



# A Multi-Criteria Decision Support System for Burial Plot Selection Using the TOPSIS Method: A Web-Based Approach

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**Abstract:** Rapid and accurate decision-making is essential in burial plot selection, particularly in urgent situations where families must simultaneously evaluate multiple criteria — price, available facilities, and land type. At TPU Al-Qobri, the absence of structured decision tools has allowed the manual selection process to persist, producing inconsistent outcomes and placing unnecessary burden on families during emotionally difficult circumstances. This study develops a web-based Decision Support System (DSS) using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to support objective burial plot selection based on multiple weighted criteria. System development follows the Software Development Life Cycle (SDLC), covering planning, analysis, design, implementation, testing, and maintenance phases. TOPSIS is applied to rank available burial plot alternatives and generate recommendations that are traceable and consistent across evaluation sessions. Testing results confirm that the system produces accurate rankings, reduces selection time, and improves administrative service management at the cemetery level. The proposed system demonstrates that structured, criterion-based decision support can replace subjective manual processes in public cemetery administration.

**Keywords:** Decision Support System; TOPSIS; Burial Plot Selection.

## 1. Introduction

Rapid, accurate, and efficient decision-making has become a fundamental requirement in various aspects of modern life, including in sensitive and time-critical contexts such as burial plot selection. This process involves not only administrative considerations but also emotional, cultural, and practical dimensions for bereaved families. In practice, individuals often face difficulties in identifying burial plots that meet multiple criteria — cost, location, accessibility, and available facilities — and these challenges are compounded by the absence of structured information systems that allow users to systematically compare available alternatives. As a result, decision-making tends to rely on subjective judgment and limited information, leading to inefficiencies and potentially suboptimal choices (Khomsatun *et al.*, 2020).

At TPU Al-Qobri, the burial plot selection process remains largely conventional and manual. Based on field observations and interviews with cemetery administrators, families are required to physically visit the site to obtain information regarding available plots, pricing, and facilities — a process that is time-consuming and often unstructured. In urgent situations such as sudden deaths, the absence of decision support tools further

increases confusion and stress for families. From an administrative perspective, the lack of centralized data management results in inconsistent information delivery and poor documentation of burial records and transactions, ultimately affecting service quality and operational efficiency (Arifin & Insani, 2023).

To address these limitations, the implementation of a Decision Support System (DSS) offers a practical and well-established approach. DSS is designed to assist decision-makers in handling semi-structured and unstructured problems through data analysis, modeling, and evaluation tools. Rather than replacing human judgment, DSS strengthens decision-making capabilities by providing structured information, analytical models, and ranked alternatives (Luo *et al.*, 2021; Sun *et al.*, 2024). Recent developments have extended this concept into Intelligent Decision Support Systems (IDSS), which incorporate artificial intelligence and knowledge-based systems to improve decision accuracy in complex environments (Han *et al.*, 2021; Ünal & Çilgin, 2022). Within this framework, Multi-Criteria Decision Making (MCDM) addresses problems involving multiple, often conflicting criteria by providing a structured methodology for evaluating alternatives based on weighted parameters — enabling decision-makers to produce consistent and rational rankings across domains such as infrastructure planning, supply chain management, and public services (Černevičienė & Kabašinskas, 2022; Dhurkari, 2022; Sreenivasan *et al.*, 2023; Tan *et al.*, 2021).

Among MCDM methods, the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is one of the most widely adopted due to its conceptual simplicity and computational efficiency. TOPSIS ranks alternatives by measuring their distance from the positive ideal solution and the negative ideal solution, producing results that are clear and straightforward to interpret (Kılıç *et al.*, 2021; Türegün, 2022). Its applicability has been demonstrated across scholarship selection, tourism destination ranking, housing evaluation, and public service contexts, where it consistently improves decision transparency and objectivity (James *et al.*, 2023; Nurkarimah & Yunianti, 2023; Putra *et al.*, 2020; Yılmaz *et al.*, 2024). Hybrid approaches combining TOPSIS with AHP or fuzzy logic have further extended its reliability in uncertain decision environments (James *et al.*, 2023; Vatankhah *et al.*, 2023).

Despite this breadth of application, the use of DSS integrated with TOPSIS in burial plot selection remains largely unaddressed in the literature. Existing studies in cemetery management have focused primarily on AHP, Weighted Product (WP), or administrative and spatial systems, rather than multi-criteria ranking mechanisms suited to rapid, user-facing decisions. This gap is particularly significant given that burial plot selection often occurs under time pressure and emotional strain — conditions that demand structured, objective support rather than informal staff-mediated processes. Therefore, this study develops a web-based DSS using the TOPSIS method to facilitate burial plot selection at TPU Al-Qobri, enabling users to evaluate alternatives across multiple criteria in a structured and objective manner while addressing the documented gap in decision support applications within cemetery management.

## 2. Related Work

### 2.1 Decision Support Systems (DSS)

Decision Support Systems (DSS) have become an established tool in assisting decision-making processes, particularly in semi-structured and unstructured problem domains. DSS combines data, analytical models, and user-friendly interfaces to support more rational and objective decision outcomes, reducing reliance on subjective judgment. The trajectory of DSS research has moved toward greater intelligence and adaptability — Luo *et al.* (2021) argue that DSS can substantially improve decision efficiency by combining analytical capabilities with knowledge-based systems, while Sun *et al.* (2024) show that modern DSS architectures are increasingly capable of handling complex, multi-variable environments, making them directly relevant to service-oriented sectors where decision conditions vary widely.

