

Symmetric Relational Data Object Model (RDOM)

RDOM primarily consists of symmetric data objects (DOBJs) and symmetric bilateral relationship data objects(R-DOBJs). R-DOBJ represents many-to-many relationship between two DOBJs (or one-to-many relationship between first DOBJ to R-DOBJ and one-to-many relationship between second DOBJ to the R-DOBJ). Following is an example (Fig. 1) RDOM consisting four DOBJs (Dobj1, Dobj2, Dobj3 and Dobj4) and six R-DOBJs (RDObj1-2,RDObj1-3, RDObj2-3, Rdoobj2-4, RDObj4-1 and RDObj3-4).

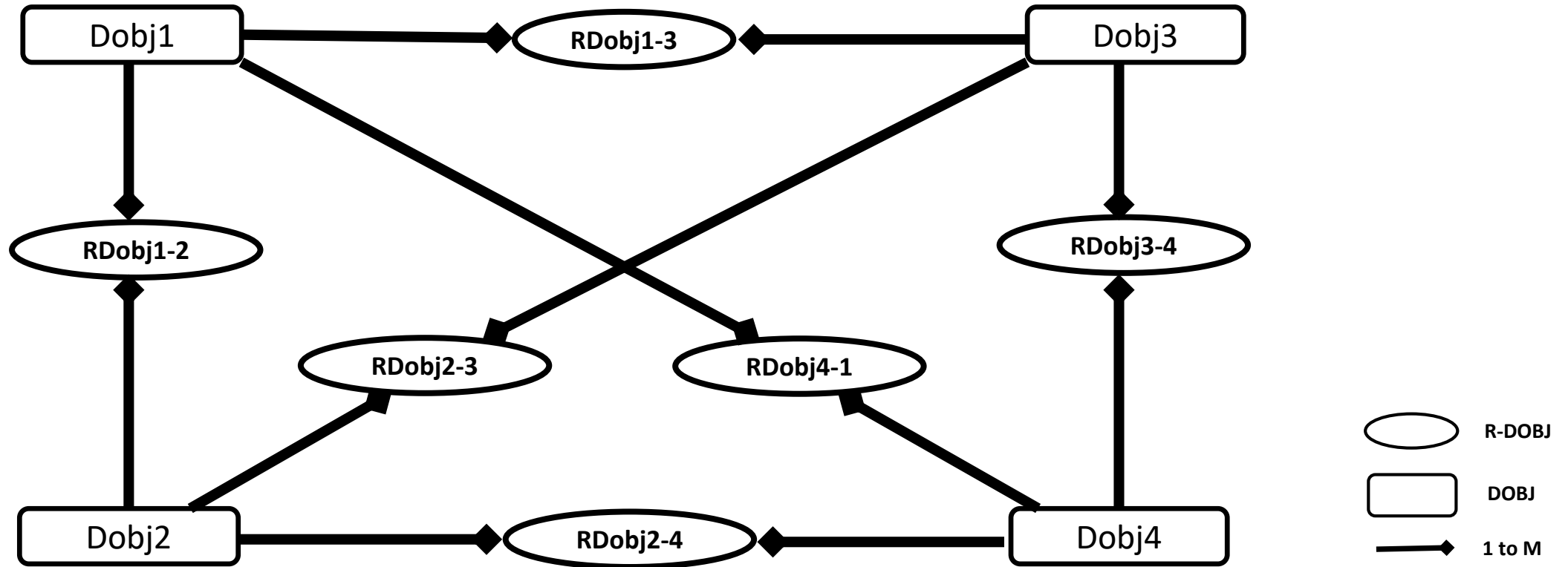


Fig. 1

DOBJ: consists of three types of relational database tables; static attributes table, aperiodic attributes table/s and periodic attributes table/s.

- **Static attributes table (S-table)**: consists of a column for DOBJ's identification (ID) attribute and columns for static attributes (whose value remains static). For example, Name and Date of Birth attributes of Customer DOBJ.
[DOBJ must have S-table with ID column. Only one S-table is allowed per DOBJ]
- **Aperiodic attributes table (A-table)**: consists of a column for DOBJ's ID attribute, a column for instance update sequence number (INSTANCE_UPDT_SEQ) and columns for aperiodic attributes (whose value changes aperiodically). INSTANCE_UPDT_SEQ column is used for storing sequentially increasing number for each update of aperiodic attribute/s value/s. For example, Mailing Address attribute of Customer. First instance of Customer's mailing address is to be stored with INSTANCE_UPDT_SEQ value of 1, next update of mailing address would be stored with INSTANCE_UPDT_SEQ value of 2 and so forth.
[DOBJ may have one or more A-tables]
- **Periodic attributes table (P-table)**: consists of a column for DOBJ's ID attribute and columns for periodic attributes (whose value is captured or recorded at every specific period). For example, monthly (or bi-weekly) employee payment attributes.
[DOBJ may have one or more sets of periodic tables]

Similarly R-DOBJ consists of three types (Static, Aperiodic and Periodic) of relational database tables. Each R-DOBJ table consists of two ID columns (for the two related DOBJ's IDs) and other columns.

