University of Baghdad
College of Engineering
JOURNAL OF ENGINEERING

Journal of Engineering

journal homepage: www.jcoeng.edu.iq

Volume 31 Number 12 December 2025

Development and Application of an Investment Decision Support System Based on Life Cycle Cost Analysis: A Case Study on Residential Complexes

Alaa M Salah *, **Kadim Erzaij**

Department of Civil Engineering, College of Engineering, University of Baghdad, Baghdad, Iraq

ABSTRACT

The growing intricacy and financial risk of residential complex projects in emerging nations require dependable decision-support tools for early investment evaluation. This research presents the design and implementation of the Residential Investment Decision Support System (RIDSS), a specialized platform based on Life Cycle Cost Analysis (LCCA). RIDSS facilitates stakeholders to assess financial feasibility by employing economic indicators such as Return on Investment (ROI) and Profitability Index (PI), while also integrating sensitivity analysis (±10% or ±20% change in cost) and dynamic cost adjustment mechanisms. Through the application of a real case study in Iraq, the system demonstrated its capability to simulate both financial success and failure, thereby enabling users to explore various investment conditions. Projects with an ROI below 15% or PI values below 1.0 were flagged as non-viable projects; in such cases, users were able to perform sensitivity testing and cost adjustments efficiently (±10% or ±20% change in cost and revenue). The results confirm RIDSS as a practical and interactive tool for early-stage decision-making in residential development, with promising potential for future expansion into multi-criteria frameworks and real-time data inputs.

Keywords: Life cycle cost analysis (LCCA), Decision support system (DSS), Return on investment (ROI), Profitability index (PI), Project feasibility.

1. INTRODUCTION

Financial funding of a construction firm plays a critical role in all stages of the firm's development process **(Okereke et al., 2022).** It has been noted that financial crises have a significant impact on the construction industry **(Khameesa and Altaay, 2022).** Moreover, management-level officials require a sound foundation for making strategic decisions. Informed decisions for business development **(Selyutina, 2018).** Corporate investment decisions, particularly those involved in technical facilities and equipment that have a primary impact on its operational success and market dominance, are critical. Such investments constitute strategic decisions, as technical equipment, such as Manufacturing

---

*Corresponding author
Peer review under the responsibility of University of Baghdad.
https://doi.org/10.31026/j.eng.2025.12.10

Article received: 28/06/2025
Article revised: 28/09/2025
Article accepted: 04/10/2025
Article published: 01/12/2025

infrastructure considered strategic due to its significant long-term impact on financial investment **(Wieke, 2025).** Residential complexes have experienced a great demand globally, as they are one of the main infrastructure elements **(Altaie and Onyelowe, 2024).** Therefore, conducting a preliminary financial analysis of the residential complex, accounting for all associated costs, is crucial for making a sound investment decision. A structured representation of the life cycle costing shown in **Fig. 1** (LCC) stages allows decision-makers to evaluate different alternatives consistently by aggregating all associated costs across each option of life span, often applying discounted cash flow techniques**. (Moins et al., 2020)** This comprehensive perspective supports informed selection decisions by accounting for acquisition, maintenance, renovation, and disposal costs over the entire analysis period **(Albuja-Sánchez and Damián-Chalán, 2024)**

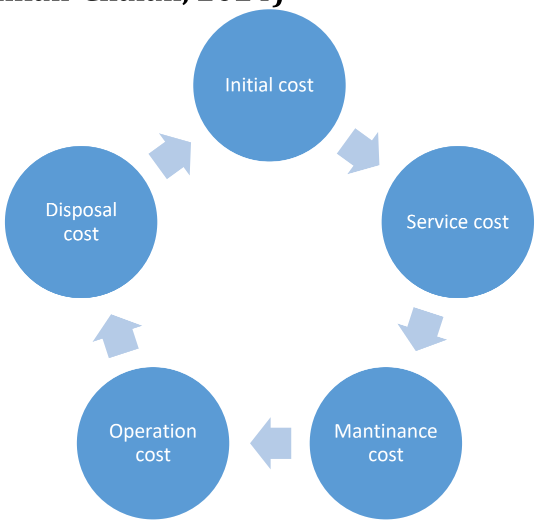


Figure 1. Life Cycle Costing Stages.

Life cycle cost analysis is one of the most attractive tools for estimating the overall costs associated with various project alternatives **(Boomen et al., 2016).** And it's a widely recognized methodology for determining the total cost incurred with managing and owning a facility **(Cecchin et al., 2025; Fuller and Petersen, 1995)**. Unlike conventional cost estimation approaches, LCCA accounts for all expenditures associated with acquisition, operating, maintaining, and eventually final disposing of an investment **(Mohammed et al., 2024; Farr and Furlong, 2023).** ensure the facility will provide the lowest complete cost of ownership, along with its quality and function**. (Deore and Ambre, 2008)** encompasses different costs involved in the entire life span of an asset, including construction cost, operation and maintenance expenses, energy consumption, equipment replacement, and disposal cost **(Dhillon, 2009).**