### 2.2 Multi-Criteria Decision Making (MCDM)

MCDM is widely used within DSS to address problems involving multiple and often conflicting criteria, allowing decision-makers to evaluate alternatives systematically based on predefined criteria and their respective weights. Černevičienė & Kabašinskas (2022) argue that MCDM improves transparency and consistency by making the evaluation process explicit and auditable, while Dhurkari (2022) adds that it is particularly useful in environments where decision variables are interdependent — a condition that applies directly to burial plot selection, where price, location, and facility quality are all interrelated. Its applicability spans infrastructure planning, public services, and resource allocation, providing a solid analytical foundation for developing reliable decision support systems.

### 2.3 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

Among MCDM methods, TOPSIS is one of the most widely applied due to its simplicity and effectiveness. The method ranks alternatives by measuring each option's distance from the positive ideal solution and the

negative ideal solution, producing results that are clear and straightforward to interpret. Kılıç *et al.* (2021) confirmed its reliability in information system evaluation, while Türegün (2022) validated its use in financial performance analysis — both pointing to the same underlying strength: TOPSIS handles multiple criteria simultaneously without requiring the problem to be reduced to a single dimension, making it well-suited for web-based decision support applications.

### 2.4 Applications of TOPSIS Across Domains

TOPSIS has been applied across a range of domains with consistent results. Nurelasari & Purwaningsih (2020) demonstrated its accuracy in housing selection, Putra *et al.* (2020) confirmed its effectiveness in tourism destination ranking, Borman *et al.* (2020) applied it to export-quality coffee bean selection, and Anggraini & Orisa (2022) used it to evaluate teacher performance. Across these studies, TOPSIS consistently produced rankings that were accurate, structured, and traceable. Setiawansyah (2022) further notes that this transparency is what builds user trust — the outputs are logical and can be explained step by step to non-technical users, which is a meaningful advantage in public service contexts.

### 2.5 Hybrid Approaches and Known Limitations

TOPSIS is not without weaknesses. Its most significant constraint is sensitivity to criteria weighting: different weight assignments can produce substantially different rankings, and the method provides no internal mechanism for determining which weights are appropriate. Thirhanudin (2024) documents this directly, noting that improper weight assignment introduces bias into the final output, while the assumption of independence among criteria may not hold in complex scenarios where variables are correlated. To address these limitations, James *et al.* (2023) combined Fuzzy AHP with TOPSIS to handle uncertainty in criteria weights, and Vatankhah *et al.* (2023) reviewed the broader trend of pairing MCDM methods to improve result stability — though these approaches add complexity that may reduce accessibility for non-specialist users, a trade-off worth considering in public service applications.

### 2.6 Research Gap and Contribution

Despite its broad application, TOPSIS has not been applied to burial plot selection in any substantive way. Most existing studies address education, tourism, or product selection, with little attention given to public service contexts such as cemetery management. Prior work in this domain has largely relied on AHP or focused on administrative and spatial systems, rather than multi-criteria ranking mechanisms designed to support user-facing decisions under time pressure. This study addresses that gap by developing a web-based DSS using TOPSIS for burial plot selection at TPU Al-Qobri — pairing decision analysis directly with operational system features that cover the full workflow from data input through reservation and reporting, providing a complete solution for both users and administrators in an emotionally sensitive and time-critical service context.

## 3. Methodology

This research was conducted at Al-Qobri Public Cemetery (TPU Al-Qobri). System development followed the Software Development Life Cycle (SDLC), which structures the process into six sequential stages: planning, analysis, design, implementation, testing, and maintenance, as illustrated in Figure 1.

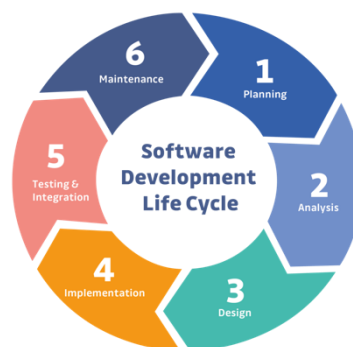


Figure 1. Software Development Life Cycle Method

The process begins with identifying system requirements and collecting data through direct observation, structured interviews with cemetery staff, and review of relevant literature. The analysis stage examines the existing manual process in detail to identify specific operational weaknesses. Based on this analysis, system design is carried out using standard modeling tools — ERD for data relationships, Use Case Diagrams for user

interactions, Activity and Sequence Diagrams for process flow, and Class Diagrams for system structure. The system is then built as a web-based application using PHP and MySQL, with the TOPSIS method embedded as the core decision-making engine. Testing is conducted using the Black Box method to verify that each function performs as specified, and maintenance procedures are defined to address future performance requirements and operational changes. From a theoretical standpoint, this study draws on the concepts of Decision Support Systems (DSS) to frame burial plot selection as a semi-structured decision problem. TOPSIS is applied as the MCDM approach, ranking available alternatives based on their measured distance from the positive and negative ideal solutions. Together, the SDLC framework and UML modeling tools ensure that the system is developed systematically and that each layer — data, logic, and interface — is designed coherently and documented clearly.

## 4. Result and Discussion

### 4.1 Results

#### 4.1.1 System Analysis

Systems analysis determines the specifics of what a proposed system should accomplish, independent of how it will be implemented. The goal is to thoroughly examine the existing process — identifying where it breaks down and what a replacement system must address — in order to plan a more effective and user-oriented solution. The running system analysis describes how information currently flows within the organization, including the typical entry and exit points of documents and decisions.

