MimamsuProPlus

User's Guide

mimamsu.com/docs

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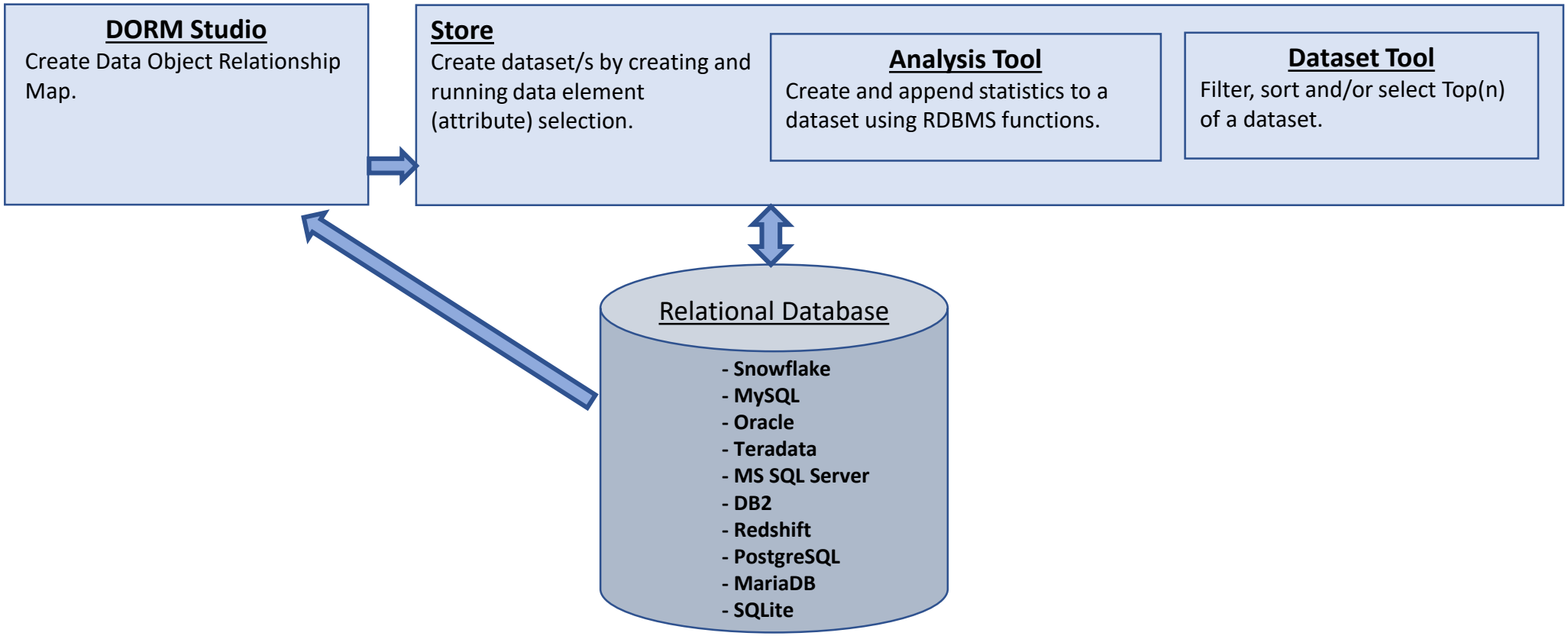
Overview

MimamsuProPlus consists of four components (DORM Studio, Store, Analysis Tool and Dataset Tool). DORM Studio is a facility to create Data Object Relationship Map (DORM) of relational database(with RDOM*) in terms of objects and attributes. Store is a facility to create dataset(with metadata) of selected attributes, as well as (optionally) run 'Path Runner' and 'Build RelTree'. Analysis Tool is a facility to perform statistical analysis, and append the statistics to the dataset. Dataset Tool is to create subset and/or filter the dataset.

Datasets, statistical analysis and subsets get stored as database table/s. For datasets and subsets a metadata table gets created together with the data table. Datasets, statistical analysis and subsets tables (together with metadata tables) can also be exported as CSV files.



* see Appendix-1: Symmetric Relational Data Object Model for details.

DORM Studio: includes facility to create Data Object Relationship Map (DORM) as well as copy, import and export map features. In addition to individual interfaces for adding DOBJ, R_DOBJ, LOOK-UP and RANGE the facility includes interfaces to create tables for all four types of objects as well (i.e. create RDOM database). It also includes 'AutoMap' and 'Verify Map' features. The 'AutoMap' adds (i.e. maps) tables and columns with standard names (see 'Standard Names for Tables and Columns' section) as DOBJ and R-DOBJ components automatically. The 'Verify Map' verifies database/schema content for adherence to Relational Data Object Model.

Store: primarily is an interface, created using DORM, to create and run data element(attributes) selection to create dataset (with Dataset Metadata[4]). Store also includes 'Analysis Tool' and 'Dataset Tool' as part of 'Work with Dataset' feature. Additionally, Store includes 'Build RelTree*' and 'PathRunner**'.

Object Relations Summary: Each dataset gets created with Object Relations Summary. It is an interactive presentation of all combinations of related object counts in the dataset. The summary shows total counts of the objects at the top. The bottom part of the summary is interactive; it shows from left to right all combinations of related object counts, from left to right in descending order of object combination size.

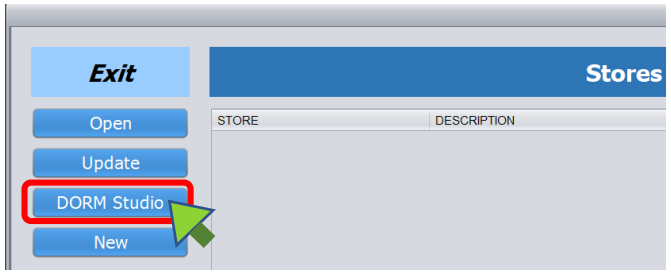
Analysis Tool: is an interface consisting of six types of functions, 1) General Functions (i.e. CASE STATEMENT, EXPRESSION), 2) DOBJ Functions (i.e. COUNT, FREQUENCY COUNT, EMBED-FN-CODE), 3) Aggregate Functions, 4) Analytic Functions, 5) String Functions and 6) Date/Time Functions. Metadata about appended statistic gets added to Dataset Metadata[4]. Also, when a statistic's table is exported as CSV file, two files get created; a file for statistic and a file for Statistic Metadata[5]. [*Note: All functions are built in functions of the database system in use*.]