The initial step in conducting LCCA is identifying all capital investment costs linked with the selected project alternative **(Kneifel and Webb, 2022).** These costs include expenditures incurred before the operational phase, such as design, construction, and commissioning activities **(Arig and Morris, 2024).** Subsequently, operational expenses should be delineated, which encompass recurring annual expenditures such as utilities and custodial services but exclude maintenance and repair costs **(Raftery and Chiang, 2005)**. It is essential to distinguish between operational expenses directly related to building functionality and ancillary administrative costs, which are generally omitted from LCCA computation **(Mohammed et al., 2024).** Maintenance costs constitute a substantial portion

of a building's total life cycle cost **(Li and Guo, 2012).** Effective maintenance management plays a vital role in mitigating major repair expenses by prolonging the service life of building assets **(Mahdi and Altaie, 2023).** In the context of Iraqi government buildings, inadequate maintenance planning and execution have been found to accelerate deterioration and escalate overall expenditures **(Mohamed and Rasheed, 2016).** Thus, integrating maintenance strategies into LCCA frameworks led to ensuring realistic and sustainable cost projection **(Crespo Marquez et al., 2014).** Furthermore, the principle of the time value of money relies on it for the entire LCCA process **(Van den Boomen et al., 2016**). This concept acknowledges that monetary values fluctuate over time, implying that expenditures incurred at different stages are not financially equivalent **(Rahman et al., 2004).** Therefore, proper discounting techniques must be applied to accurately compare costs incurred at different stages during the project's life cycle **(Jawad and Ozbay, 2006)**. Despite the comprehensive nature of existing LCCA methodologies **(Reddy et al., 2014)**, there is a notable lack of research that has focused on systematically integrating maintenance and repair cost differentiation within residential project assessment **(Rosita et al., 2023).** This gap underscores the need for developing advanced decision-support systems capable of capturing the nuanced dynamics of long-term facility management costs, which this study seeks to fulfill.
This study aims to develop and implement an investment decision support system grounded in life cycle cost analysis principles, with a specific focus on evaluating residential complex projects. A case study will be utilized to demonstrate the system's applicability and validate its effectiveness.

2. METHODOLOGY

The proposed methodology is structured into three sequential stages:

1. **Baseline Financial Evaluation**
   - The system calculates Profitability Index (PI) and Return on Investment (ROI) using discounted cash flows.
   - Decision rule: if PI≥1 and ROI≥15%, the project is accepted; otherwise, proceed to the next stage.
2. **Sensitivity Analysis**
   - Key variables (cost, revenues, discount rate, sales period) are varied by
   - If the project is infeasible, proceed to cost adjustment.
3. **Cost Adjustment**
   - Alternative strategies (pricing adjustment) are applied to modify costs or revenues.
   - The system recalculates PI and ROI.
   - The cycle repeats until the project meets acceptance thresholds or is declared infeasible.

Application:
This framework was applied to the case study housing complex, documenting results for each stage (baseline → sensitivity → adjustments) to ensure transparent and structured decision-making.

3. RESEARCH DESIGN

This study adopts a design science research methodology aimed at developing and evaluating an artifact, RIDSS, that addresses a practical challenge in investment decision-making. The research design follows three structured phases:

- Conceptual Development: involves identifying the need for a structured decision-support framework in real estate investment, grounded in LCCA.
- System Implementation: Focus on the development of the RIDSS tool with interfaces for data input, financial evaluation, sensitivity analysis, and reporting.
- Empirical Validation: Application of the system to a residential complex case in Iraq to assess its effectiveness, interpret outputs, and validate performance under multiple cost scenarios.

This design-centric approach ensures that the system is both theoretically sound and applicable for investment professionals and urban developers.

4. FINANCIAL INDICATORS

4.1 Return on Investment (ROI)

It is a widely used financial metric that assesses the profitability of an investment in relation to its cost. **(Zamfir et al., 2016; Crosby et al., 2018).** It is typically expressed as a percentage, offering a clear measure of how efficiently resources are being utilized to generate profits **(Damodaran, 2012).**

ROI measures the financial gain or loss from an investment compared to its cost **(Hassanzadeh and Bigdeli, 2018).** It is calculated using the following formula, Eq. (1), by **(Risi et al., 2018)**.

$$ROI = \frac{Net\ Profit}{Initial\ investment} \times 100\% \tag{1}$$

Where

- Net Profit: Total profits minus total costs (including both operating and capital expenses).
- Initial Investment: The total expenses of the investment.

Globally, an ROI above 15–20% is considered profitable for real estate **(Geltner et al., 2007)**

4.2 Profitability Index (PI)

It is a capital budgeting technique where the discounted value of projected cash inflows is compared with the initial investment on a relative basis. **(Bhattacharjee, 2012)** It is calculated as the ratio of the present value (PV) of the anticipated cash inflow to the present value (PV) of the cash outflow, i.e., the initial cost of the project. The metric reflects the relationship between the investment and a proposed project's payoff. It is also known as the benefit-cost ratio. It can be worked out either in unitary or in percentage terms **(Gurau, 2012).** The formula Eq. (2):

$$PI = \frac{\sum PV_{future\ Revenue}}{\sum PV_{Total\ Cost}} \tag{2}$$

Where:

- PI > 1: The residential complex is considered financially viable and acceptable for investment **(Ravi and Gosavi, 2023)**
- PI < 1: The complex is financially unfeasible and rejected **(Ravi and Gosavi, 2023).**
- PI = 1: The decision is neutral **(Ravi and Gosavi, 2023).**

5. CASE STUDY

5.1 Project Overview

The case study examines a residential complex situated in Iraq. Assessed using actual financial statements issued by the Iraqi Association of Accountants and Auditors (Najaf Branch), dated July 1st, 2023. The primary objective is to evaluate the investment viability of the project through the RIDSS framework using key financial metrics and life cycle cost analysis.

5.2 Financial Inputs

Tables 1 and 2 present the summary of the financial figures extracted from the audited records for the residential complex. The total revenue was estimated at 237,772,240,000 IQD.

Table 1. Investment costs details (Iraqi Dinar)**.**

Investment costs	
Construction cost	167996040000
Infrastructure cost	16799604000
Equipment/furnishing cost	16799604000
Other initial cost	2555000

Table 2. Operation costs details (Iraqi Dinar).