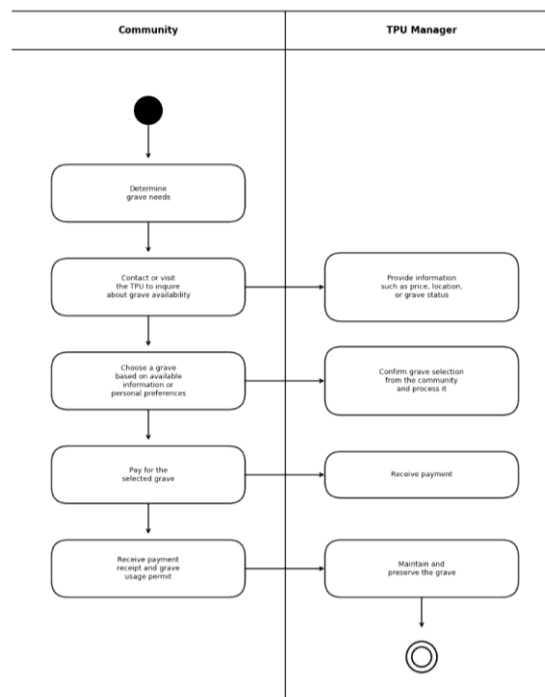


Figure 2. Running System Analysis

Figure 2 presents a swimlane activity diagram representing the current burial plot selection process, involving two main actors: the Community and the TPU Manager. The process begins when the community identifies a burial need and contacts or visits the cemetery to obtain information about plot availability, pricing, and location. The TPU Manager provides this information, after which the community selects a suitable plot based on their preferences. The manager then confirms and processes the selection, the community makes payment and receives a receipt along with a burial usage permit, and the manager records the transaction before proceeding with plot maintenance. The diagram makes visible the degree to which the entire process depends on physical presence and direct staff involvement — there is no point at which a family can evaluate alternatives independently or access standardized information without mediation. Based on the identified weaknesses of the existing process, a web-based decision support system is proposed to address the lack of structured evaluation tools and centralized data management.

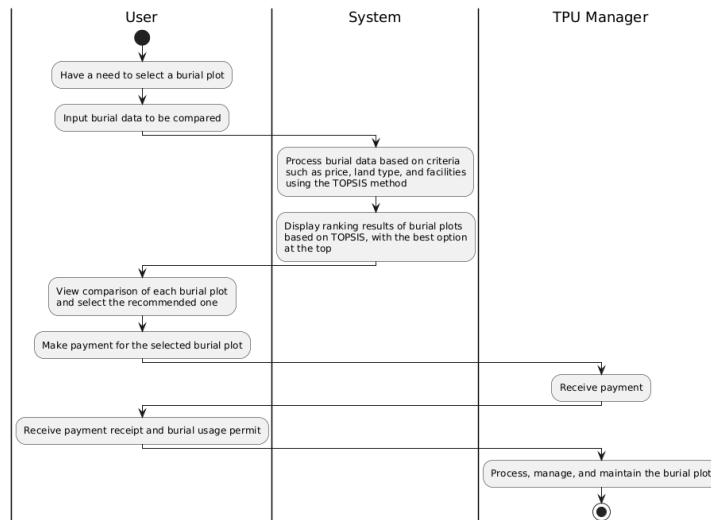


Figure 3. Proposed System Analysis

Figure 3 illustrates the activity flow of the proposed system, involving three actors: the User, the System, and the TPU Manager. The user begins by identifying the need to select a burial plot and entering relevant data for comparison. The system processes this input using predefined criteria — price, land type, and available facilities — through the TOPSIS method, generating a ranked list of alternatives with the best option at the top. The user reviews the results, selects a recommended plot, and proceeds to payment, after which the TPU Manager handles administrative responsibilities including reservation processing, plot management, and issuance of the payment receipt and burial usage permit. The key distinction from the current process is that the user can evaluate alternatives without requiring staff to mediate every step, and the ranking is generated consistently based on fixed criteria and weights.

#### 4.1.2 Database Design

An Entity Relationship Diagram (ERD) describes data entities and their relationships using standardized notations, serving as the structural foundation for the database.

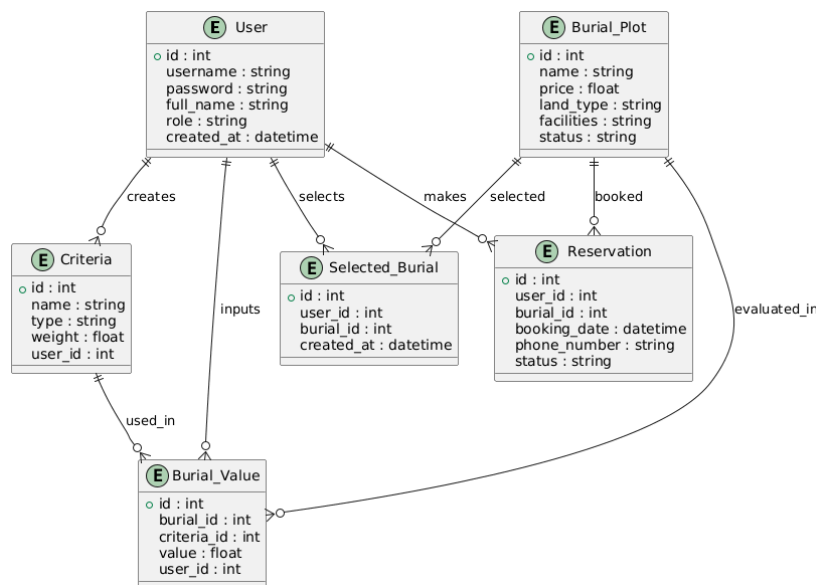


Figure 4. Entity Relationship Diagram

Figure 4 presents the ERD for the proposed system, consisting of six main entities: User, Kriteria (Criteria), Makam (Burial Plot), Nilai\_Makam (Grave Evaluation Values), Makam\_Terpilih (Selected Grave), and Pemesanan (Reservation). The User entity sits at the center of the relational structure, connected to criteria creation, evaluation value input, plot selection, and reservation management. The Makam entity stores plot-specific data including price, land type, facility details, and availability status, while Kriteria defines the evaluation parameters and their associated weights. Nilai\_Makam acts as a bridge between Makam and Kriteria by storing the scores used in the TOPSIS calculation, Makam\_Terpilih records selection outcomes based on

ranking results, and Pemesanan manages booking transactions made by users. ERD-to-LRS transformation converts the entity-relationship model into a Logical Record Structure (LRS) format, translating conceptual data relationships into a table-based representation suitable for physical database implementation.