Dataset Tool: includes features to subset and/or order a dataset. It also includes features to save a subset as database table and export the subset as CSV file. Each Saved subset is created with associated Subset Metadata[6] table.

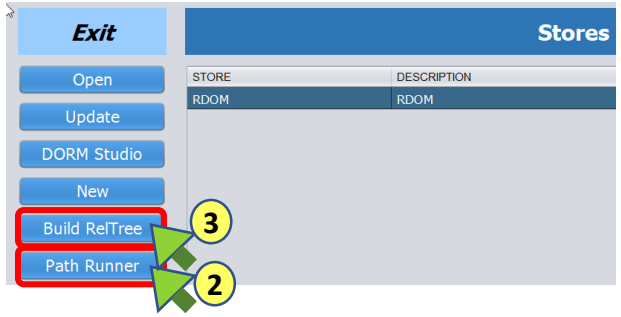
* See 'Appendix-2 Build RelTree' for details.
** See 'Appendix-3 PathRunner' for details.
[4] See 'Dataset Metadata' for details.
[5] See 'Statistic Metadata' for details.
[6] See 'Subset Metadata' for details.

Quick Summary

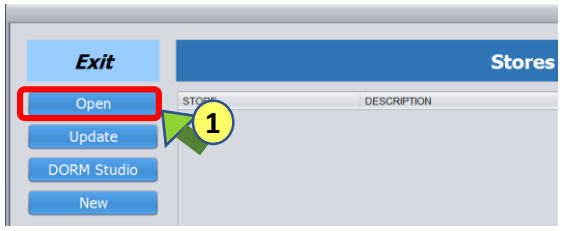
Step 1: Create Data Object Relationship Map (DORM) of the database/schemas (with RDOM*) using 'DORM Studio'.

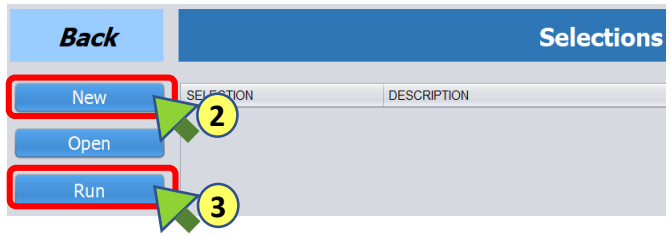


Step 2: Create 'Store' using the DORM.
(Optionally) run 'PathRunner' and 'Build RelTree'.

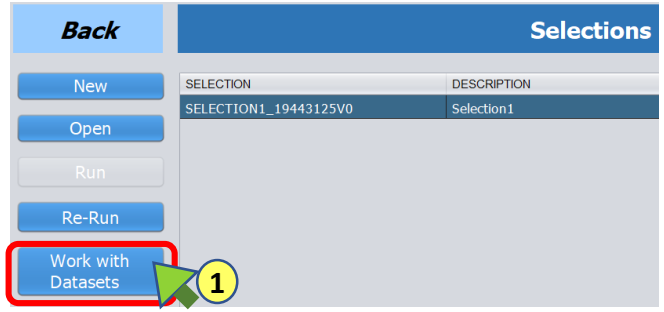


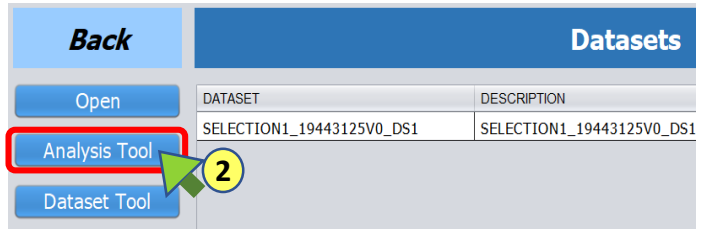
Step 3: Create and run data element 'Selection' to create dataset/s.



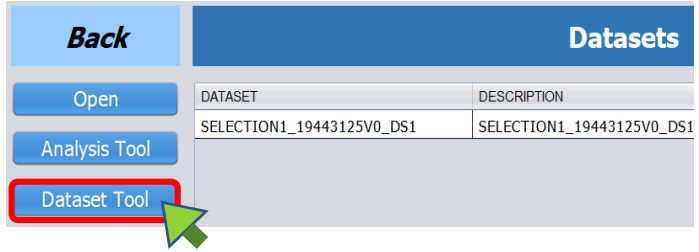


Step 4: Run (and append) statistics on the dataset.