Operation costs	
Maintenance cost	2090000
Utilities cost	18878160
Administrative cost	111048000

6. SYSTEM DESCRIPTION AND INTERFACES FOR RIDSS

To complement the theoretical and methodological foundations of the research, a custom-built software application titled Residential Investment Decision Support System (RIDSS) was developed to operationalize the evaluation of residential complex projects based on Life Cycle Cost Analysis (LCCA) and translates the analytical framework into an interactive digital platform that enables decision-makers to simulate various investment scenarios, input cost data, and compute indicators, below the structure of the proposed system shown in **Fig. 2.** Features of a web application:

1. Easy access: It can be used from any device connected to the internet.
2. Automatic updating: The application is updated on the server.
3. Integration with the internet: Web applications can integrate with other internet tools.

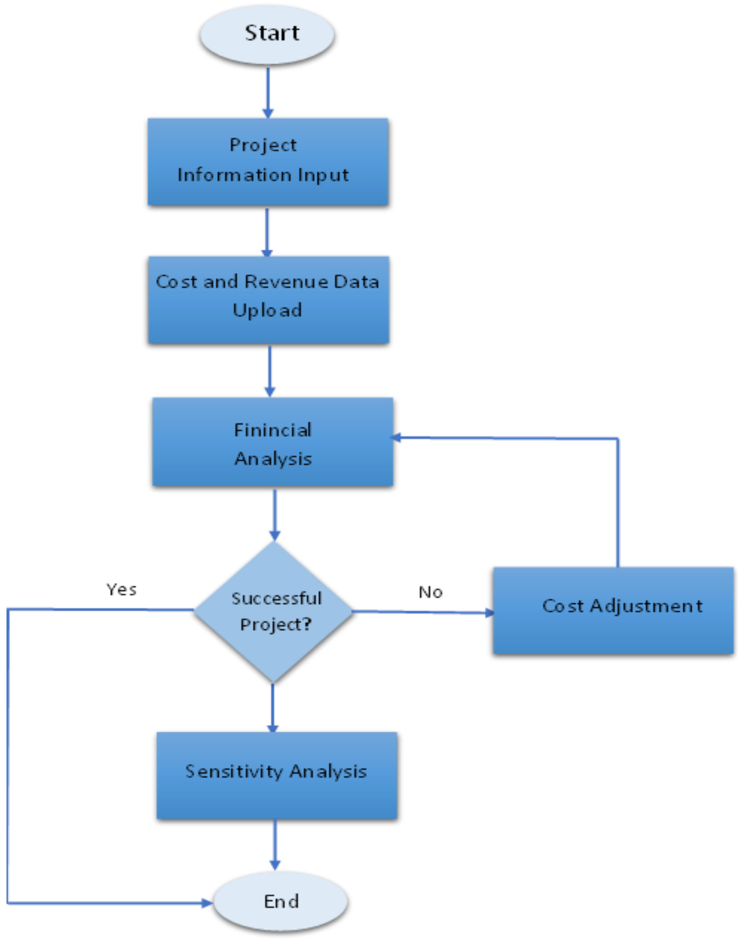


Figure 2. Structure of the proposed system.

6.1 Login Interface

The system initiates with a secure login screen that grants access exclusively to registered users. The screen includes fields for username and password, ensuring data confidentiality and user-specific access. A "Forgot Password?" option is available to enhance usability.

6.2 Home Dashboard

Once logged in, users are presented with a personalized dashboard that displays the user's name and a navigation sidebar. This sidebar includes:

- Home
- Start Project
- About System
- Papers

The central section feature contains the system logo and author credit, creating a professional and branded appearance.

6.3 Project Initialization Form

By selecting "Start Project," the user is directed to the Project Information page, where essential details related to the investment are entered, such as

- Project Name

- Currency (IQD, USD)
- Discount Rate
- Analysis Date
- Selling Period (by years)
- Project Location

This data serves as the foundation for subsequent financial computations.

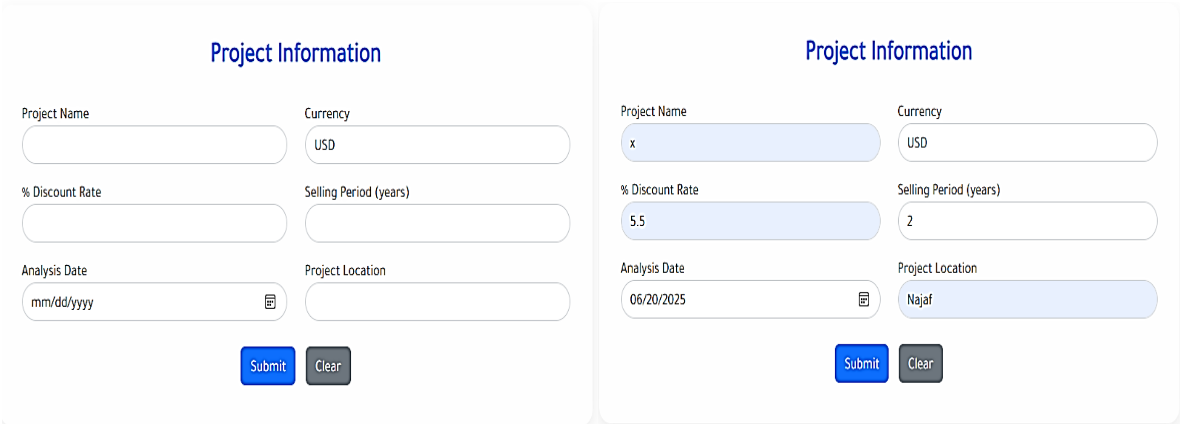


Figure 3. Project Initialization interface.

6.4 Cost and Revenue Entry Interface

After submitting the project metadata, users proceed to input detailed financial data categorized into three sections

- Investment Costs
- Operating Costs
- Total Revenues

Each field allows direct numerical input in real time upon submission.