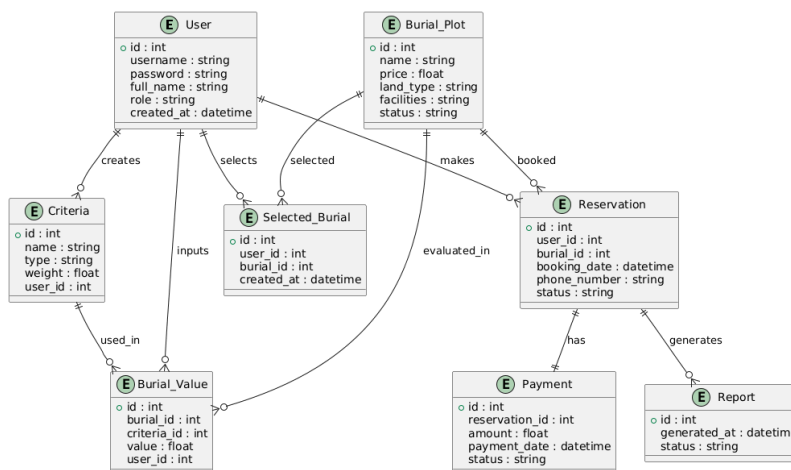


Figure 5. Transformation of ERD to LRS

Figure 5 presents the expanded relational structure, which adds two entities to those defined in the ERD: Payment and Report. The Payment entity manages financial transactions associated with reservations, while the Report entity supports administrative monitoring and data reporting. The remaining entities — User, Criteria, Burial Plot, Burial Value, Selected Burial, and Reservation — retain their roles as described in the ERD, forming an integrated database structure that supports decision analysis, transaction processing, and system management within a single data model. The Logical Record Structure (LRS) provides a detailed specification of the database schema, including attribute definitions, data types, and key constraints such as primary keys, foreign keys, unique keys, and null value rules for each entity in the system.

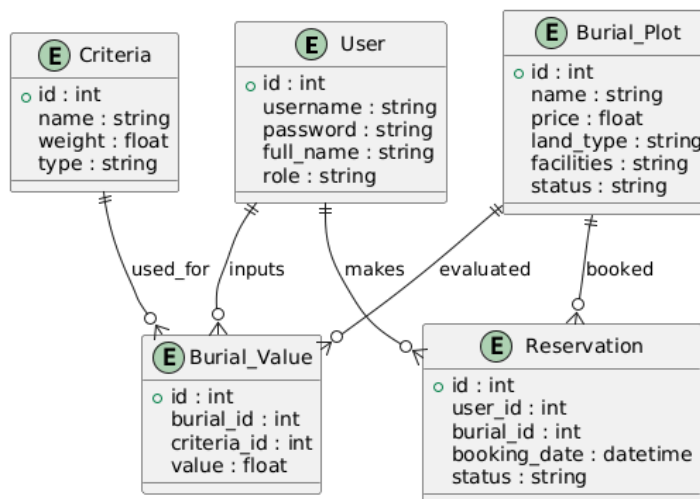


Figure 6. Logical Record Structure

#### 4.1.3 System Design

A Use Case Diagram is a UML component used to describe interactions between actors and a system, providing a high-level overview of system functionalities and illustrating how different users engage with available features.

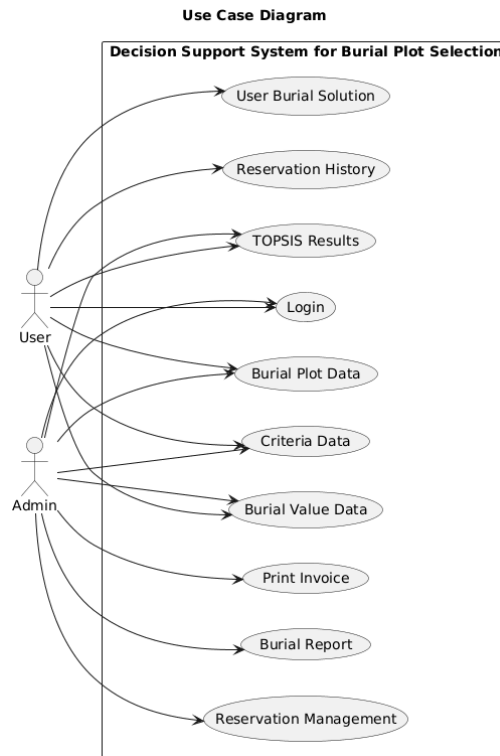


Figure 7. Use Case Diagram

Figure 7 illustrates the interaction between two primary actors — the User and the Admin — within the system. Both actors can access core functionalities including login, burial plot data management, criteria data management, burial value data management, and TOPSIS result viewing. The User is primarily oriented toward decision-making activities such as viewing ranked burial plot recommendations and checking reservation history, while the Admin holds extended access covering reservation management, invoice printing, and burial report generation. The separation of roles ensures that administrative functions do not interfere with the user-facing decision process, and vice versa. Activity diagrams are UML tools used to model workflows by illustrating the sequence of actions between actors and the system, including decision points and alternative execution paths. The following diagrams describe the key processes within the system.