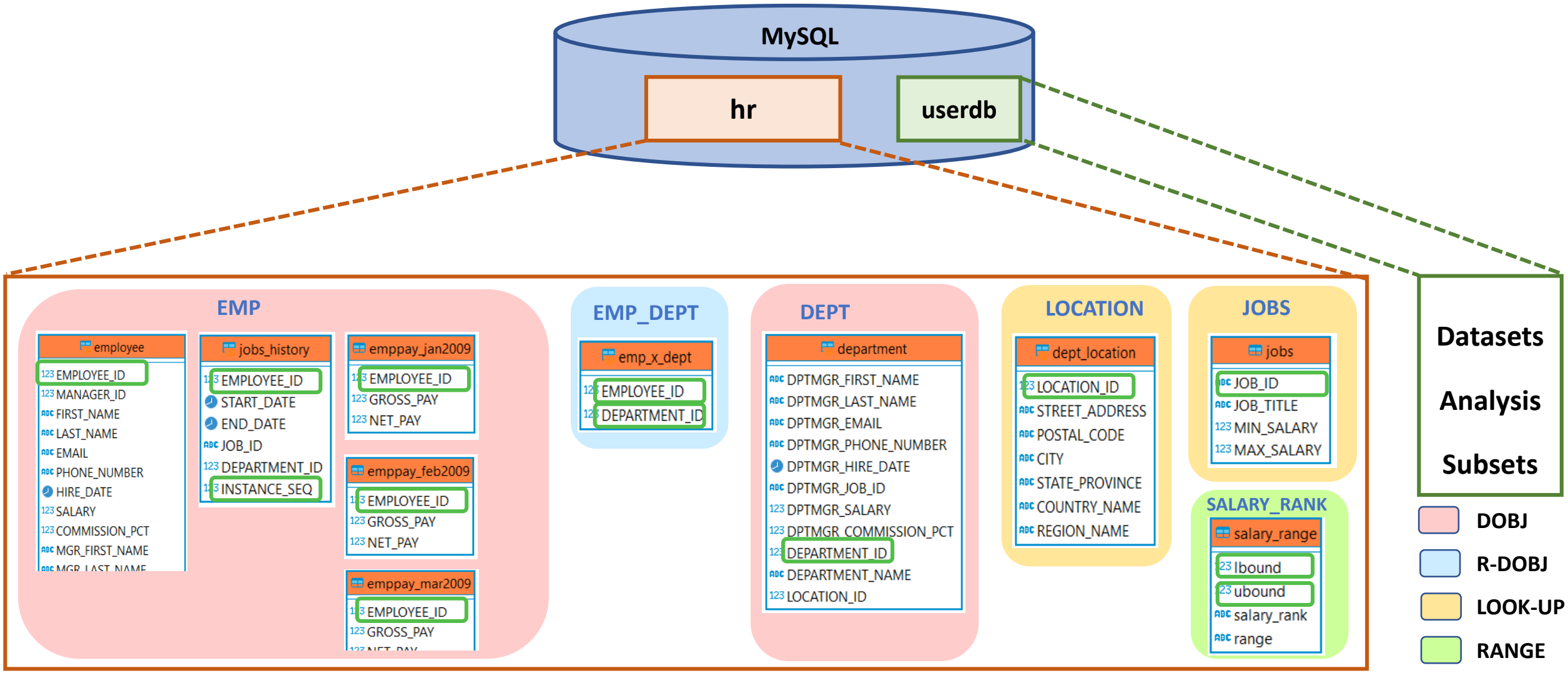
Step 5: Subset and/or filter the dataset.



* see Appendix-1: Symmetric Relational Data Object Model for details.

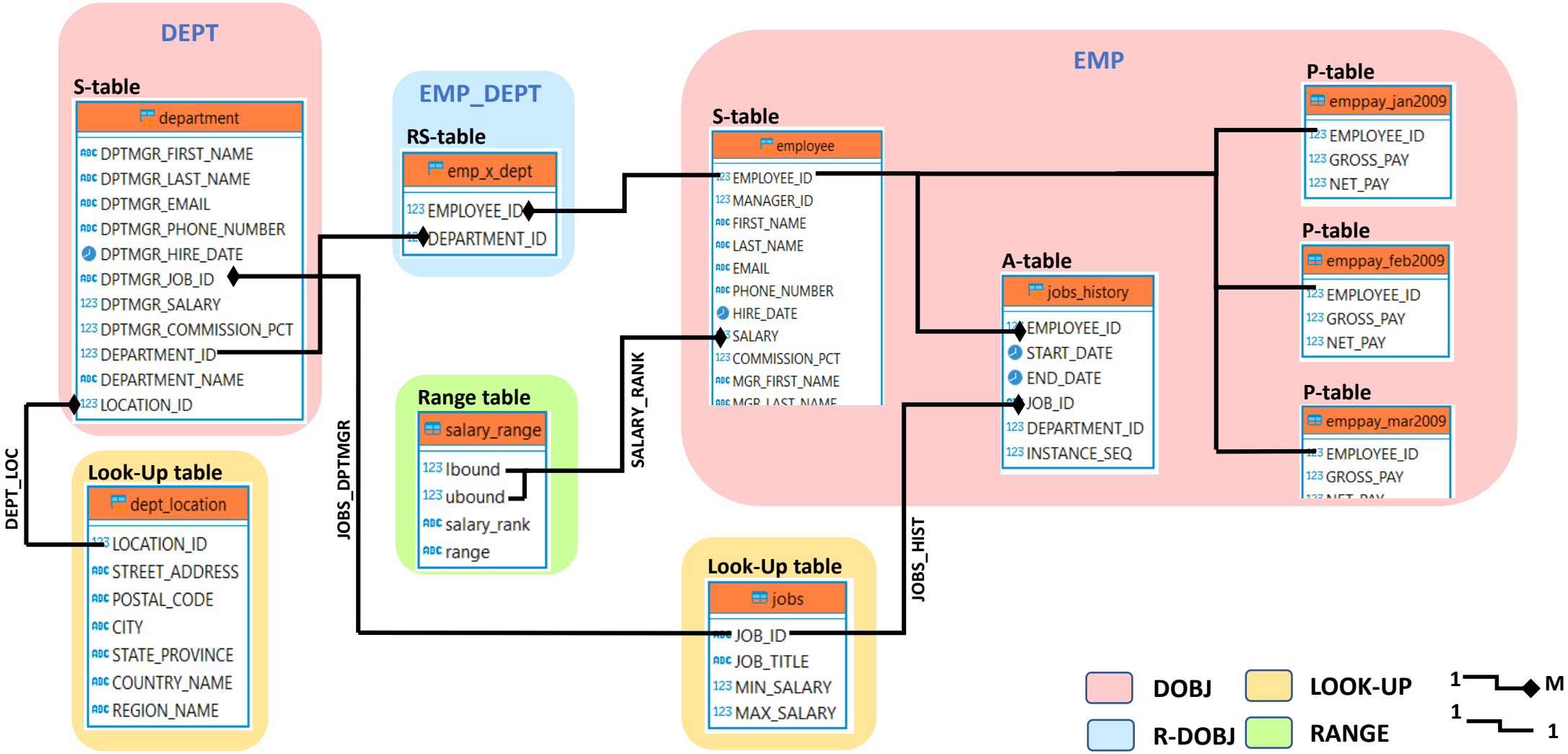
Example (HR Database)

There are two databases (i.e. schemas) 'hr' and 'userdb' on MySQL server. 'hr' database tables and views contain employee and department data and 'userdb' is used to store datasets, statistical analysis and subset tables. For the most part this guide refers to this example.