DOBJ Data Model template (Fig. 2):

- **S TABLE (Static attributes table):** consists of ID column (DOBJ_ID) as primary-key and columns for static attributes (S_attr1, S_attr2, ...).
- **A TABLEs (Aperiodic attributes tables):** consist of ID column (DOBJ_ID) and sequence number column (INSTANCE_UPDT_SEQ) combined as primary-key, and columns for aperiodic attributes (A_attr_1,). Relationship from S_TABLE to A_TABLEs are of type one-to-many.
- **Pn TABLE ns (Periodic attributes tables):** consist of ID column (DOBJ_ID) as primary-key and columns for periodic attributes (P1_attr_1, P1_attr_2,....). Relationships from S_TABLE to P_TABLEs are of type one-to-one.

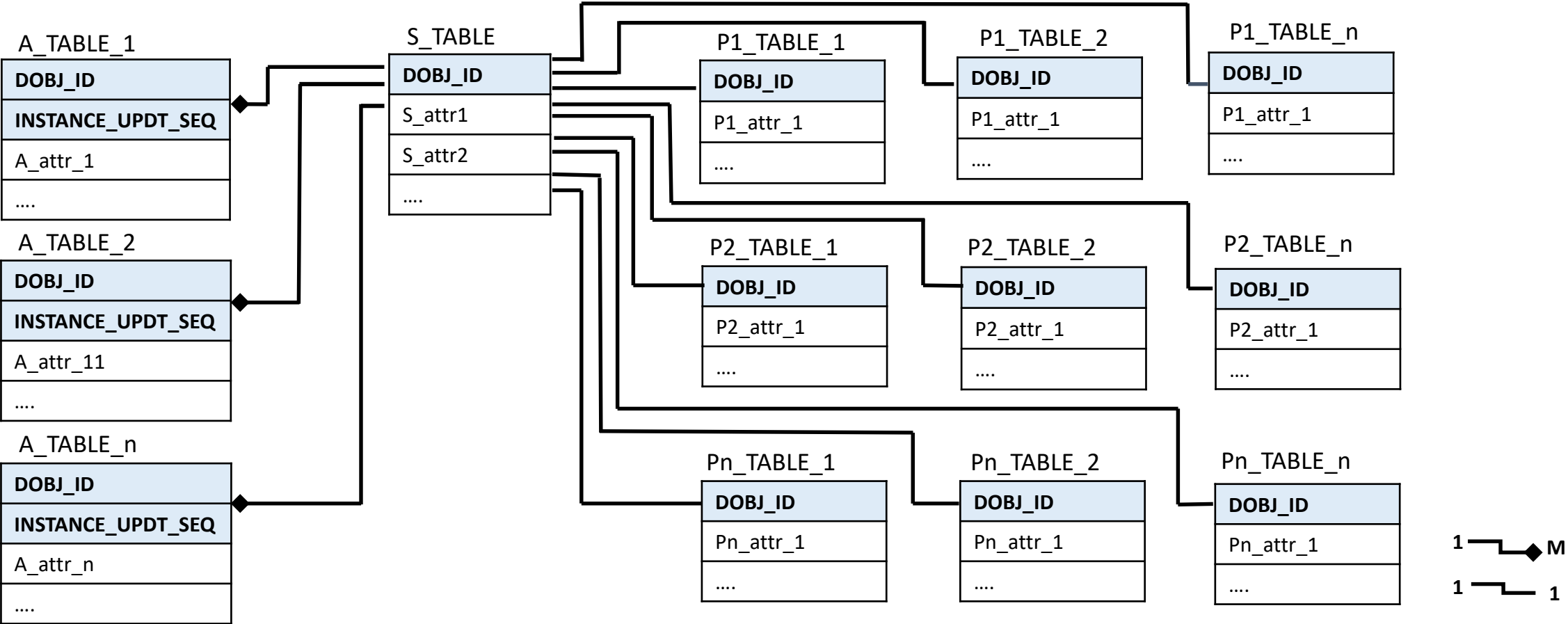


Fig. 2

R-DOBJ Data Model template (Fig. 3):