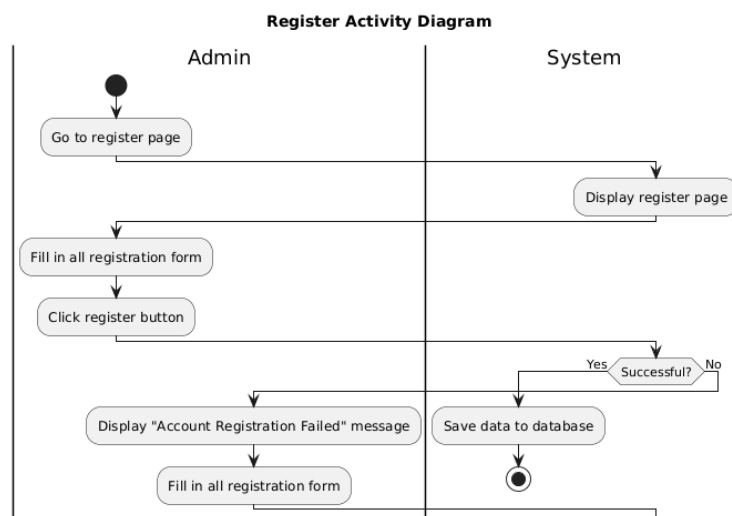


Figure 8. Activity Diagram — Register

Figure 8 models the registration process involving the Admin and the System. The Admin accesses the registration page, fills in the required information, and submits the form. The system validates the submission: if successful, the data is stored in the database and the process ends; if not, an error message prompts the Admin to re-enter the data. This validation step prevents duplicate or malformed accounts from being created in the system.

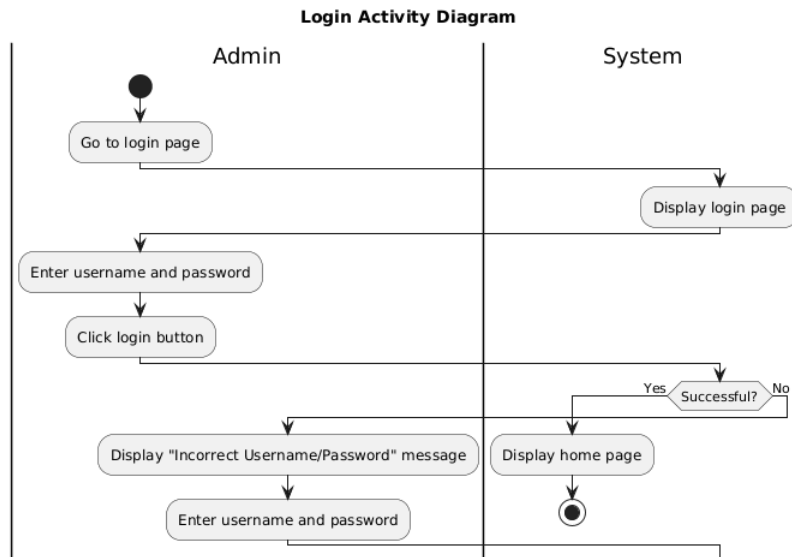


Figure 9. Activity Diagram — Login

Figure 9 describes the login process. The Admin enters a username and password, and the system validates the credentials against stored records. Successful authentication redirects the Admin to the home page, while incorrect credentials trigger an error message requiring re-entry. The process is intentionally straightforward to avoid unnecessary friction for users accessing the system.

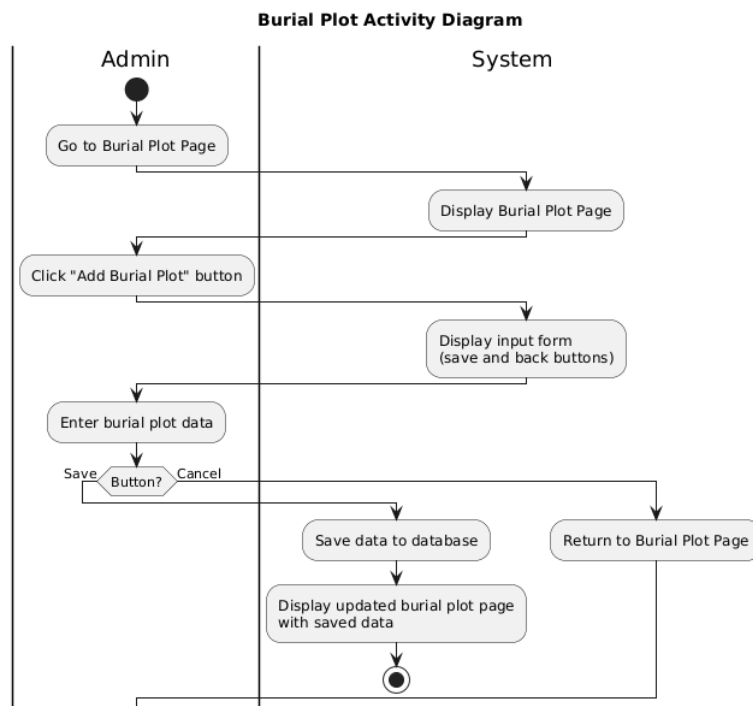


Figure 10. Admin Grave Activity Diagram

Figure 10 illustrates burial plot data management. The Admin accesses the burial plot page and initiates data entry by clicking "Add Burial Plot," which prompts an input form with save and cancel options. If the Admin saves the entry, the system stores the record and refreshes the burial plot page with the newly added information. If cancelled, the system returns to the main page without writing any data, preventing accidental entries without requiring a separate confirmation step.