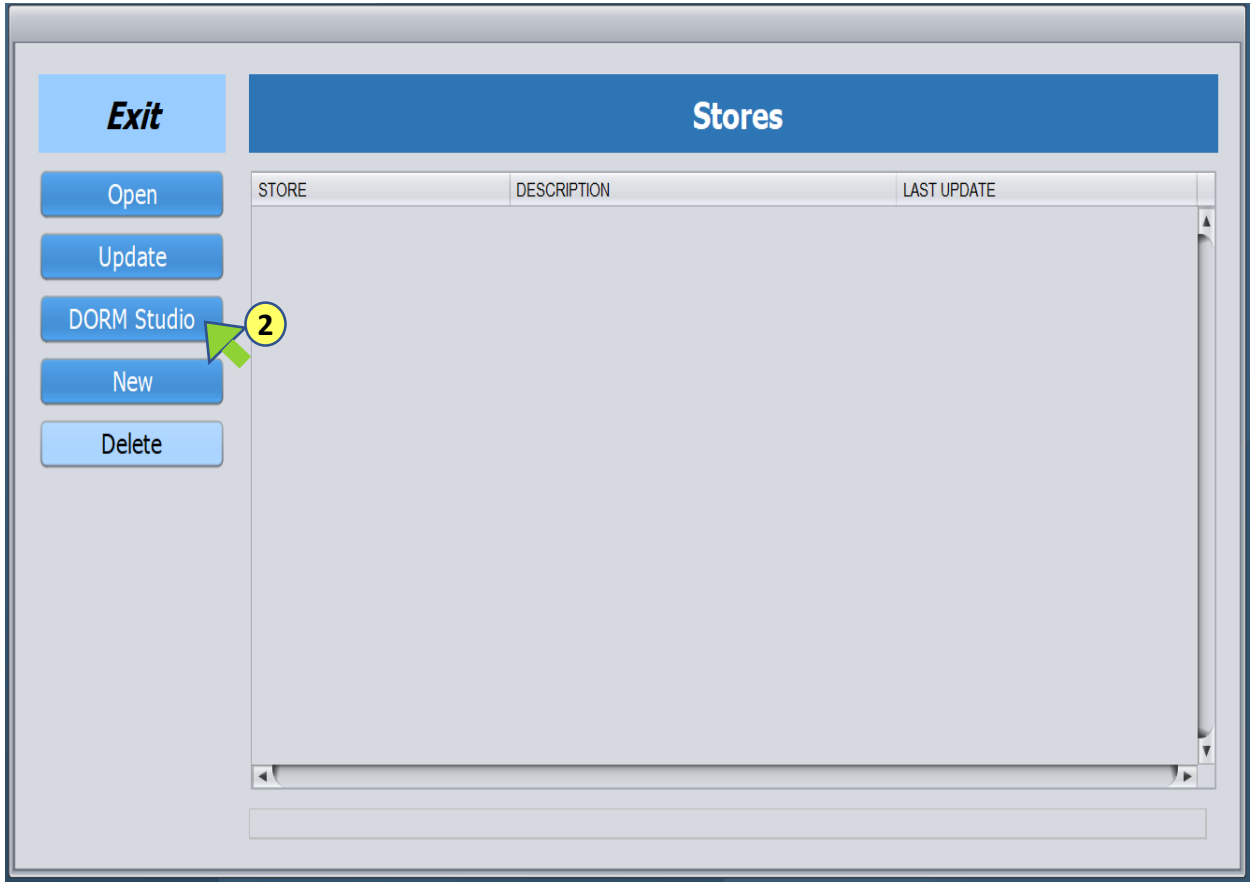
Example (HR Database)

(RDOM diagram)



In terms of relational database, DEPARTMENT_ID and EMPLOYEE_ID are primary-keys (not NULL) for 'department' and 'employee' tables (i.e. S-tables) respectively. For 'jobs_history' table (i.e. A-table) EMPLOYEE_ID + INSTANCE_SEQ is primary-key where EMPLOYEE_ID is foreign-key to 'employee' table. For 'emppay_jan2009', 'emppay_feb2009' and 'emppay_mar2009' tables (i.e. P-tables) EMPLOYEE_ID is primary-key and foreign-key to 'employee' table. For 'emp_x_dept' table (i.e. RS-table) EMPLOYEE_ID + DEPARTMENT_ID is primary-key (not NULL) and are foreign-keys to 'employee' and 'department' tables respectively.

- **Launch MimamsuProPlus**
- **Open DORM Studio**



Enter — Enter MimamsuProPlus.

Close MimamsuProPlus.

Open — Open selected store.

Update — Update selected store (after associated map update).

DORM Studio — Open DORM Studio.

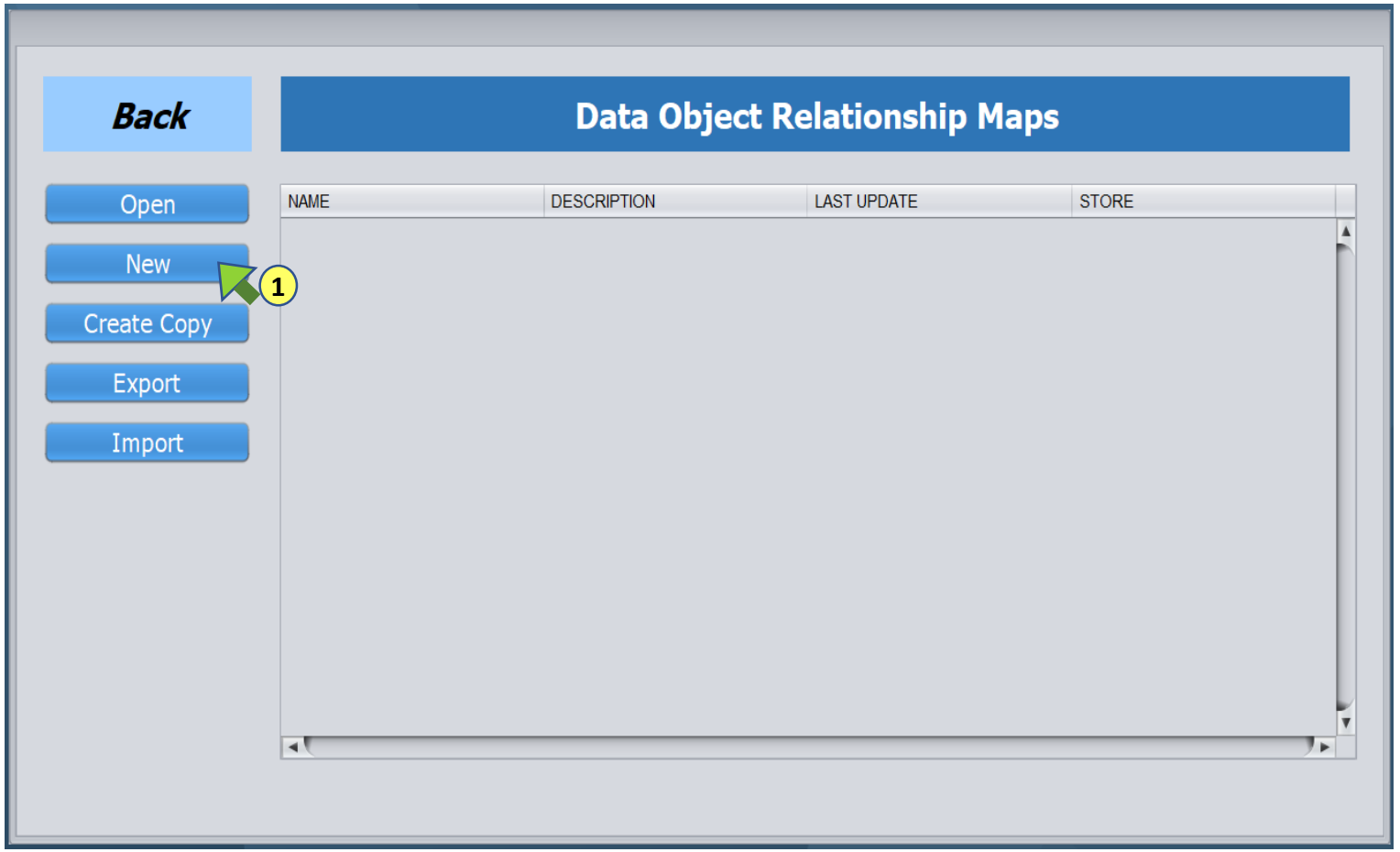
New — Create new store.