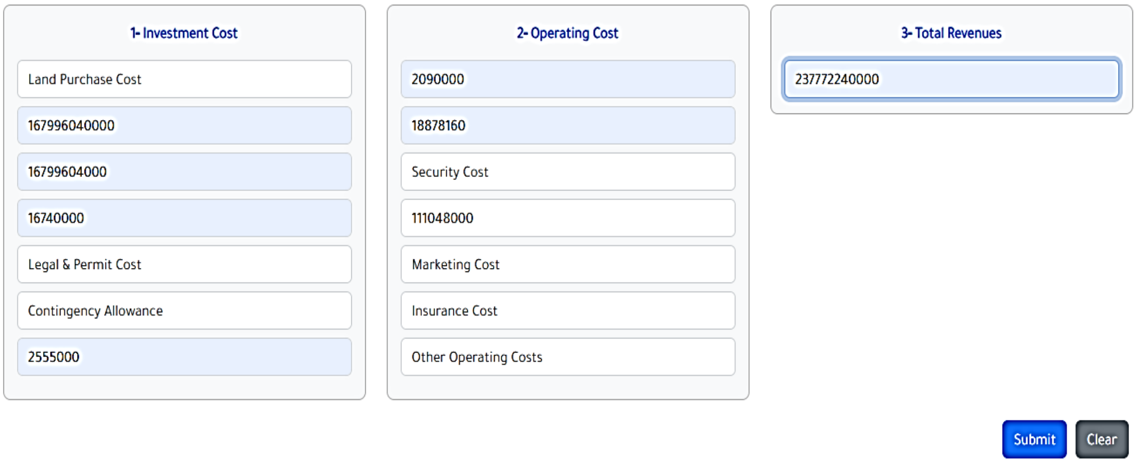


Figure 4. Costs and Revenue entry.

As illustrated in **Fig. 6**, all cost fields are optional, allowing users to choose to enter only the total investment cost, total operating cost, and total revenues without filling in the detailed breakdowns. This feature enhances the system's flexibility and accommodates the availability of summarized financial inputs.

6.5 Evaluation Output

Upon submitting all the data, **Fig. 5** shows the calculations and displays key investment indicators:

- Return on Investment (ROI)
- Profitability Index (PI)

An evaluation panel indicates the project's state, whether it is successful or unsuccessful, based on thresholds such as ROI > 15% and PI > 1.0. The applied formulas used are presented clearly, and the results are color-coded for intuitive interpretation (green for success, red for failure).

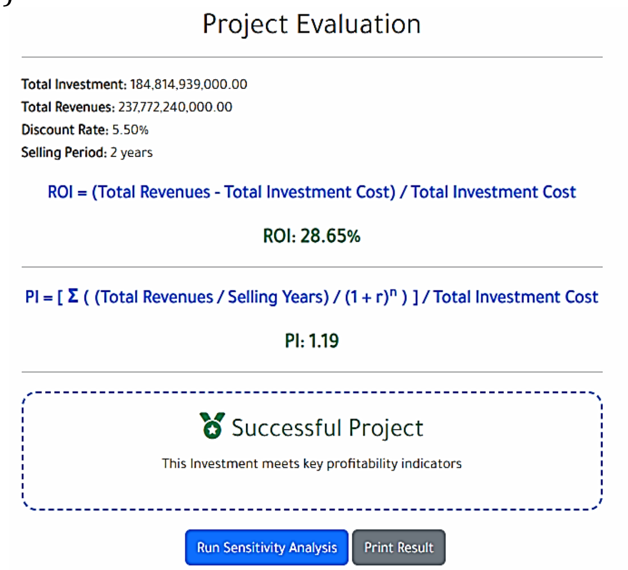


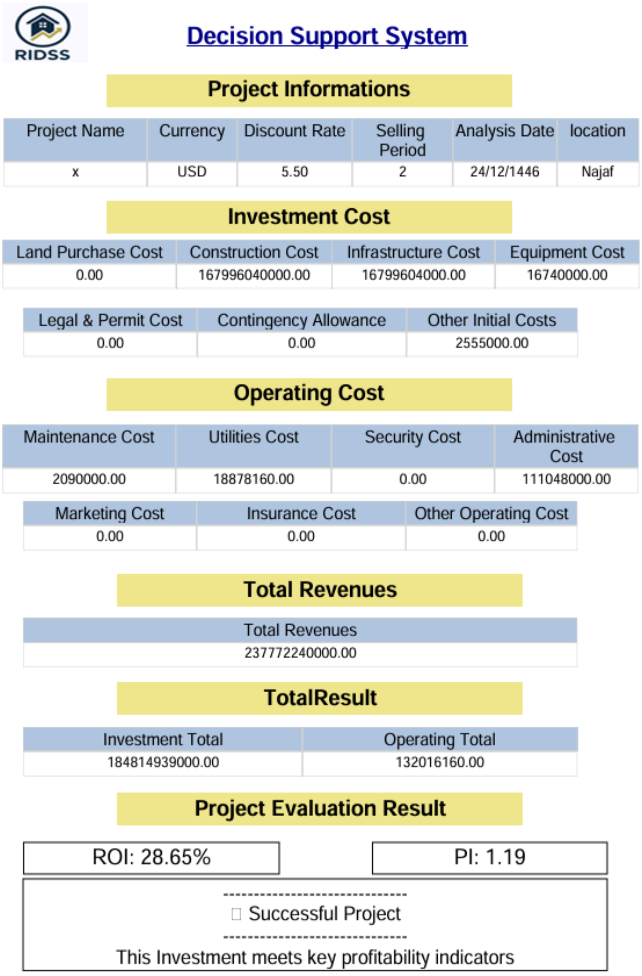
Figure 5. Financial indicators result.

If the user opts to conduct only a financial evaluation using economic indicators (ROI and PI), the system allows direct printing of the results, as shown in **Fig. 6**. Alternatively, the user may proceed with additional analysis through the Sensitivity Analysis module, illustrated in **Fig. 7**.

