

Travel Reimbursement System Conceptual Model

Date: 03/07/2025

Summary of Conceptual model

The Travel Expense Reimbursement System is designed to streamline the process of managing travel expenses for university employees. It ensures compliance with financial policies while maintaining an organized structure for approvals and reimbursements. The conceptual model captures essential components of the travel expense workflow, including pre-travel approvals, post-travel reporting, budget allocation, and final reimbursements. Key entities such as Employee, Supervisor, Budget Officer, and University Financial Services Officer play critical roles in this system, ensuring a structured process for submitting, approving, and reimbursing travel expenses. The model also incorporates relationships to reflect hierarchical approvals and financial oversight, ensuring that each travel request is handled efficiently and transparently. By integrating structured data storage, this system enhances record-keeping, accountability, and compliance with institutional guidelines.

Purpose of Database

The primary purpose of this database is to establish a structured and efficient system for processing travel reimbursements while ensuring financial accountability and compliance with university policies. The database will facilitate the seamless tracking of travel approvals, expenses, and reimbursements, providing a clear audit trail for financial oversight. By implementing a well-defined entity-relationship model, the system enables standardized data entry, reduces manual errors, and ensures that reimbursements adhere to predefined financial regulations. Additionally, this database will enhance reporting capabilities, allowing administrators to analyze travel expenses and optimize budget allocations. Ultimately, the system aims to support a fair, transparent, and efficient travel reimbursement process that benefits both employees and financial administrators within the university.

Model Description:

Entities and Attributes

The model is developed around seven primary entities:

1. Department:

The Department entity represents the academic or administrative unit to which an employee belongs. This entity serves as a reference to categorize employees based on their organizational affiliation.

Purpose: It provides background information about an employee's departmental association without influencing the travel reimbursement process. It helps maintain organizational clarity by linking employees to their respective departments.

Attributes:

Department_ID	Unique identifier for the department (Primary Key).
Department_Name	The official name of the department.

2. Employee:

The Employee entity stores essential information about university personnel who may undertake official travel. This entity helps link each travel request and expense report to the correct individual.

Purpose: It creates a single record for every staff member involved in travel, ensuring accurate tracking of requests and expenses. It streamlines communication and accountability by linking employees to their respective departments and roles.

Attributes:

Employee_ID	Unique identifier for the employee (Primary Key).
FName	Employee's first name, part of composite attribute of

	Name.
Minit	Employee's middle name initial, part of composite attribute of Name.
LName	Employee's last name, part of composite attribute of Name.
Email	Official email address for communication.
Workstation address	Physical address of the employee's primary work location (from the HR system).

3. Pre-Travel Approval Report:

The Pre-Travel Approval Report entity documents the initial travel plan, including estimated costs, duration, and justification for the trip. This report is submitted by the traveler and reviewed by the supervisor prior to any actual expenses being incurred.

Purpose: It helps supervisors gauge the necessity and cost-effectiveness of the proposed travel in advance. It sets a reference point for subsequent expense evaluations, ensuring requests are authorized under transparent conditions.

Attributes:

Approval_Report_ID	Unique identifier for each pre-travel approval report (Primary Key).
Est. Amount	Estimated total cost of the trip category wise (airfare, lodging, meals, etc.).
Category	Classifies the expense type (transportation, meal, lodging, etc.).
Number of Days	Duration of the planned travel.
Approval Status	Indicates if the report is approved, pending, or rejected.

4. Supervisor:

The supervisor entity captures details of the traveller's estimated expenses and has the authority to approve or reject travel requests before they are executed. Supervisors act as the initial gatekeepers, confirming whether a proposed trip aligns with the University's goals.

Purpose: It ensures that all proposed travel meets necessary criteria and budget considerations before expenses are incurred. It provides a clear decision point for travel requests, upholding financial and policy compliance.

Attributes:

Supervisor_ID	Unique identifier for the supervisor (Primary Key).
Approval_Auth	Indicates whether the supervisor has approved the specific pre-travel approval report.

5. Post-Travel Expense Report:

The Post-Travel Expense Report entity consolidates all actual expenses incurred during the trip. The traveler submits it after returning, attaching receipts and justifications. The Budget Officer then reviews these expenses for accuracy and adherence to policy for final reimbursement approval.

Purpose: It provides an auditable record of travel-related spending, linking actual costs back to the initial estimates. It ensures legitimate expenses are reimbursed and disallowed items are identified before payment is issued.