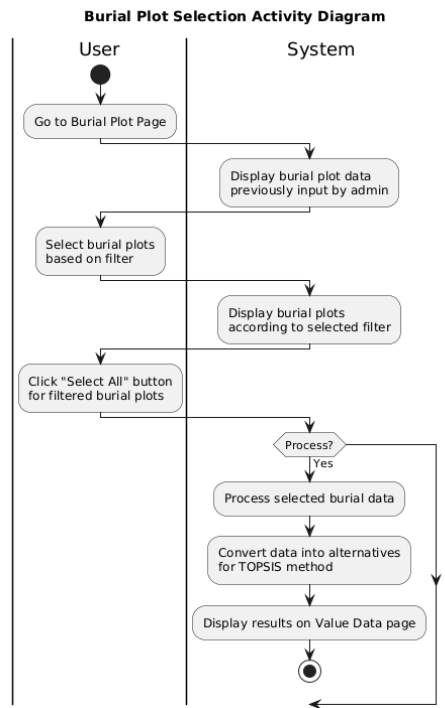


Figure 11. User Activity Diagram of the Cemetery

Figure 11 represents the process by which a user selects burial plots for TOPSIS evaluation. The user accesses the burial plot page, views available data entered by the Admin, applies filters based on specific criteria, and selects all relevant plots using the "Select All" function. The system then converts the selected plots into alternatives formatted for TOPSIS analysis and displays the results on the value data page. The filtering step is particularly important — it allows users to narrow the option set before analysis, keeping the ranking output relevant to their specific situation.

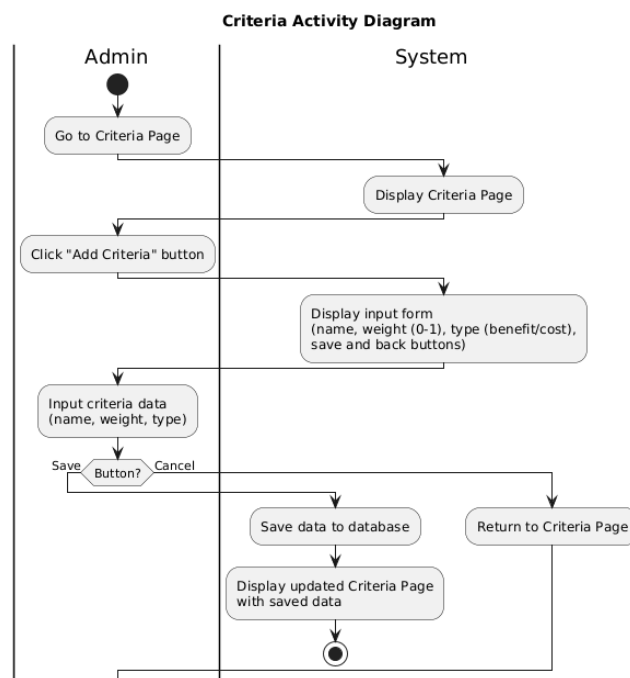


Figure 12. Criteria Activity Diagram

Figure 12 covers criteria data management. The Admin accesses the criteria page and adds new criteria by entering a name, weight (ranging from 0 to 1), and type — either benefit or cost. The benefit/cost distinction determines how TOPSIS calculates distances from the ideal solutions: benefit criteria favor higher values, while

cost criteria favor lower ones. Accurate criteria setup is a prerequisite for meaningful ranking results, as the weight values directly influence the final alternative rankings.

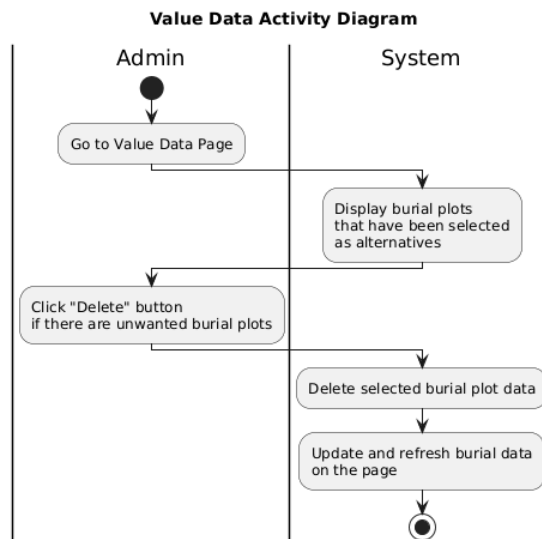


Figure 13. User Grave Value Activity Diagram

Figure 13 describes the value data management step that precedes TOPSIS analysis. The Admin accesses the Value Data page, reviews the list of burial plots selected as evaluation alternatives, and can remove any irrelevant entries by clicking "Delete." The system deletes the record and refreshes the display accordingly. This step gives users direct control over the input to the analysis, ensuring that only relevant alternatives are carried forward into the ranking process.

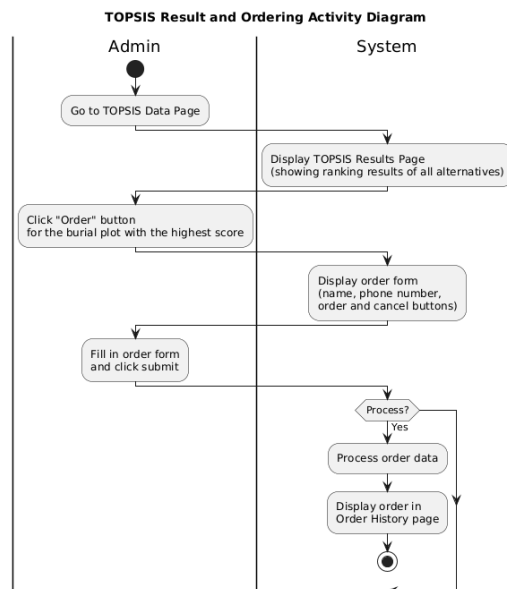


Figure 14. User TOPSIS Results Activity Diagram

Figure 14 illustrates how TOPSIS results are used to initiate a reservation. The Admin accesses the TOPSIS Data page, where the system displays all ranked burial plot alternatives. The Admin selects a preferred plot — typically the highest-ranked option — and clicks "Order," prompting an order form that requests name and phone number. After submission, the system records the order in the Order History page. The direct connection between the ranking output and the ordering process reduces the steps required to act on the recommendation, making the transition from decision to transaction seamless.