- **RS TABLE (Static attributes table):** consist of ID columns (DOBJ1_ID + DOBJ2_ID) as primary-key and columns for static attributes (RS_attr1, RS_attr2, ...).
- **RA TABLEs (Aperiodic attributes tables):** consist of ID columns (DOBJ1_ID + DOBJ2_ID) and sequence number column (INSTANCE_UPDT_SEQ) combined as primary-key, and columns for aperiodic attributes (RA_attr_1, ...). Relationship from RS_TABLE to RA_TABLEs are of type one-to-many.
- **RPn TABLE ns (Periodic attributes tables):** consist of ID columns (DOBJ1_ID + DOBJ2_ID) as primary-key and columns for periodic attributes (RP1_attr_1, RP1_attr_2,....). Relationships from RS_TABLE to RP_TABLEs are of type one-to-one.

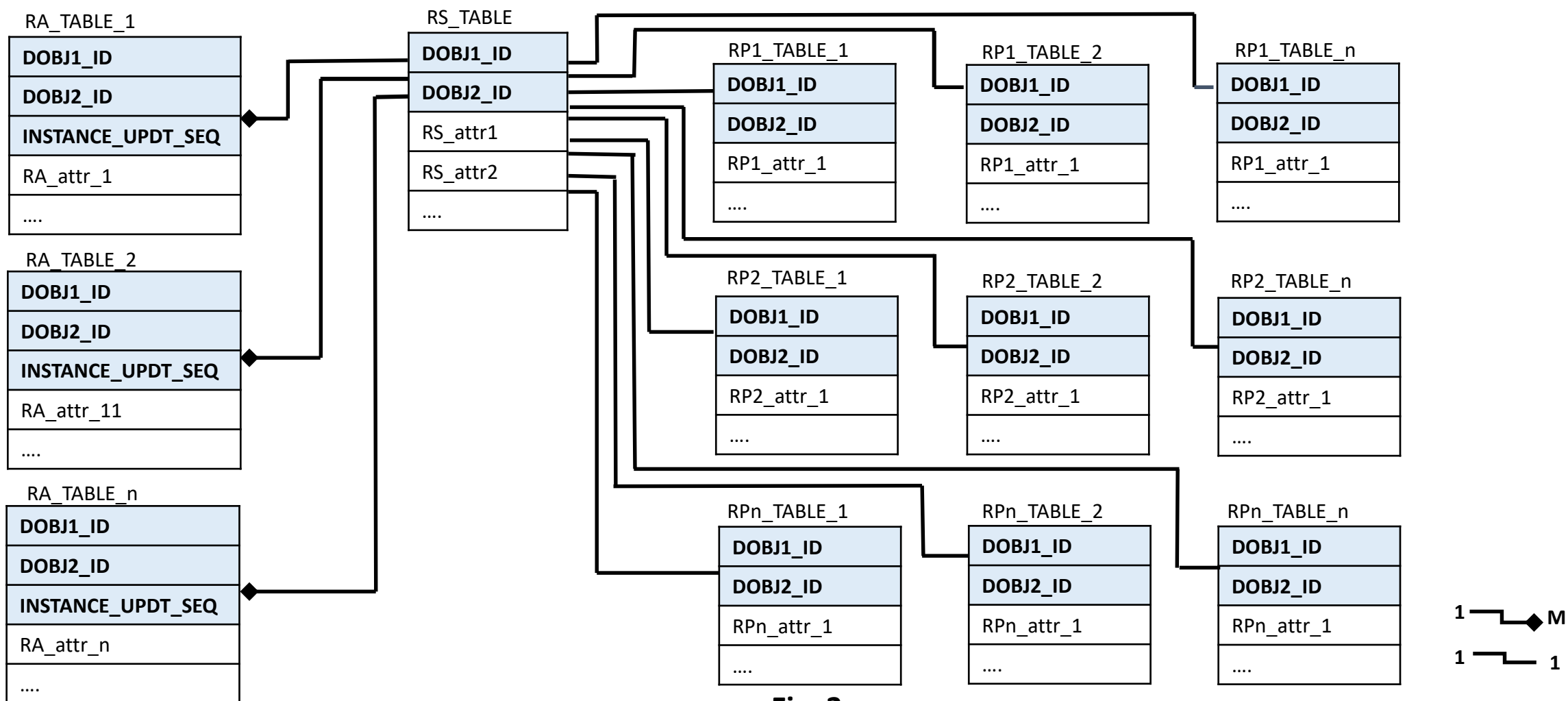


Fig. 3

In addition to DOBJ and R-DOBJ, RDOM may include Look-Up (LOOK-UP) and Range (RANGE) associations.