Delete — Delete selected store.

Exit — Exit MimamsuProPlus.

DORM Studio:

- New map



Open — Open selected map.

New — Create new map.

Create Copy — Create duplicate copy of the selected map.

Export — Export selected map as a file.

Import — Import map from a file.

Back — Return to main menu (or application home page).

NAME — Map name.

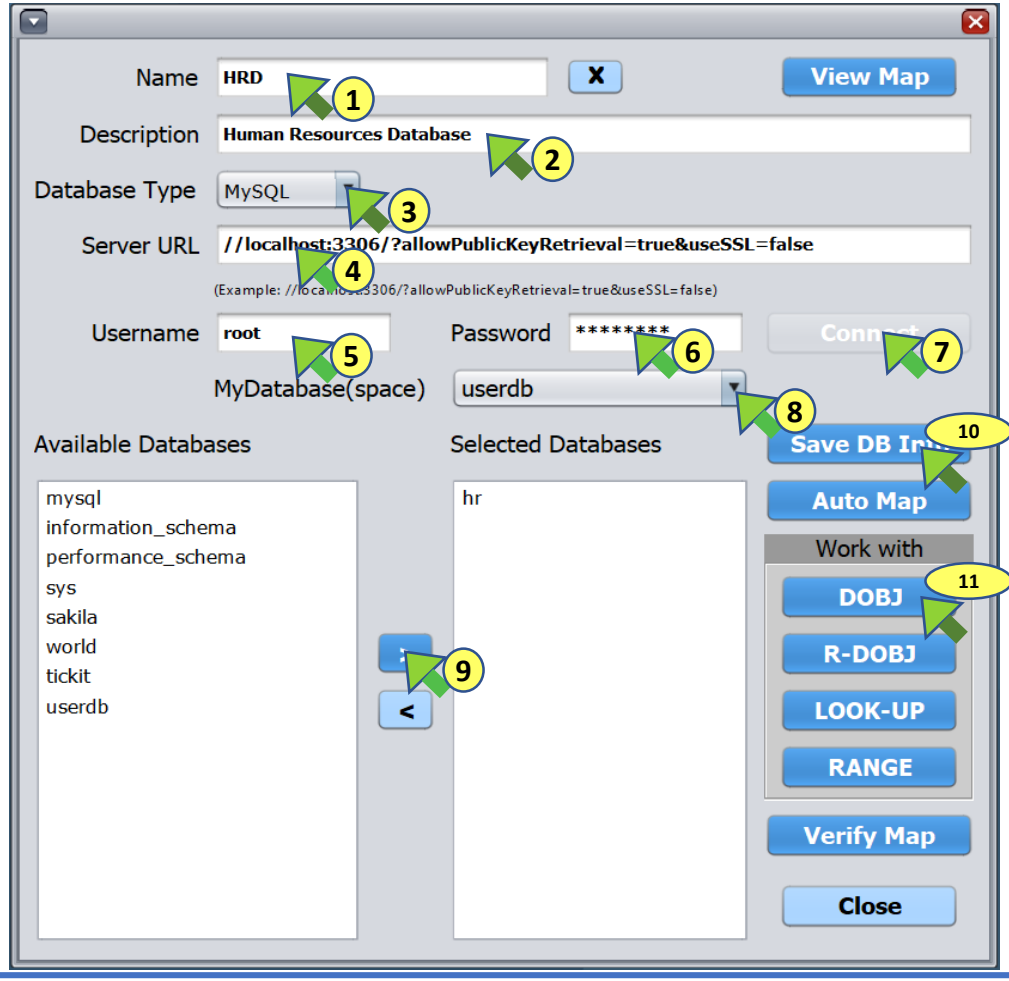
DESCRIPTION — Map description.

LAST UPDATE — Last update timestamp.

STORE — Name of associated store.

DORM Studio:

- New map
- New DOBJ



If prompted, copy/paste the link into browser, download the driver file and add using folder button.

RDBMS	Server URL
Snowflake	//<org>-<account>.snowflakecomputing.com/?db=<MyDatabase>
Teradata	//<IP or hostname>/DATABASE=<MyDatabase>,DBS_PORT=1025
Oracle	@<hostname>:1521:<sid>
SQLServer	//<hostname>:1433 (Instance Name: <instance_name>)
Redshift	//<cloudhost>.redshift.amazonaws.com:5439/<MyDatabase>
DB2	//<hostname>:50000/<DatabaseName>
MySQL	//<hostname>:3306/<?parameters>
MariaDB	//<hostname>:3306/<?parameters>
PostgreSQL	//<hostname>:5432/<DatabaseName>
SQLite	<folderPath>/<folder_name>

Name Enter name for the new map.