6.6 Sensitivity Analysis Module

To adjust the robustness of the investment, users can access the Sensitivity Analysis module. This section allows

- Adjustment of investment, operating, and revenue costs by specific percentages (e.g., ±10% or ±20%).
- Recalculation indicators based on adjusted inputs.
- This analysis examines the project's ability to withstand economic fluctuations. By modifying the cost inputs and observing the corresponding changes in financial indicators, users gain valuable insights into the project's financial stability under varying scenarios .
- To assess the robustness of the investment, users can access the Sensitivity Analysis module. This section allows:
- Manual adjustment of investment, operating, and revenue costs by a specific percentage
- Recalculation of the indicators ROI and PI based on adjusted inputs.



RIDSS

Decision Support System

Project Informations

Project Name	Currency	Discount Rate	Selling Period	Analysis Date	location
x	USD	5.50	2	24/12/1446	Najaf

Investment Cost

Land Purchase Cost	Construction Cost	Infrastructure Cost	Equipment Cost
0.00	167996040000.00	16799604000.00	16740000.00

Legal & Permit Cost	Contingency Allowance	Other Initial Costs
0.00	0.00	2555000.00

Operating Cost

Maintenance Cost	Utilities Cost	Security Cost	Administrative Cost
2090000.00	18878160.00	0.00	111048000.00

Marketing Cost	Insurance Cost	Other Operating Cost
0.00	0.00	0.00

Total Revenues

Total Revenues
237772240000.00

TotalResult

Investment Total	Operating Total
184814939000.00	132016160.00

Project Evaluation Result

ROI: 28.65% PI: 1.19

Successful Project

This Investment meets key profitability indicators

Figure 6. Financial analysis result report.

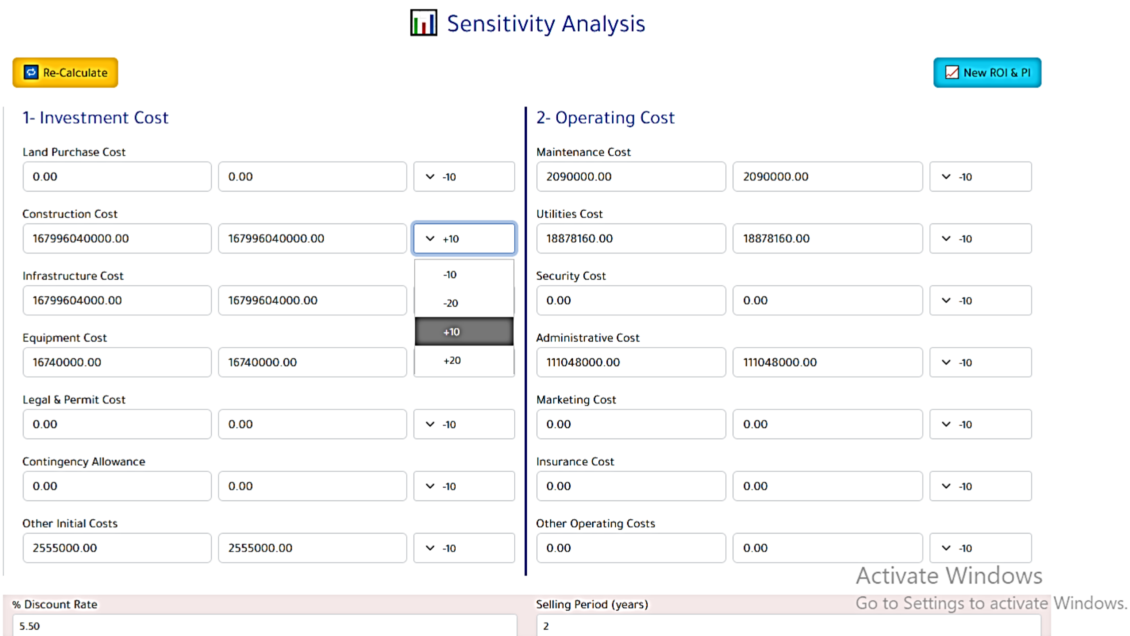


Figure 7. Sensitivity analysis interface.

The module is important for identifying the impact of economic uncertainties on project performance.

6.7 Cost Adjustment Phase

If a project is deemed unsuccessful, users have the option to navigate to the Cost Adjustment interface. This feature supports the reconfiguration of:

- Construction and operation costs
- Revenue targets
- Discount rate
- Investment period

To showcase the functionality of this interface, project costs can be deliberately altered to produce unsuccessful results. This allows a clearer presentation of how the adjustment process works in practice, as illustrated in Interface 8.

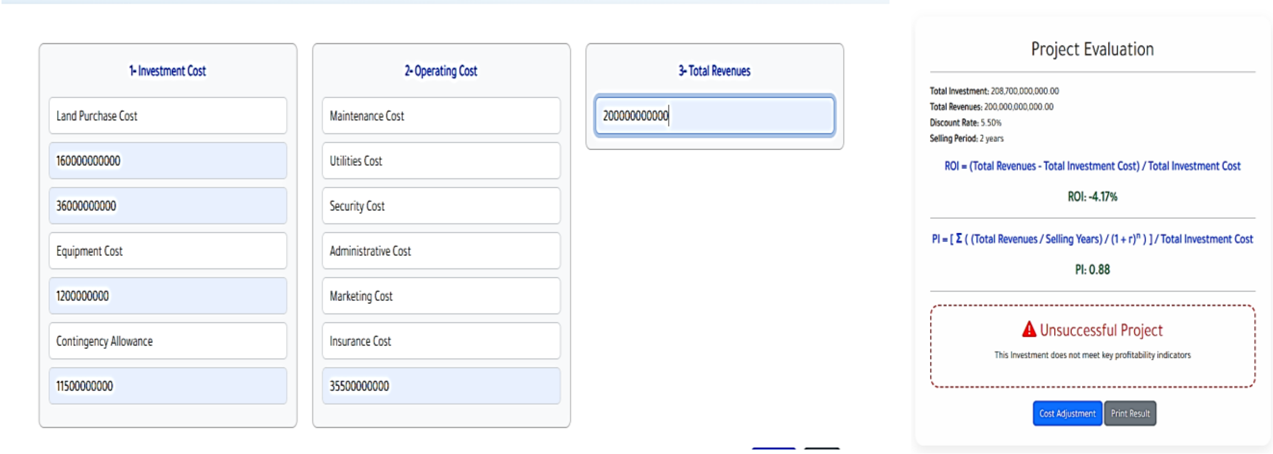


Figure 8. Hypothetical costs to demonstrate the interface functionality**.**

Fig. 9 below illustrates the tool for adjusting costs, sales years, and the discount rate, recalculating the economic indicators to bring the project to acceptable success thresholds.