LOOK-UP: consists of a relational database table. The table consists of a look-up column (as primary-key) and one or more columns for look-up values (Fig.4).

RANGE: consists of a relational database table. The table consists of a column for lower bound of range, a column for upper bound of range and one or more columns for the range description/information (Fig.4). Lower bound column concatenated with upper bound column, is primary-key.

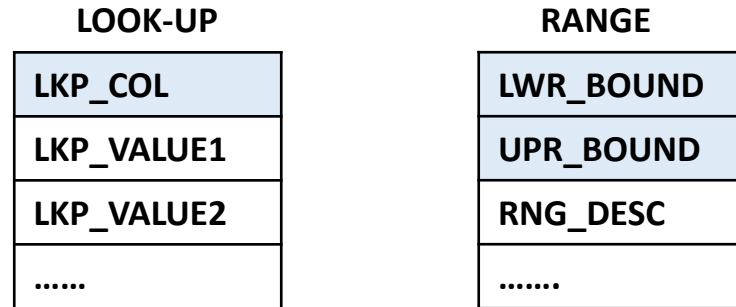


Fig. 4

- A Look-Up (and Range) may be associated with one or more non-ID columns of one or more tables of DOBJs and R-DOBJs. Also, a non-ID column may be associated with one or more Look-up (and Range).

RDOM Constraints:

- Primary-key column value in all tables (of all four types of data objects) must not be NULL.
- INSTANCE_UPDT_SEQ column value, in Aperiodic tables, must be a positive integer starting with 1 for first (or original) row for an instance.
- In a DOBJ: DOBJ_ID column of Aperiodic and Periodic tables must not contain value that does not exist in DOBJ_ID column of Static table.
- In a R-DOBJ: DOBJ1_ID and DOBJ2_ID columns of Static table must not contain value that does not exist in DOBJ_ID columns of the two respective DOBJs.
- In a R-DOBJ: DOBJ1_ID and DOBJ2_ID columns of Aperiodic and Periodic tables must not contain value that does not exist in DOBJ1_ID and DOBJ2_ID columns of Static table.

RDOM as Super Model

RDOM can also be implemented as Super Model, on existing relational model, in the form of combination of existing tables and views on existing tables.

Following are the four general rules for implementing RDOM as Super Model.

Rule-1: Minimize number of DOBJs: By consolidating relevant tables into DOBJs; and separating DOBJ tables from LOOK-UP tables.

Rule-2: If a table contains object hierarchy then flatten the object hierarchy into a table (or a view) by means of additional columns.

Rule-3: If an object hierarchy exists in the form of multiple tables then combine the tables into one table (or a view).

Rule-4: Maximize number of RDOBJs, possibly relating all DOBJs to each other.

Example: In this example (Fig. 5), HR Database contains seven tables (DEPARTMENTS, EMPLOYEES, JOB_HISTORY, JOBS, LOCATIONS, COUNTRIES, REGIONS) for employee-manager hierarchy, department, location, jobs and employees' job history.

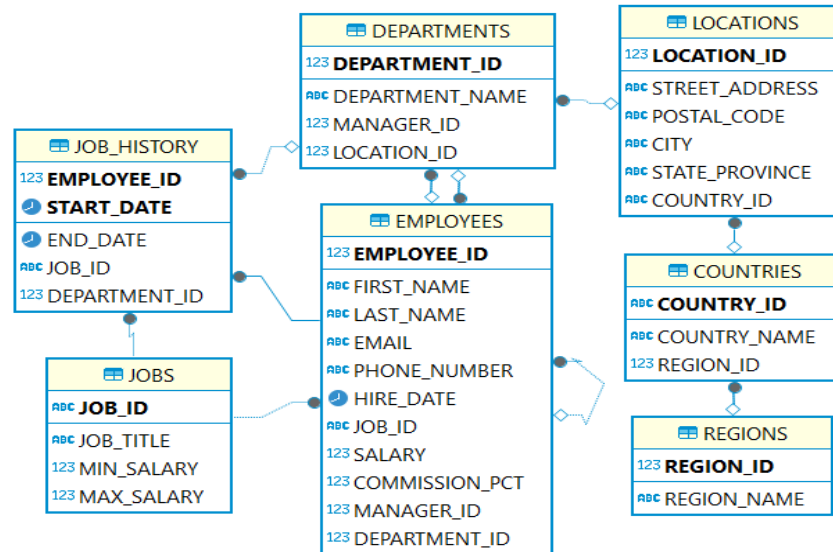


Fig. 5

Example (continued)

