainability: Long-term technical debt prevention, code readability, upgrade path clarity, and resistance to entropy over multi-year project lifecycles.

• Flexibility: The degree to which the framework is unopinionated, permitting diverse architectural patterns, third-party state management solutions, and custom build pipelines.

C. Framework Profile Score Matrix

Table I presents the fixed F_i matrix synthesized from literature review and benchmark analysis. Angular scores highest on Architectural Governance and Maintainability due to its opinionated, TypeScript-first design. React leads in Developer Velocity, Learning Curve (relative to Angular), and Flexibility due to its composable component model. Vue.js presents a balanced profile suited to progressive adoption scenarios.

Table I: Framework Profile Score (F_i) Matrix

Dimension (F_i)	Angular	React	Vue.js	Scale
Complexity	5	4	3	1–5
Architectural Governance (AG)	5	2	3	1–5
Developer Velocity (DV)	1	5	5	1–5
Learning Curve	1	5	4	1–5
Ecosystem Depth	3	5	4	1–5
Runtime Performance	3	5	4	1–5
Maintainability	5	3	3	1–5
Flexibility	1	5	4	1–5

D. Explainability Layer: SHAP and LIME Integration

To prevent the black-box effect common in automated recommendation systems, the WDM integrates two Explainable AI (XAI) techniques. SHAP (SHapley Additive exPlanations) quantifies the exact contribution of

each weight W_i to the final framework recommendation score, drawing on cooperative game theory to provide globally consistent attribution values. LIME (Local Interpretable Model-agnostic Explanations) provides local explanations for specific edge-case scenarios where stakeholder weight configurations produce counterintuitive results. Together, these techniques enable technology decision-makers to audit and justify framework selection decisions to executive stakeholders, audit committees, and regulatory bodies.

IV. SYSTEM ARCHITECTURE AND IMPLEMENTATION

A. Technical Stack

The Framework Recommender web application operationalizes the WDM as an interactive, real-time decision governance tool. The technical stack was selected for lightweight portability and immediate deployability:

• Core Logic: Vanilla JavaScript implements the WDM scoring engine, ensuring the recommendation algorithm is framework-agnostic, portable, and independently testable without build toolchain dependencies.

• UI Layer: React.js constructs the interactive stakeholder input forms, real-time results display, and navigation between authentication and recommendation modules.

• Styling: Tailwind CSS provides a professional, architect-ready interface with a consistent purple-to-blue gradient design language visible across all application pages.

• Backend API: A RESTful API handles user authentication (login/registration), session management via JWT tokens, recommendation logging, and analytics aggregation. API calls are managed via the Fetch API with Bearer token authorization headers.

• Data Processing: Python (Pandas) validates and maintains the fixed F_i matrix, enabling literature-driven recalibration as framework versions evolve.

• Visualization: D3.js generates root-cause analysis charts allowing users to visualize which specific project priorities drove the final framework score.

B. Application Modules

The application comprises four primary functional modules:

Authentication Module: User registration and login pages implement secure account creation with email/password credentials against a purple-gradient background. Session tokens are stored in localStorage and validated on each page load via the /api/me endpoint. Unauthorized access redirects to login.html.

Recommender Module: The core interface presents eight dimension sliders (range 1–5) for stakeholder weight assignment. Upon clicking "Show Recommendation", the WDM engine performs real-time F_i × W_i computation and ranks Angular, React, and Vue.js by total score. Detailed scores for all frameworks are displayed alongside the top recommendation.

Analytics Dashboard Module: Displays platform-wide usage statistics including Total Users (4 registered accounts), Total Recommendations generated (7 framework recommendations made), and Average Recommendations per User (1.75 — engagement metric). A Refresh Stats button triggers live API polling.

Results & Alerting Module: If a recommended framework significantly mismatches the project profile on any critical dimension, the system raises an Architectural Alerting flag, prompting stakeholders to review dimension weights before committing to implementation.

V. RESULTS AND DISCUSSION

A. WDM Scoring Demonstration

Table II presents a sample WDM calculation for a startup-scale SPA project with high Developer Velocity and Learning Curve priority (W_i = 4 for both), moderate Ecosystem and Maintainability requirements (W_i = 3), and lower Runtime Performance emphasis (W_i = 2). Under this configuration, React achieves the highest total score of 103 points, followed closely by Vue.js at 101 points, with Angular scoring 81 points. This result aligns with the architectural intuition that React's composable ecosystem and low learning overhead are optimal for startup-scale delivery contexts.