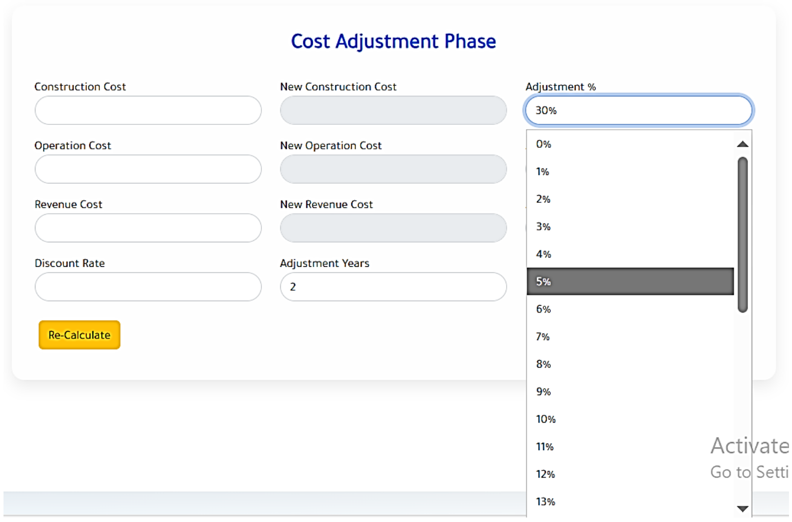


Figure 9. Cost adjustment.

Following the adjustment, new ROI and PI values are generated to explore if the project can achieve viability under revised conditions. **Fig. 10** shows the result after multi-input adjustment.

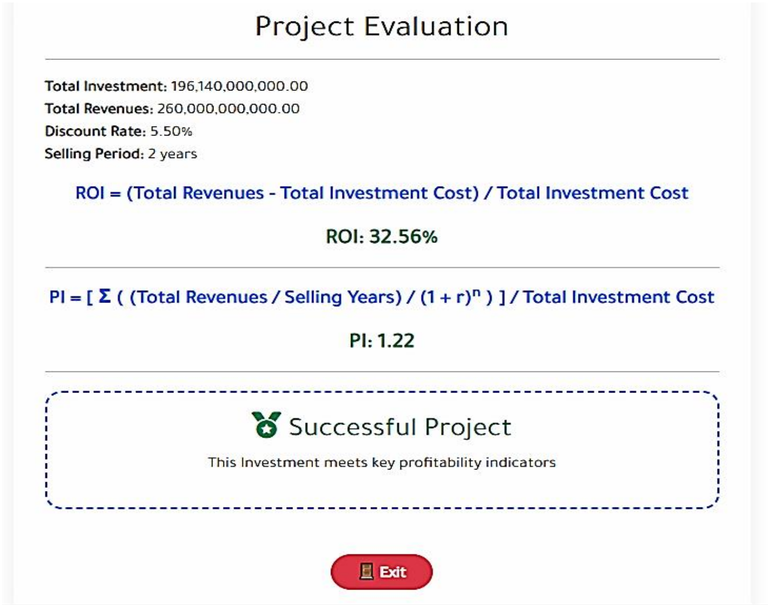


Figure 10. Economic Indicators and Project Success Status.

6.8 Report Generation

The system includes a robust report generation module designed to support documentation, presentation, and archiving investment evaluations. Upon completing the analysis, users can produce comprehensive reports that summarize key input parameters, financial results, sensitivity testing outcomes, and final investment viability status.
The report includes:

- Project details (name, date, discount rate, analysis duration, location)
- Total initial cost, O&M cost, and total revenues
- Calculated financial metrics: ROI and PI with pass/fail status
- Sensitivity analysis results under multiple scenarios
- Adjusted cost inputs (if applicable) and recalculated the indicators

Reports can be exported in PDF format for easy sharing with stakeholders or printed directly from the system interface. The report layout is professionally designed with clear headings, color-coded results, and labeled figures (e.g., evaluation chart, scenario tables).
This feature enhances the transparency and traceability of investment decisions by allowing users to maintain a well-organized record of their analysis and outcomes. The reports are suitable for both internal use and formal submission to financial reviewers, engineers, and potential investors.
The system provides functionality to print evaluation results and export sensitivity analysis reports, supporting documentation, and reporting for stakeholders.

7. RESULTS AND DISCUSSION

The application of the designed system on the residential complex revealed that the system successfully evaluated project viability using financial indicators. The results confirmed its

effectiveness in supporting investment decision-making with higher accuracy and transparency.
The RIDSS tool was validated through a real case study of a residential complex project in Iraq. The system accurately computed ROI and PI values based on actual financial data and provided a clear classification of project viability. Projects with an ROI below 15% or PI values below 1.0 were flagged as non-viable projects; in such cases, users were able to perform sensitivity testing and cost adjustments efficiently.
The interface demonstrates effectiveness in supporting both summary-level and detailed-level input, and the inclusion of optional sensitivity and cost adjustment modules provided depth to the evaluation process. Users found the results visually intuitive, particularly due to the use of color coding and scenario-based outputs.