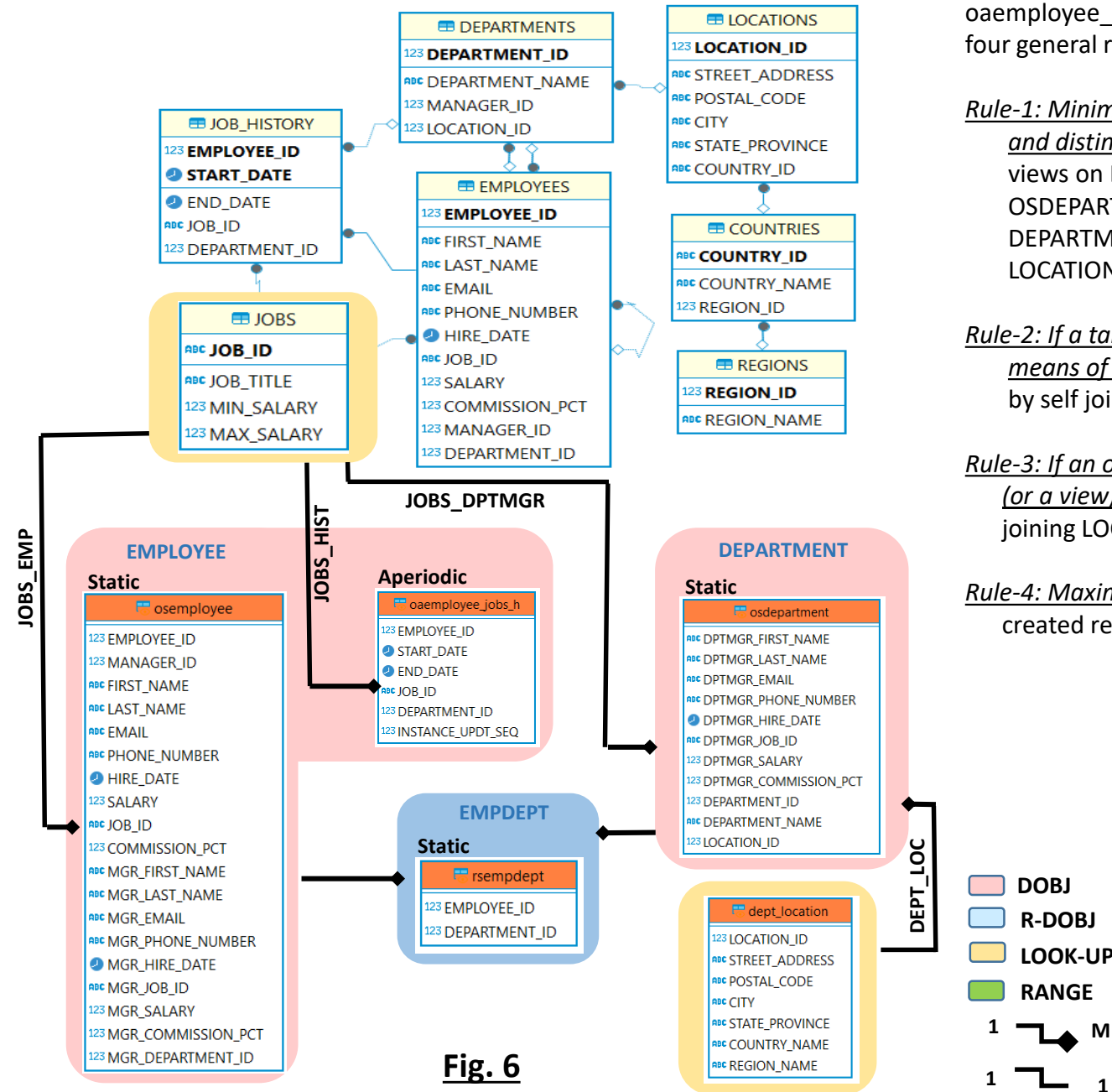


Fig. 6

To implement RDOM as Super Model on existing relational model, five views (osemployee, oaemployee_jobs_h, rsempdept, osdepartment, dept_location) are created with consideration of the four general rules.