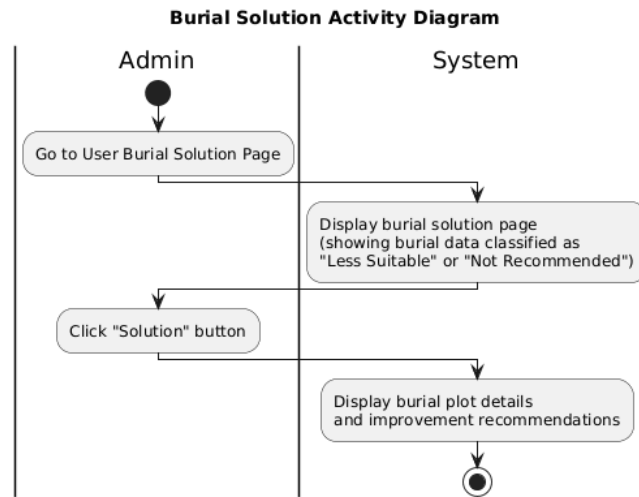


Figure 15. Grave Solution Activity Diagram

Figure 15 represents the process of reviewing burial plots categorized as "Less Suitable" or "Not Recommended" by the TOPSIS analysis. The Admin navigates to the User Burial Solution page, selects a specific plot by clicking "Solution," and the system presents detailed data along with recommendations for improvement or alternative considerations. This feature acknowledges that lower-ranked plots may still be selected for reasons outside the defined criteria set, and the system supports that decision with relevant contextual information.

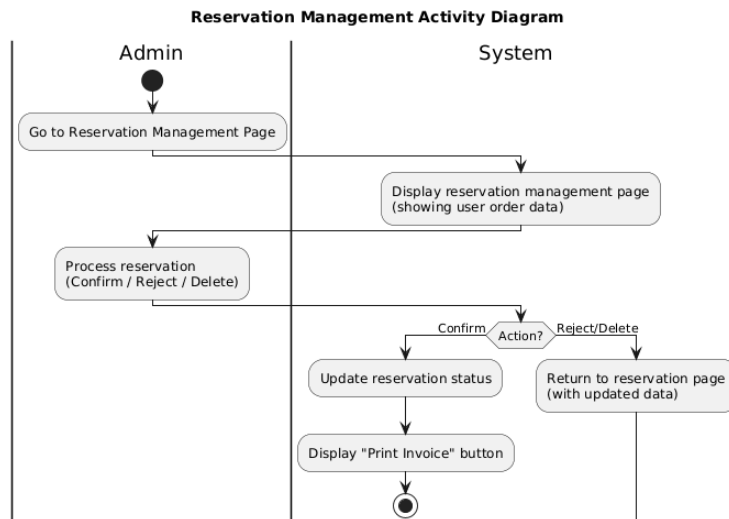


Figure 16. Order Management Activity Diagram

Figure 16 covers reservation management. The Admin accesses the Reservation Management page, reviews submitted reservations, and processes each one by choosing to confirm, reject, or delete. Confirmation triggers an additional option to print an invoice, while rejection and deletion update the reservation status and return the Admin to the management page. The three-option structure reflects real operational conditions where not all reservations follow a straightforward path, giving administrators the flexibility to handle exceptions without workarounds.

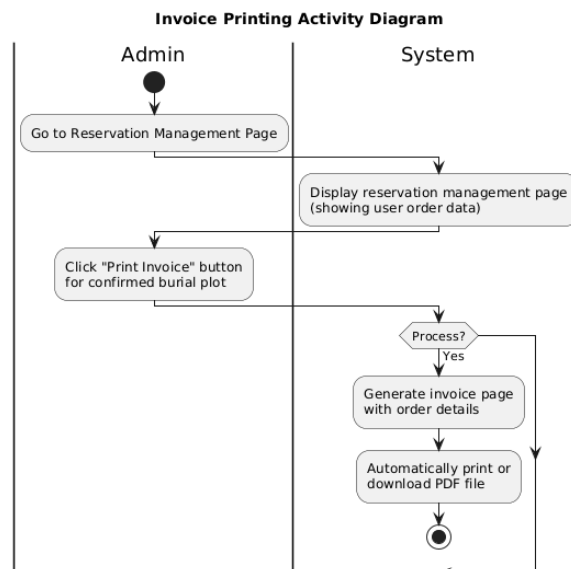


Figure 17. Invoice Printing Activity Diagram

Figure 17 describes the invoice generation process. After identifying a confirmed reservation, the Admin clicks "Print Invoice," and the system generates an invoice page containing complete order details. The system then either initiates printing directly or allows the document to be downloaded as a PDF file. Automated document generation at this stage removes a manual step that would otherwise require staff to produce invoices separately outside the system.