8. STUDY LIMITATIONS

Despite the system's strengths and viability, several limitations should be noted:

- The current version of RIDSS is limited to two financial indicators (ROI and PI), excluding others like NPV, IRR, or BCR, which could enhance the robustness of results
- The model operates on static financial data without dynamic linking to market fluctuations
- The tool currently supports the evaluation of a single project only and lacks multi-project comparison capabilities.
- User inputs are entered manually; automation from financial sheets or APIs is not yet integrated.

9. CONCLUSIONS

The proposed System provides a scientific approach for evaluating the economic feasibility of residential projects. It streamlines the investment decision-making process by employing a structured, indicator-based framework combined with adjustable cost scenarios and sensitivity analysis. Sensitivity analysis addition offered a deeper understanding of project robustness under cost and revenue fluctuations, while the cost adjustment module gave practical pathways for improving projects that initially appeared infeasible.

Acknowledgements

This work was supported by the University of Baghdad, College of Engineering, Department of Civil Engineering. The assessment and testing of the RIDSS platform were conducted as part of the Master's Thesis Project.

Credit Authorship Contribution Statement

Alaa Mohammed Salah: Writing – original draft, review & editing, research, and data collection. Kadhim Raheem Erzij: Supervision, review & editing, validation, project management.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCES

Altaie, M.R. and Onyelowe, K., 2024. Identifying failure factors in the implementation of residential complex projects in Iraq. *Journal of Engineering*, 30(02), pp. 1–15. https://doi.org/10.31026/j.eng.2024.02.01

Albuja-Sánchez, J. and Damián-Chalán, A., 2024. Leveraging life cycle cost analysis (LCCA) for optimized decision making in adobe construction materials. *Applied Sciences*, 14(5), P. 1760. https://doi.org/10.3390/app14051760

Arig, T. and Morris, L., 2024. State of Alaska – Department of Education & Early Development 3rd Edition Finance & Support Services / Facilities 2024: Guidelines for utilizing life cycle cost analysis and cost–benefit analysis. State of Alaska – Department of Education & Early Development.

Bhattacharjee, K.K.P.D., 2012. *Engineering economics and costing*. S. Chand Publishing. https://books.google.iq/books?id=oXCa96h2KbQC

Cecchin, D., Penna, A., Sorgato, M., Bertolini, L. e Gastaldi, M., 2025. Life cycle assessment (LCA) in construction materials – review. *Agronomy Research*, 23, pp. 293–321. https://doi.org/10.15159/AR.25.041

Crespo Marquez, A., Parra Marquez, C., Gómez Fernández, J.F., López-Campos, M.A. and González Díaz, V., 2014. Life cycle cost analysis (LCCA) consideration within the built and in-use assets maintenance management. In: Engineering Assets and Public Infrastructures in the Age of Digitalization, pp. 81–99. https://doi.org/10.1007/978-94-007-2724-3_6

Crosby, N., Devaney, S. and Wyatt, P., 2018. The implied internal rate of return in conventional residual valuations of development sites. *Journal of Property Research*, 35(3), pp. 234–251. https://doi.org/10.1080/09599916.2018.1506810

Damodaran, A., 2012. *Investment valuation: tools and techniques for determining the value of any asset*. John Wiley & Sons. ISBN: 978 1118011522

De Risi, R., De Paola, F., Turpie, J. and Kroeger, T., 2018. Life cycle cost and return on investment as complementary decision variables for urban flood risk management in developing countries. *International Journal of Disaster Risk Reduction*, 28, pp. 88–106. https://doi.org/10.1016/j.ijdrr.2018.02.026

Deore, S.A. and Ambre, H.P., 2008. Life cycle cost analysis of a residential building. *International Research Journal of Engineering and Technology*, P. 7259. https://www.irjet.net/archives/V6/i5/IRJET-V6I51037.pdf

Dhillon, B.S., 2010. *Life cycle costing for engineers*. Boca Raton, FL: CRC Press/Taylor & Francis. https://doi.org/10.1201/9781439816899

Farr, J.V. and Furlong, I.J., 2023. *Engineering economics of life cycle cost analysis. 2nd ed*. Boca Raton, Florida. https://doi.org/10.1201/9781003254782

Fuller, S.K. and Petersen, S.R., 1995. *Life cycle costing manual*. NIST Handbook, 135. https://doi.org/10.6028/NIST.HB.135-1995

Geltner, D.M., Miller, N.G., Clayton, J., and Eichholtz, P., 2007. *Commercial real estate: analysis & investments*. Cengage Learning. ISBN 978-0324305487.

Gurau, M.A., 2012. The use of profitability index in economic evaluation of industrial investment projects. Proceedings in Manufacturing Systems, 7(1), pp. 55–58.

Hassanzadeh, M. and Bozorg Bigdeli, T., 2018. Return on investment (ROI) in research and development (R&D): towards a framework. *In: Proceedings of 14th International Conference on Webometrics, Informetrics and Scientometrics & 19th COLLNET Meeting 2018 – Collaboration - Impact on Productivity and Innovation*. https://doi.org/10.22032/dbt.39330

Khameesa, A.S. and Altaay, M.R., 2022. Evaluating the efficiency of finance methods in residential complex projects in Iraq. *Technology & Applied Science Research*. https://doi.org/10.48084/etasr.4663

Kneifel, J.D. and Webb, D., 2022. Life cycle costing manual for the federal energy management program. https://doi.org/10.6028/NIST.HB.135e2022

Li, C.S., and Guo, S.J., 2012. Life cycle cost analysis of maintenance costs and budgets for university buildings in Taiwan. *Journal of Asian Architecture and Building Engineering*, 11(1), pp. 87–94. https://doi.org/10.3130/jaabe.11.87

Mahdi, I. and Altaie, M., 2023. Factors affecting building maintenance practices: Review. *Journal of Engineering*, 29, pp. 153–172. https://doi.org/10.31026/j.eng.2023.12.10