Rule-1: Minimize number of DOBJs: By consolidating relevant tables together into DOBJs; and distinguish DOBJ tables from LOOK-UP object tables: OSEMPLOYEE and OAEMPLOYEE_JOBS_H views on EMPLOYEES and JOBS_HISTORY tables are incorporated into EMPLOYEE data object, OSDEPARTMENT view (which includes employee columns for department manager) on DEPARTMENTS table is incorporated as DEPARTMENT data object and rest of the four tables (JOBS, LOCATIONS, COUNTRIES, REGIONS) are identified as look-up tables.

Rule-2: If a table contains object hierarchy then flatten the object hierarchy into a table (or a view) by means of additional columns: OSEMPLOYEE view is created with additional columns for manager, by self joining EMPLOYEES table, to flatten Employee-Manager hierarchy.

Rule-3: If an object hierarchy exists in the form of multiple tables then combine the tables into one table (or a view): DEPT_LOCATION view is created representing location-country-region hierarchy, by joining LOCATIONS, COUNTRIES and REGIONS tables.

Rule-4: Maximize number of RDOBJs, possibly relating all DOBJs to each other: RSEMPDEPT view is created representing RDOBJ for EMPLOYEE and DEPARTMENT data objects.

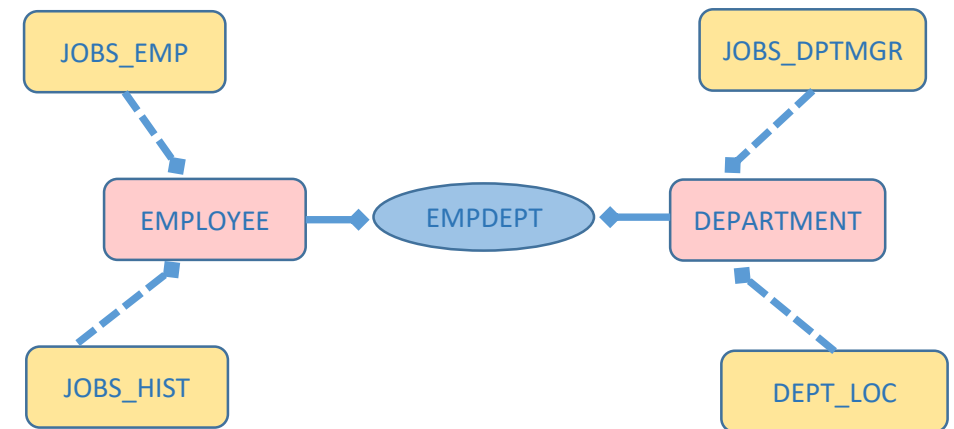


Fig. 6(a) RDOM diagram

Data Object Relationship Map (DORM)

DORM contains RDOM information in the form of two tables (Fig. 7); a table representing data object relationships in terms of database, table, table category and ID (i.e. key) column/s and a table representing object attributes in terms of attribute name, attribute description, attribute type, attribute object, database and table. DORM is created using DORM Studio facility of Mimamsu (<https://mimamsu.com>). Mimamsu uses DORM to populate Store (a component of Mimamsu) user interface in terms of objects and attributes. MimamsuProPlus (a Mimamsu edition) also uses DORM to derive and update additional instances of object relations in the database.

Fig 7(a) is a screenshot of Map View (part of DORM Studio) of HR Database example in prior section (i.e. ‘DORM as Super Model’). The map contains, diagonally, DOBs and at intersection RDOBJ. Look-up associations are listed with associated DOBJs.

DATA OBJECT RELATIONS TABLE	ATTRIBUTES TABLE
MAP_ID	MAP_ID
TABLE_FROM_DB	ATTR_DB
TABLE_FROM	ATTR_DOBJ
TABLE_TO_DB	ATTR_DOBJ_DESC
TABLE_TO	ATTR_TABLE
TABLE_FROM_KEY	ATTR_CATGRY
TABLE_TO_KEY	ATTR_NAME
TABLE_FROM_CATGRY	ATTR_DESC
TABLE_TO_CATGRY
.....

Fig. 7

DEPARTMENT (L) DEPT_LOC (L) JOBS_DPTMGR	
EMPDEPT	EMPLOYEE (L) JOBS_EMP (L) JOBS_HIST

Fig. 7(a)