Description Enter brief description of the map.

Database Type Select database type from menu.

Server URL Enter server address of the database.

Username Enter your username for the database.

Password Enter your password for the database.

Connect Connect(logon) to the database.

MyDatabase(space) Select a database space for datasets, analysis and subsets.

> Add database to selected databases.

< Remove database from selected databases.

Save DB Info Save database type, database selections, address (URL) and Username.

Auto Map Auto-create map entries for DOBJ and R-DOBJ components based on the standard table and column names. (See 'Standard Names for Tables and Columns'.)

Verify Map Check for NULL and duplicate values in ID columns; and verify objects relationships.

DOBJ Create/edit Data Object/s.

R-DOBJ Create/edit Relationship Data Object/s.

LOOK-UP Create/edit Look-Up object.

RANGE Create/edit Range object.

Close Close map. (all add/edits will be saved.)

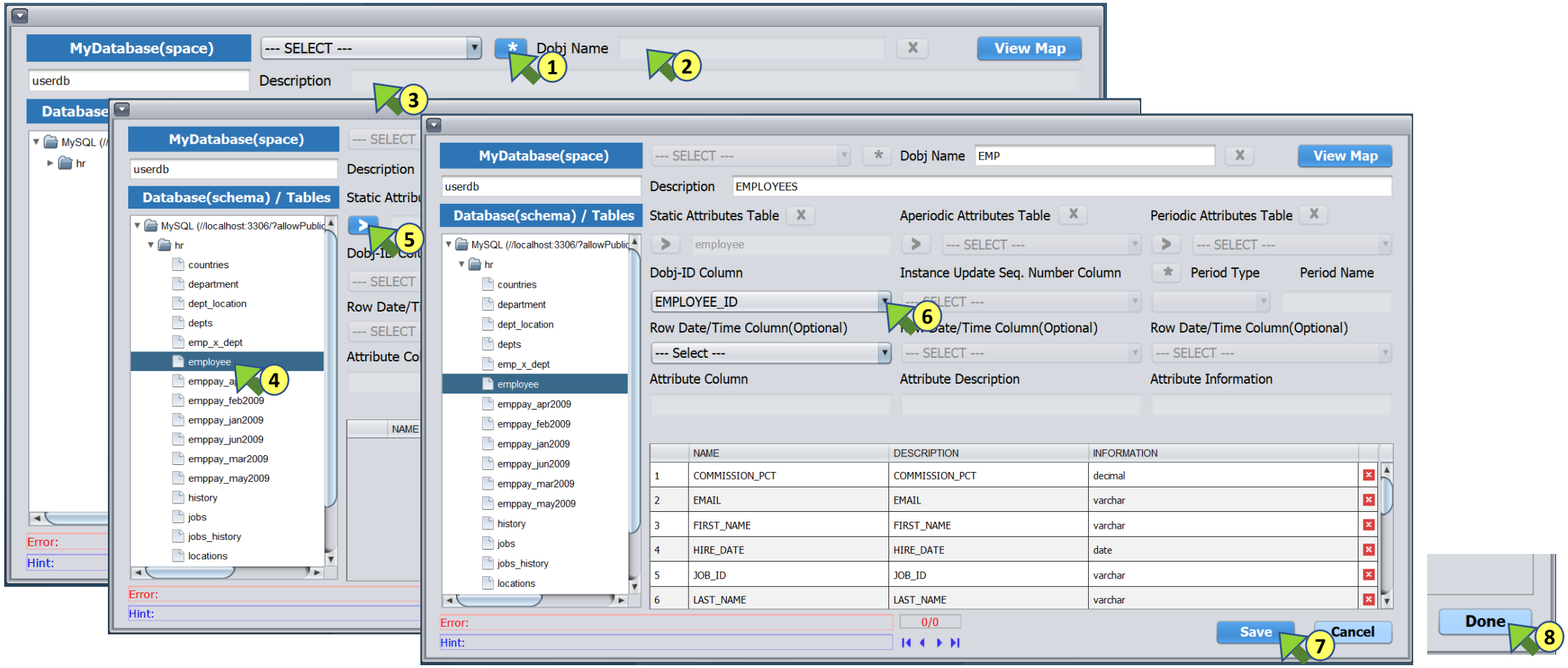
Close map. (all add/edits will be saved.)

View Map View map in a tabular form.

X Delete map.

DORM Studio:

- New DOBJ 'EMP'
- Add Static Table



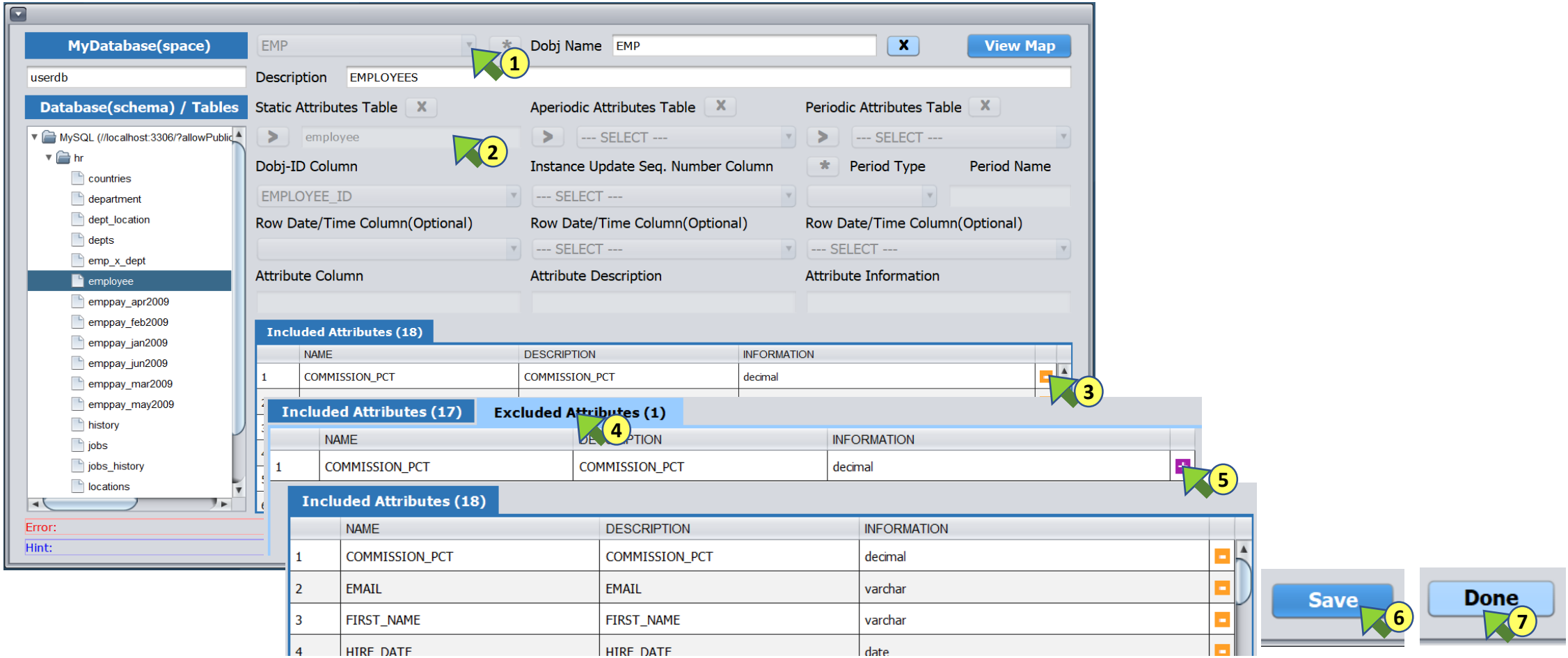
*	Create new.
Dobj Name	Enter name of the Dobj.
Description	Enter small description of the Dobj.
>	Add selected table's info to Dobj.
X	Delete from the map.
x	Exclude attribute from the Dobj.

Static Attributes Table	Select from left and add Static attributes table.
Dobj-ID Column	Select Dobj-ID column from drop down.
Row Date/Time Column	Select row timestamp column from drop down.
Aperiodic Attributes Table	Select from left and add Aperiodic attributes table
Instance Update Seq. Number Column	Select row update seq. column from drop down.
Periodic Attributes Table	Select from left and add Periodic attributes table
Period Type	Create new Period Type(or select from drop down)
Period Name	Enter Period name.
Attribute Description	Description of selected (from table below) attribute (editable).
Attribute Information	Additional info. about selected (from table below) attribute (editable).

Save	Save add/edits.
Cancel	Cancel add/edits.
Done	Close Dobj
View Map	View map in a tabular form.

DORM Studio:

- Edit 'EMP' DOBJ
- Edit Static Table



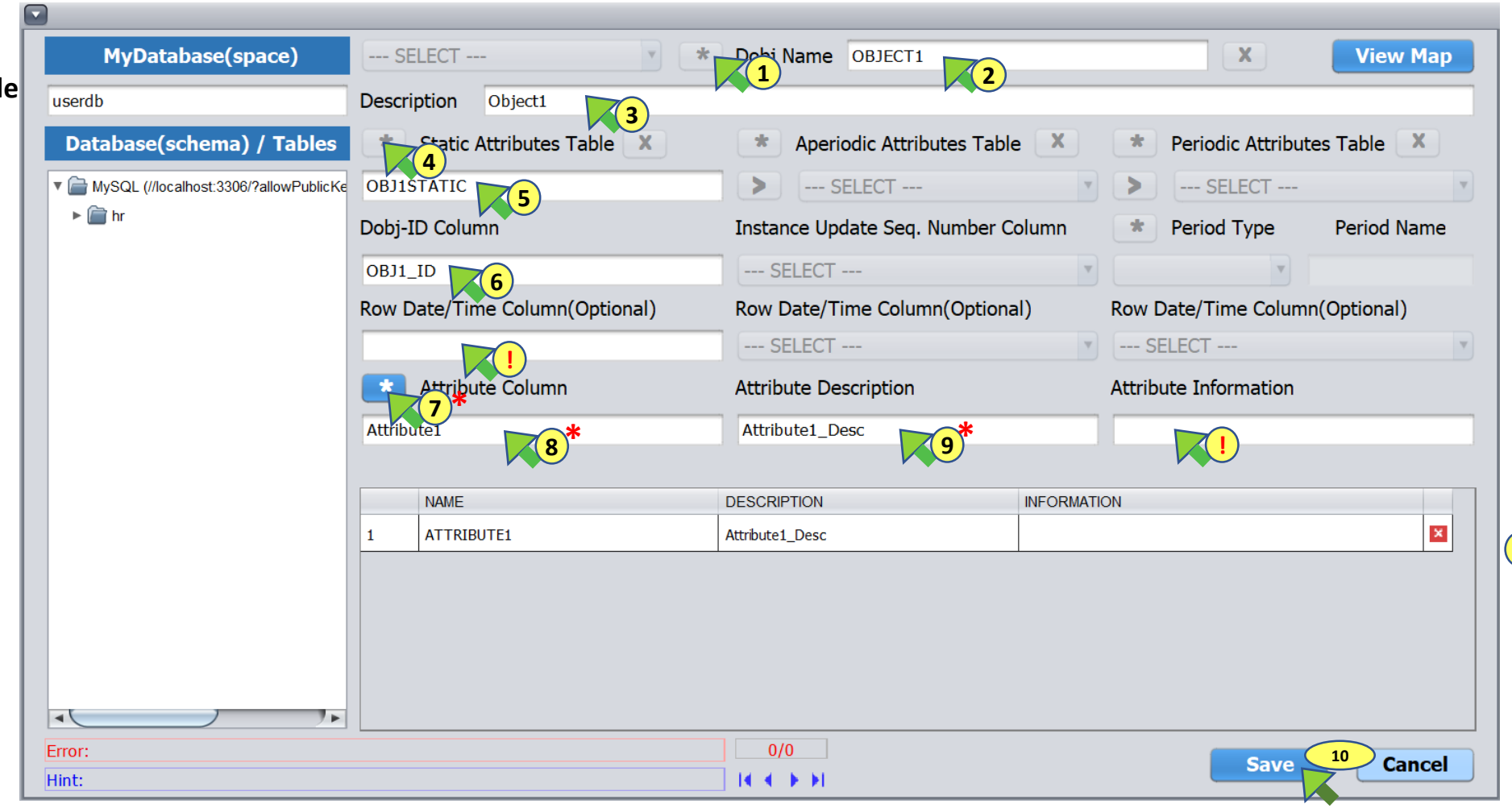
*	Create new.
Dobj Name	Enter name of the Dobj.
Description	Enter small description of the Dobj.
>	Add selected table's info to Dobj.
X	Delete from the map.
Included Attributes	Shows included attributes.
Excluded Attributes	Shows excluded attributes.
-	Exclude attribute from DOBJ.
+	Include attribute in DOBJ.