Attributes:

Vendor_Name	Name of the merchant or service provider for travel (e.g. travel agencies).
ReceiptFile	Multi-valued attribute, reference to the digital receipt(s) uploaded for documentation.
Amount	All expenses claimed in this report.

Report_ID	Unique identifier for each post-travel expense report (Primary Key).
Start_Date	Actual start date of the trip, for expense calculation.
End_Date	Actual end date of the trip, for expense calculation.
Destination	Location(s) visited during travel.
Description	Brief note explaining the nature of each expense.
Insurance Coverage	Indicates whether additional travel insurance was purchased or required.
Hotel_name	Name of the hotel.
Meal_type	Classifies meal expenses (per diem, actual cost, or included in conference fees).
Transportation Type	Indicates how the traveler travelled (air, rental car, personal vehicle, etc.).
Total_Amount	Derived attribute, includes the summation of all expenses till the payment date claimed by the traveller.

6. Budget Officer:

The Budget Officer entity responsible for allocating funds to employees by processing reimbursements for approved travel expenses. The Budget Officer ensures that disbursements are made promptly and efficiently, facilitating smooth financial transactions for travelers.

Purpose: It ensures that travelers receive the allocated funds as reimbursements, enabling seamless financial support for university-related travel.

Attributes:

BudgetOfficer_ID	Unique identifier for the budget officer (Primary Key).
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Payment_Date	Date on which the budget officer authorizes or schedules the payment.
Approval_Auth	Indicates whether the budget officer has reimbursed the expenses to the traveller or not.

7. University Financial Service Officer (UFS):

The UFS entity oversees the financial compliance of travel expense reports by verifying that all submitted expenses align with university policies and budgetary constraints. The UFS officer plays a crucial role in ensuring financial accountability and adherence to institutional regulations.

Purpose: It safeguards financial integrity by validating expense reports against university guidelines before authorizing reimbursements.

Attributes:

UFS_ID	Unique identifier for the UFS representative (Primary Key).
Role	Describes the function (e.g., policy monitor, compliance officer, etc.).

Relationships

1. Relationship Name: 'Belongs To'

Entities Involved: Employee → Department

Type of Relationship: Many-to-Many (M:N)

Purpose: An employee can be associated with multiple departments, and a department can have multiple employees working under it. This is represented in the EER diagram with a standard M:N relationship, which means no strict one-to-one or one-to-many constraint is enforced.

Cardinality Representation: The double line between Employee and Department indicates that every employee must belong to at least one department, and every department must have employees.

2. Relationship Name: 'Submits'

Entities Involved: Employee → Pre-Travel Approval Report

Type of Relationship: One-to-One (1:1)

Purpose: Employees who will travel in the future must submit the pre-travel approval report, which consists of the estimated travel expenses.

Cardinality Representation: The single line between Employee and Submits ensures that only employees who will travel must submit a report, while others are not required. The double line between Submits and Pre-Travel Approval Report ensures that every employee who will be a traveller has an associated report.

3. **Relationship Name:** 'Submits'

Entities Involved: Employee → Post-Travel Expense Report

Type of Relationship: One-to-One (1:1)

Purpose: Employees who have traveled submit post-travel expense report detailing their expenses and travel activities.

Cardinality Representation: The single line between Employee and Submits ensures that only employees who have traveled must submit a report, while others are not required. The double line between Submits and Post-Travel Expense Report ensures that every employee who was a traveller has an associated report.

4. **Relationship Name:** 'Overseen by'

Entities Involved: Post-Travel Expense Report → University Financial Service Officer

Type of Relationship: Many-to-One (N:1)

Purpose: The University Financial Service (UFS) officer verifies post-travel expense report based on policies and guidelines of the university.

Cardinality Representation: The single line between UFS officer and 'Overseen by' indicates that not all travel reports will be checked by all the UFS officers. The double line between 'Overseen By' and Post-travel expense report ensures that every report is recorded and evaluated by the UFS officer.

5. **Relationship Name:** 'Approved by'

Entities Involved: Pre-Travel Approval Report → Supervisor

Type of Relationship: Many-to-One (N:1)

Purpose: Supervisors are responsible for approving pre-travel expense reports submitted by employees before their trips.

Cardinality Representation: The double line between 'Approved by' and Pre-Travel Approval Report ensures that every pre-travel approval report is formally reviewed and recorded. The single line between 'Approved by' and Supervisor indicates that not all supervisors must approve every report, but each report is assigned to only one supervisor for approval.

6. **Relationship Name:** 'Reimbursed by'

Entities Involved: Post-Travel Expense Report → Budget Officer

Type of Relationship: Many-to-One (N:1)

Purpose: Budget Officers are responsible for reimbursing approved travel expenses based on the submitted post-travel expense reports.

