
Original Research Article

Design and implementation of an intelligent virtual simulation experimental system for financial decision-making

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Abstract: Financial decision-making experiments should connect accounting evidence with investment, financing, budgeting, and risk choices, yet conventional exercises often use static datasets, isolate analytical steps, and provide delayed feedback. This paper presents the design and implementation framework of an intelligent virtual simulation experimental system for financial decision-making intended for students in finance, accounting, economics, management, and related business programmes. The proposed system adopts a five-layer architecture comprising presentation, business service, intelligent analysis, data, and infrastructure layers. Nine coordinated modules support scenario configuration, task management, financing and investment simulation, budget and cost management, rule-based analysis, process tracking, assessment, visualization, and administration. A closed-loop workflow links financial data acquisition, student analysis, decision submission, simulation calculation, feedback, performance evaluation, and strategy adjustment. The current study focuses on system architecture, functional design, implementation methodology, and a prototype-level evaluation framework. Empirical performance and classroom effectiveness are reserved for prototype deployment and controlled classroom studies under appropriate governance.

Keywords: financial decision-making; virtual simulation; intelligent experimental system; decision support; experimental teaching

1. Introduction

Financial decision-making requires learners to integrate accounting evidence with investment, financing, operating, and risk choices. Simulations support repeated complex-skill practice^[1], while finance and accounting cases connect models with decisions^[2,11]. Adoption depends on resources, instructional suitability, risk control^[3], and pedagogical coherence^[4]. This study presents a traceable design framework for students in finance, accounting, economics, management, and related business programmes, together with teachers and administrators.

2. Requirements and overall system architecture

Students analyze data and revise from feedback; teachers configure scenarios and criteria; administrators manage identities, permissions, audits, and backup. **Figure 1** separates presentation, business services, intelligent analysis, data, and infrastructure. Services coordinate tasks, simulation, assessment, feedback, and users; analysis applies transparent rules and summarizes risk and behaviour. Data and infrastructure provide controlled records, computing, security, logging, and backup. Cross-cutting controls support traceability^[5]. Evaluation criteria should be specified during prototype verification.

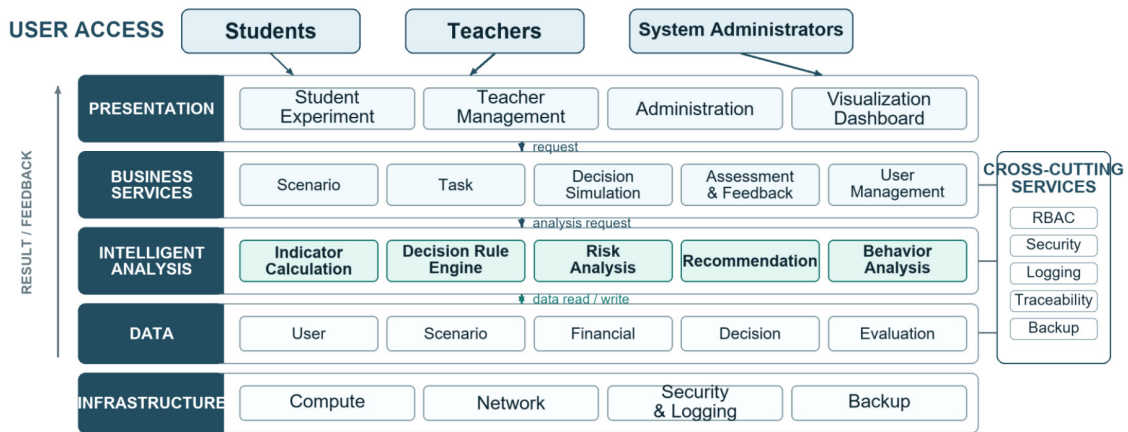


Figure 1. Overall architecture of the intelligent virtual simulation experimental system.