Mohamed, S.R. and Professor, A., 2016. Maintenance management in Iraqi government buildings. *STM Journals*. Available at: www.stmjournals.com

Mohammed, A., Ogunbode, E.B., Adekunle, A.A., and Yusuf, I.O., 2024. Life cycle cost analysis of a three-storey building in Abuja, *Nigeria. Nile Journal of Engineering and Applied Science*, 2(1), P. 1. https://doi.org/10.5455/njeas.188731

Moins, B., France, C., and Audenaert, A., 2020. Implementing life cycle cost analysis in road engineering: a critical review on methodological framework choices. *Renewable and Sustainable Energy Reviews,* 133, P. 110284. https://doi.org/10.1016/j.rser.2020.110284

Okereke, R., Pepple, D. and Eze, E., 2022. Major finance sources in construction project delivery and impact of financing in the construction industry. *Borneo Journal of Sciences and Technology*, 4, pp. 112–124. https://doi.org/10.35370/bjost.2022.4.2-13

Ozbay, K. and Jawad, D., 2006. The discount rate in life cycle cost analysis of transportation projects. *In: Transportation Research Board 85th Annual Meeting, Washington, DC. National Academy of Sciences*.

Raftery, J. and Chiang, Y.H., 2005. The construction sector in the Asian economies. Taylor & Francis Group.

Rahman, S. and Vanier, D.J., 2004, May. Life cycle cost analysis as a decision support tool for managing municipal infrastructure. In *CIB 2004 triennial congress,* 2(1), pp. 1-11. Ottawa, ON, Canada: National Research Council (NRC).

Ravi, B.N.G. and Gosavi, S., 2023. *Financial management: e-Book for MBA, 2nd Semester*, SPPU. Thakur Publication Private Limited. https://books.google.iq/books?id=HaHhEAAAQBAJ

Reddy, V.R., Kurian, M. and Ardakanian, R., 2014. Life-cycle cost approach for management of environmental resources: A primer. *Springer International Publishing (SpringerBriefs in Environmental Science).*

Rosita, E., Yustiarini, D., and Nurasiyah, S., 2023. Life cycle cost analysis of building maintenance. *Jurnal Ilmiah Pendidikan Teknik dan Kejuruan*, 16, P. 121. https://doi.org/10.20961/jiptek.v16i2.67729

Selyutina, L., 2018. Innovative approach to managerial decision-making in construction business. *Materials Science Forum*, 931, pp. 1113–1117. https://doi.org/10.4028/www.scientific.net/MSF.931.1113

van den Boomen, M., Schoenmaker, R., Verlaan, J.G. and Wolfert, A.R.M., 2017. Common misunderstandings in life cycle costing analyses and how to avoid them. *In: Life-Cycle of Engineering Systems: Emphasis on Sustainable Civil Infrastructure: Proceedings of the 5th International Symposium on Life-Cycle Engineering, Delft, Netherlands*, pp. 1729–1735. https://doi.org/10.1201/9781315375175-251

Wieke, S., 2025. Life cycle cost analysis in investment projects – examination of case studies and risk mitigation with Monte Carlo simulation. *Scientific Review Engineering and Environmental Sciences*, 34(1), pp. 3–18. https://doi.org/10.22630/srees.9798

Zamfir, M., Manea, M.D. and Ionescu, L., 2016. Return on investment – indicator for measuring the profitability of invested capital. *Valahian Journal of Economic Studies,* 7(2), pp. 79–86. https://doi.org/10.1515/vjes-2016-0010

تطوير وتطبيق نظام دعم اتخاذ القرار الاستثماري استنادًا إلى تحليل دورة الحياة الكلفية: دراسة حالة على المجمعات السكنية

الاء محمد صلاح *، كاظم رحيم ارزيج

قسم الهندسة المدنية ,كلية الهندسة ,جامعة بغداد , بغداد , العراق

الخلاصة

إن التعقيد المتزايد والمخاطر المالية المرتبطة بمشاريع المجمعات السكنية في الدول النامية يتطلبان أدوات دعم قرار موثوقة لتقييم الاستثمارات في مراحلها المبكرة. يقدم هذا البحث تصميم وتنفيذ نظام دعم اتخاذ القرار الاستثماري السكني(RIDSS) ، وهو منصة متخصصة تعتمد على تحليل دورة الحياة الكلفية .(LCCA) يتيح النظام لأصحاب المصلحة تقييم الجدوى المالية من خلال مؤشرات اقتصادية مثل العائد على الاستثمار (ROI) ومعامل الربحية(PI) ، كما يدمج أدوات تحليل الحساسية (تغيّر في الكلفة بمقدار ±10% أو ±20%)وآليات تعديل الكلفة بشكل ديناميكي(تغيّر في الكلفة,والايرادات بمقدار ±10% أو ±20) ومن خلال تطبيق دراسة حالة واقعية في العراق، أظهر النظام قدرته على محاكاة سيناريوهات النجاح والفشل المالي، مما يمكّن المستخدمين من استكشاف ظروف استثمارية مختلفة حيث ان المشاريع التي سجّلت عائداً على الاستثمار (ROI) أقل من 15% أو قيم مؤشر الجدوى (PI) أقل من 1.0 اعتُبرت مشاريع غير قابلة للتنفيذ. وتؤكد النتائج أن نظام RIDSS يمثل أداة عملية وتفاعلية لدعم اتخاذ القرار في مراحل التخطيط الأولية لتطوير المشاريع السكنية، مع إمكانية واعدة للتوسع المستقبلي نحو أطر متعددة المعايير وبيانات محدثة في الوقت الحقيقي.

الكلمات المفتاحية: تحليل دورة الحياة الكلفية (LCCA)، نظام دعم اتخاذ القرار (DSS)، العائد على الاستثمار (ROI)، معامل الربحية (PI)، جدوى المشروع.