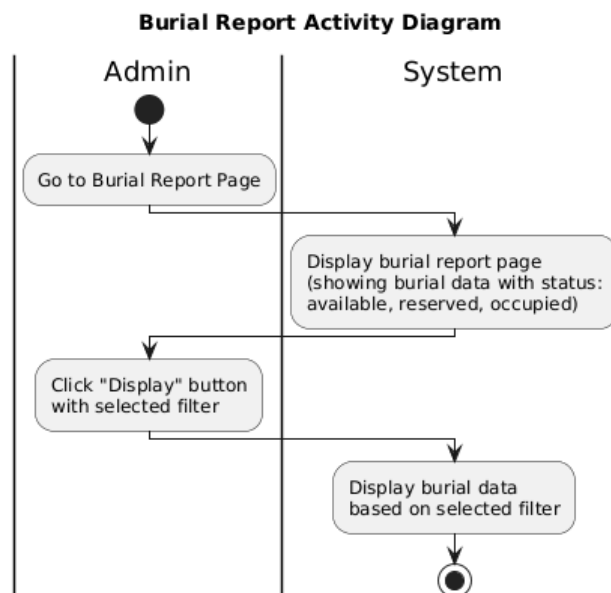


Figure 18. Activity Diagram for Grave Reports

Figure 18 illustrates the burial report generation process. The Admin accesses the Burial Report page, where the system displays plot data categorized by status — available, reserved, or occupied. The Admin applies specific filters and clicks "Display," and the system returns the corresponding records. This reporting function gives administrators a current view of plot inventory and transaction data without requiring manual tallying or cross-referencing separate records.

#### 4.1.4 Program Implementation

The system is built using PHP and MySQL, with a web-based interface designed for accessibility across standard browsers. Core interfaces include registration and login pages, admin and user dashboards, and data management pages for burial plots, criteria, and evaluation values. The registration page allows users to create accounts by entering essential information such as name, email, and password, while the login page ensures secure authentication through credential validation. The dashboard serves as the main control panel for both

actors, providing an at-a-glance summary of key system data — number of available plots, defined criteria, pending evaluations, and current ranking results. Data management pages allow administrators to input, update, and manage records with a consistent interface structure, and the criteria management feature specifically enables the assignment of weights and types (benefit or cost), which are required inputs for the TOPSIS calculation to function correctly. The full decision-making workflow — from data entry through TOPSIS analysis, plot selection, reservation, and reporting — is supported within a single platform. The TOPSIS results page presents ranked alternatives and allows users to proceed directly to reservation through an integrated ordering form. Order history, reservation management, invoice printing, and burial report pages are all accessible from the same system, enabling administrators to track transactions, confirm or reject orders, generate invoices, and monitor plot inventory without switching between separate tools. The implementation demonstrates that a structured decision-making process and operational service management can be delivered within a unified web-based system.

## 4.2 Discussion

The system developed in this study confirms that TOPSIS can be applied effectively in burial plot selection — a domain that has received little attention in the DSS literature despite its clear practical relevance. The system processes multiple criteria, including price, land type, and available facilities, and produces ranked alternatives that reflect user preferences in a consistent and traceable manner. This finding aligns with Nurelasari & Purwaningsih (2020), who demonstrated that TOPSIS provides accurate recommendations in housing selection involving multiple criteria, and with Putra *et al.* (2020), who confirmed its capacity to generate logical and structured rankings in tourism destination selection. Setiawansyah (2022) further emphasized that TOPSIS improves decision accuracy and transparency by evaluating alternatives based on predefined criteria — a characteristic that is particularly valuable in public service contexts where decisions must be justifiable to users under time pressure. Embedding TOPSIS within a web-based platform improves accessibility and usability, allowing users to filter, compare, and select burial plots without relying on staff to mediate every step. This supports the argument by Arifin & Insani (2023) that pairing decision-making methods with information systems improves both decision quality and user experience. The system bridges the gap between analytical output and practical action by connecting ranking results directly to the reservation workflow — a design choice that reduces the number of steps a user must take to act on a recommendation. Compared to prior studies in scholarship selection (Al Harits & Al Majid, 2023), employee evaluation (Anggraini & Orisa, 2022), and product selection (Borman *et al.*, 2020), this research addresses a context where urgency and emotional pressure are defining factors, demonstrating that TOPSIS functions reliably under conditions that differ substantially from those in established application domains.

The limitations of TOPSIS identified in prior research are present here as well. Criteria weights are assigned by the administrator, which introduces a degree of subjectivity that the method itself cannot resolve — Thirhanudin (2024) documents this sensitivity directly, noting that improper weight assignment can bias the final ranking. The assumption of independence among criteria presents a related concern; as noted by Kilič *et al.* (2021), this condition may not hold in complex scenarios where evaluation variables are correlated. These constraints do not undermine the system's utility, but they do point toward clear directions for future development. Combining TOPSIS with AHP for structured weight determination, or with fuzzy logic to handle uncertainty in criteria values, would address the most significant weaknesses while maintaining the method's interpretability for non-technical users — a balance that matters in public service applications where outputs must be explainable to a general audience.

## 5. Conclusion and Recommendations

This study has produced a web-based Decision Support System for burial plot selection at TPU Al-Qobri, built on the TOPSIS method to address the documented limitations of the existing manual process. The system assists users and administrators in evaluating burial plots across multiple criteria — price, facilities, and land type — in a structured and objective manner, generating ranked alternatives that help users identify the most suitable option according to their preferences. The complete workflow, from registration and data input through TOPSIS-based analysis, reservation management, invoice generation, and reporting, is supported within a single platform. Black Box testing confirms that the application performs as specified and meets user requirements. The results demonstrate that a criterion-based DSS can improve decision accuracy, reduce selection time, and support more consistent service management in public cemetery administration.

Two areas warrant attention in future work. First, criteria weights are currently assigned manually by the administrator, which introduces subjectivity that the TOPSIS method alone cannot resolve. Incorporating a structured weighting approach — such as AHP — would reduce this dependency and produce more defensible weight assignments. Second, the system has been developed and tested at a single cemetery site; broader

deployment across different cemetery types and administrative contexts would provide stronger evidence of its generalizability and adaptability.

## Acknowledgment

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