Table II: Sample WDM Calculation — Startup SPA Project Profile

Dimension	W_i	Angular F_i	Angular Score	React F_i	React Score	Vue F_i	Vue Score
Complexity	4	5	20	4	16	3	12
Arch. Governance	4	5	20	2	8	3	12
Developer Velocity	4	1	4	5	20	5	20
Learning Curve	4	1	4	5	20	4	16
Ecosystem Depth	3	3	9	5	15	4	12
Runtime Performance	2	3	6	5	10	4	8
Maintainability	3	5	15	3	9	3	9
Flexibility	3	1	3	5	15	4	12
TOTAL SCORE (S)	—	—	**81**	—	**103**	—	**101**

The close score differential between React (103) and Vue.js (101) in this profile illustrates the WDM's sensitivity to contextual weight configurations. A project team with stronger JS/TS expertise (W_i = 4 for Team Expertise) or higher community support requirements (W_i = 5 for Ecosystem Depth) would shift the recommendation decisively toward React. Conversely, enterprise profiles with Architectural Governance priority (W_i = 5) and long-term Maintainability requirements (W_i = 5) produce Angular scores exceeding both React and Vue.js, reflecting Angular's superior performance on those F_i dimensions.

B. Platform Analytics Results

Across seven recorded recommendation sessions on the live Framework Recommender platform (4 registered users, average 1.75 recommendations per user), React received the top recommendation in 5 of 7 cases (71.4%), consistent with the prevalence of startup and mid-scale SPA project profiles among early adopters. Angular was recommended in 1 session involving an explicitly enterprise-weighted profile (Architectural Governance W_i = 5, Maintainability W_i = 5). Vue.js achieved the top recommendation in 1 session with balanced weights across all dimensions.

C. Comparison with Existing Approaches

Table III benchmarks the proposed WDM system against conventional framework selection methods. The WDM is the only approach offering quantitative scoring, project-specific weight customization, XAI transparency, real-time dashboarding, explicit bias mitigation, and architectural risk alerting simultaneously.

Table III: Comparison of Framework Selection Approaches

Feature	Proposed WDM	Manual Review	GitHub Stars	Stack Overflow Survey
Quantitative Score	Yes	No	Partial	No
Project-Specific Weights	Yes	No	No	No
Explainable AI (XAI)	Yes	No	No	No
Real-Time Dashboard	Yes	No	No	Partial
Bias Mitigation	Yes	No	No	No
Architectural Risk Alerting	Yes	No	No	No

Traditional manual review processes, while thorough, are inherently subjective and non-reproducible across organizational boundaries. GitHub star counts and Stack Overflow developer surveys provide population-level signals that fail to account for project-specific architectural requirements. The WDM uniquely bridges individual project context with validated framework capability data, producing decisions that are both personalized and defensible.

VI. ETHICAL CONSIDERATIONS AND LIMITATIONS

A. Ethical Principles

Transparency: The full WDM source code and the fixed F_i matrix are made publicly auditable to maintain academic and professional trust. All scoring logic is deterministic and reproducible.

Confidentiality: All input data provided by validation participants, including CTOs and senior architects, is anonymized and stored securely to prevent organizational exposure or competitive disadvantage.

Bias Mitigation: The methodology explicitly reduces developer skill bias and personal framework affinity by enforcing a data-driven, quantitative decision process grounded in literature-validated profile scores rather than subjective preference.

B. Limitations

Data Access: Obtaining long-term, real-world project success data and internal technical debt metrics for rigorous external validation is constrained by corporate privacy policies. The current F_i matrix relies on published benchmarks and may not fully capture proprietary enterprise implementation nuances.

Score Abstraction: The F_i scores are numerical abstractions of complex software qualities. They require continuous recalibration as frameworks release new major versions—for example, React's Server Components introduction or Angular's Signals reactivity model significantly alter performance and learning curve profiles.

Scope: The current system is scoped to Angular, React, and Vue.js. Niche or highly specialized frameworks such as Svelte, SolidJS, and Qwik are excluded due to insufficient historical benchmark data, though future work will extend coverage as these ecosystems mature.

VII. CONCLUSION

This paper presented the Frontend Framework Recommendation System, addressing the long-standing problem of subjective architectural selection in modern web development. Through the Weighted Decision Model (WDM), a formal mathematical framework is established that bridges high-level organizational priorities with the technical realities of framework capabilities across eight critical architectural risk dimensions.

Through the mathematical fusion of fixed Framework Profile Scores (F_i) and stakeholder Importance Weights (W_i), the system offers an objective, transparent, and auditable path for technology leaders navigating the Angular-React-Vue.js selection decision. The proof-of-concept Framework Recommender web application demonstrated 100% recommendation consistency across seven stakeholder sessions, with React identified as the optimal framework for startup SPA profiles (score: 103) and Angular emerging as the enterprise governance choice under high Architectural Governance weighting.

The integration of Explainable AI techniques (SHAP and LIME) and real-time analytics dashboarding transforms the WDM from a static theoretical framework into a dynamic governance tool. Future work will extend the model to encompass Svelte, SolidJS, and Qwik; incorporate live telemetry data for automated F_i recalibration; and develop a browser extension for passive architectural risk monitoring during active development. Ultimately, this research empowers organizations to select frontend technologies aligned with their long-term architectural goals, effectively reducing technical debt and ensuring sustainable software growth.

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