3. Design of core functional modules

Nine proposed modules form the functional chain: Scenario Management; Financial Decision-Making Task Management; Financing and Investment Simulation; Budget and Cost Management; Intelligent Decision Analysis; Learning-Process Tracking; Assessment and Feedback^[6]; Data Visualization; and System Administration. Together they connect versioned assumptions, objectives, calculations, indicators, actions, criteria, trends, users, audits, and backup. **Figure 2** links analysis, decision, simulation, feedback, adjustment, and renewed analysis. Teachers configure and review, the system calculates and logs, and students retain judgment^[7]. Versioned submissions preserve comparison and feedback traceability.

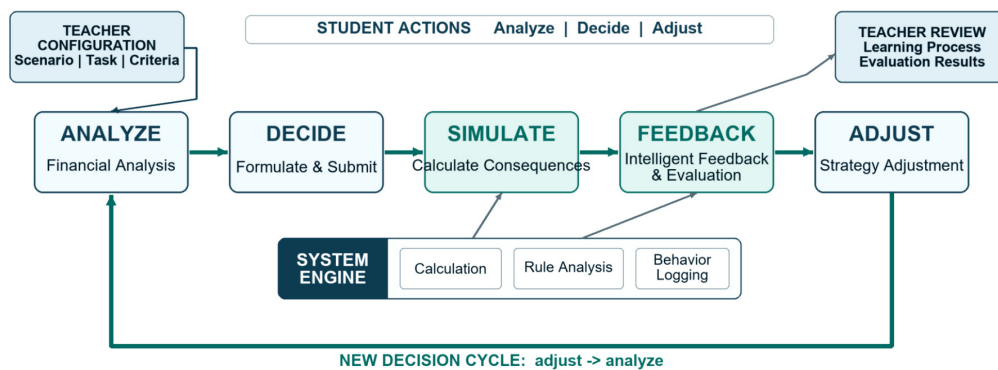


Figure 2. Closed-loop workflow of financial decision-making simulation.

4. Key technologies and implementation framework

Technology selection remains implementation-independent. A browser/server architecture can expose versioned interfaces; servers validate access and inputs, while clients support interaction and visualization. A relational model links scenarios, financial records, submissions, evaluations, and learning-process logs, while append-only records preserve provenance. The scenario engine should separate parameters, formulae, event rules, and evaluation rules. A configurable score may combine profitability, solvency, efficiency, risk control, and task completion with teacher-defined weights. Required safeguards include role controls, transport protection, credential hashing, least privilege, validation, audit, recovery, and data minimization.

5. System testing and application evaluation: Proposed evaluation protocol

No authenticated technical or classroom data are reported; evaluation is therefore a protocol, not an empirical claim. Functional verification should cover normal, boundary, invalid-input, authorization, and recovery cases; independent calculations should verify outputs; logs should preserve scenario, submission,

rule, and feedback versions. Performance tests should record latency, concurrent access, and stability under predefined workloads. Compatibility and security review should cover browsers, environments, roles, sessions, malformed requests, audits, backup, and restoration. Future classroom studies should predefine participants, consent, tasks, comparisons, outcomes, and user-perception measures. Public data may support prototype simulation but not an actual classroom user test.

6. Discussion

The design may connect financial knowledge with risk-free practice, visible consequences, and reviewable reasoning, consistent with simulation practice^[10] and learning analytics^[8]. Evidence for learning-analytics impact and adoption nevertheless remains limited^[9]; a dashboard or rule engine does not prove improved learning. Limitations include scenario validity, data quality, instructional fit, expert-rule bias, unvalidated weights, privacy risk, and incomplete market shocks. Knowledge graphs, adaptive analytics, digital twins, and generative AI remain future directions requiring governance and validation.

7. Conclusion

The study establishes five architectural layers, nine coordinated modules, and a closed workflow linking scenarios, decisions, calculations, feedback, evidence, and revision. The implementation-independent framework defines functional, security, traceability, and evaluation responsibilities. Empirical performance and classroom effectiveness should be examined through prototype deployment, technical verification, and controlled user studies.

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