Cardinality Representation: The double line between 'Reimbursed by' and Post-Travel Expense Report ensures that every approved post-travel expense report is processed for reimbursement. The single line between 'Reimbursed by' and Budget Officer signifies that while each report is reimbursed by a specific officer, not all budget officers necessarily process every report.

Hierarchy Statement: The Employee entity serves as the superclass, with three disjoint subclasses—Supervisor, Budget Officer, and University Financial Services Officer. The disjoint constraint ('d') ensures that each employee belongs to only one of these roles, and the single line from Employee to each subclass indicates that not all employees hold these specialized positions.

Challenges Faced

1. **Should meal, lodging, and transportation be considered as entities?**

Challenge: Meals, lodging, and transportation expenses are critical to the system, but determining how to best represent them is a key design decision.

There are two main viewpoints:

Viewpoint A: Treat meals, lodging, and transportation as attributes of the report. The argument here is that these details are all covered by the receipt file, which will connect each receipt to a spending category. Hence, these expenses can be treated as attributes within the post-travel report entity. This would simplify the database by reducing the number of entities, resulting in fewer tables and relationships to manage.

Viewpoint B: Treat meals, lodging, and transportation as separate entities. This perspective argues that these categories represent complex events with numerous attributes and relationships that should be managed independently. Each travel report may include different combinations of meals, lodging, and transportation costs, which vary as travelers consume different meals, choose different hotels, and use different airlines, buses, or metro systems. Thus, these three objects should be treated as distinct entities.

Resolution: We agreed with Viewpoint A - meals, lodging, and transportation should be treated as attributes of the reports. The rationale is that the main attribute "receiptFile" covers most details of these expenses, and it interacts only with the post-travel report. Moreover, policies would not change significantly over time, as travelers would typically travel between designated locations, with each expense choice covered by receipt files. Representing these three objects as attributes reduces the complexity of the diagram and system while ensuring future readability.

2. Should budget and sponsored projects be considered as entities?

Challenge: Budgets and sponsored projects are critical to the system since they cover travel costs, but determining how to represent them is a key design decision.

There are two main viewpoints:

Viewpoint A: Neglect budget and sponsored project details. The argument here is that budget and sponsored project information is implicitly represented through the budget officer and supervisor roles. Since

travelers need their reports approved by supervisors who understand the applicable spending limits, explicit representation is unnecessary. This would simplify the database by reducing the number of entities and relationships.

Viewpoint B: Treat budget and sponsored projects as separate entities. This argument maintains that budgets and sponsored projects are distinct elements that should be handled carefully and treated as separate objects.

3. Discussion of cardinality and participation constraints.

Cardinality and participation constraints define the numerical relationships between entities, determining how many instances of one entity can or must relate to instances of another. We defined these constraints based on the rules outlined in the Travel Reimbursement documents. In cases where explicit details weren't provided, we referenced corresponding real-world situations.

Some challenging cardinality and participation constraints in the EER diagram include:

1. Approved_by (Report - Supervisor)

- Cardinality: A report is approved by one supervisor, and one supervisor can approve many reports.
- Participation: Every report must be approved by a supervisor, but not all supervisors need to approve reports. Sometimes there may be fewer reports than supervisors, leaving some supervisors without approval responsibilities.
- Discussion: One viewpoint argued that this should be a 1:1 relationship, as typically a single report would be covered by a single designated supervisor. However, another viewpoint suggested a 1:M relationship, considering scenarios where a single supervisor might handle all reports for a department. Ultimately, we concluded that the 1:M relationship is more appropriate.

2. Submits (Employee - Report)

- Cardinality: An employee can submit multiple reports, and each report must be submitted by an employee.
- Participation: Every report must be submitted by an employee, but not all employees need to submit reports if no travel is required.
- Discussion: One viewpoint argued for a 1:1 relationship, as an employee submits a report and a report is submitted by an employee. However, another viewpoint suggested a 1:M relationship, considering scenarios where a single employee might submit multiple reports for different travel reimbursements. We concluded that the 1:M relationship is more appropriate.

3. Belongs_to (Employee - Department)

- Cardinality: An employee can belong to multiple departments, and each department can have multiple employees.
- Participation: Every employee must belong to a department, and every department must have employees.
- Discussion: One viewpoint argued for a 1:N relationship, with one employee belonging to one department. However, in reality, many professors and employees belong to multiple departments, and each department has multiple employees, making this an M:N relationship.

Conceptual Model Design