Static Attributes Table	Select from left and add Static attributes table.
Dobj-ID Column	Select Dobj-ID column from drop down.
Row Date/Time Column	Select row timestamp column from drop down.
Aperiodic Attributes Table	Select from left and add Aperiodic attributes table
Instance Update Seq. Number Column	Select row update seq. column from drop down.
Periodic Attributes Table	Select from left and add Periodic attributes table
Period Type	Create new Period Type(or select from drop down)
Period Name	Enter Period name.
Attribute Description	Description of selected (from table below) attribute (editable).
Attribute Information	Additional info. about selected (from table below) attribute (editable).

Save	Save add/edits.
Cancel	Cancel add/edits.
Done	Close Dobj
View Map	View map in a tabular form.

DORM Studio:

- Create Static Attributes Table



(!) Optional

* Repeat (7 8 9) for each Attribute.

(**Continued on next page**.)

* Create new.

Dobj Name Enter name of the Data Object.

Description Enter small description of the Data Object.

X Delete from the map.

Exclude attribute from the Look-Up.

Static Attributes Table New Static attributes table name

Dobj-ID Column New Dobj-ID column name.

Attribute Column New attribute column name.

Attribute Description Description of attribute (editable).

Attribute Information Additional info. about attribute (editable).

Row Date/Time Column(Column for row update date/time.

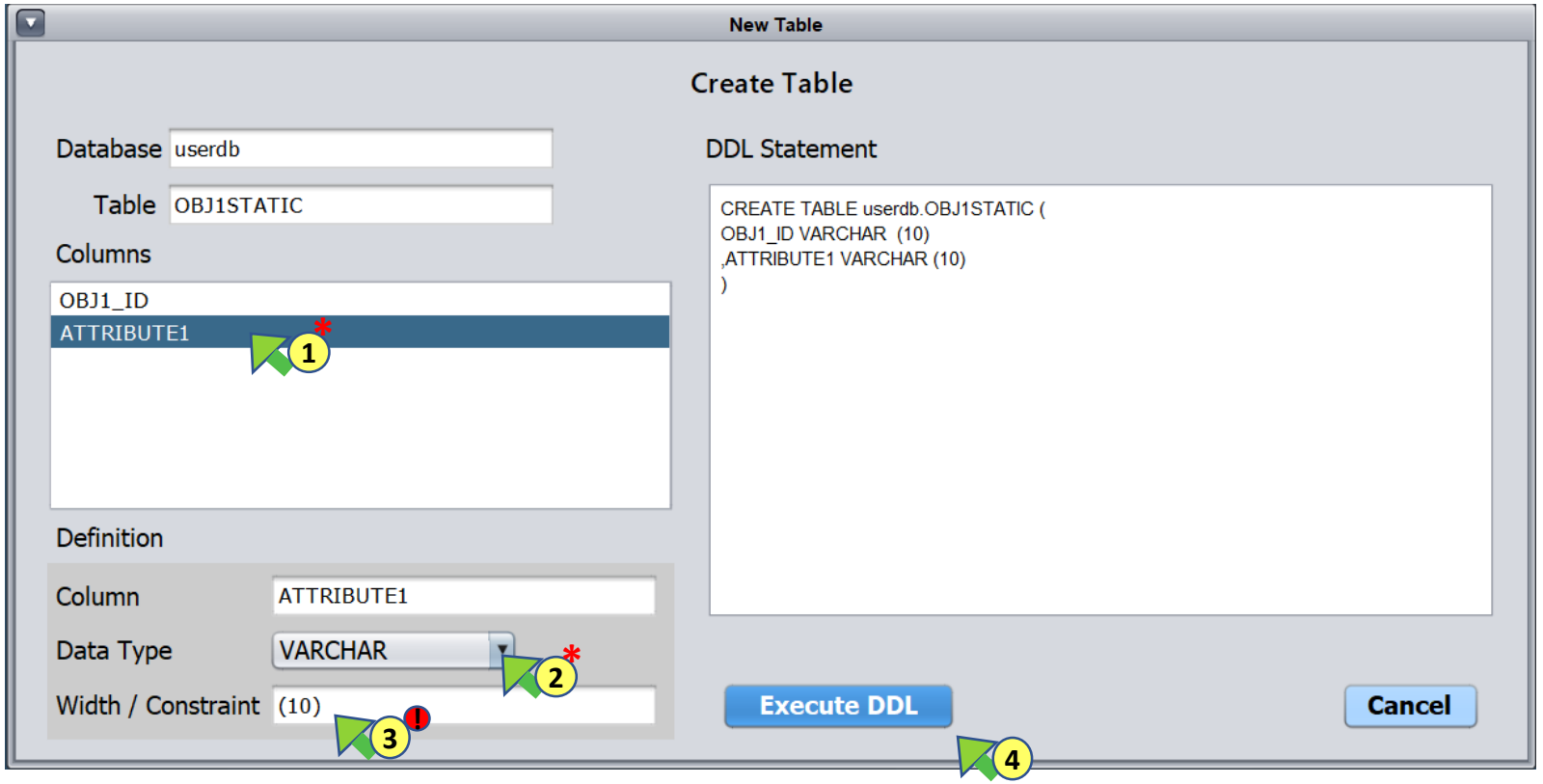
Save Save add/edits.

Cancel Cancel add/edits.

View Map View map in a tabular form.

DORM Studio:

- Create Static Attributes Table



* For each column repeat (1), (2) and (3) (for some data types such as VARCHAR)

❗ After typing Width (and/or Constraint) press Enter or click in DDL Statement box on the right.

Database MyDatabase (space)

Table Table to be create

Columns Columns to be created

Data Type Select Data Type for the column

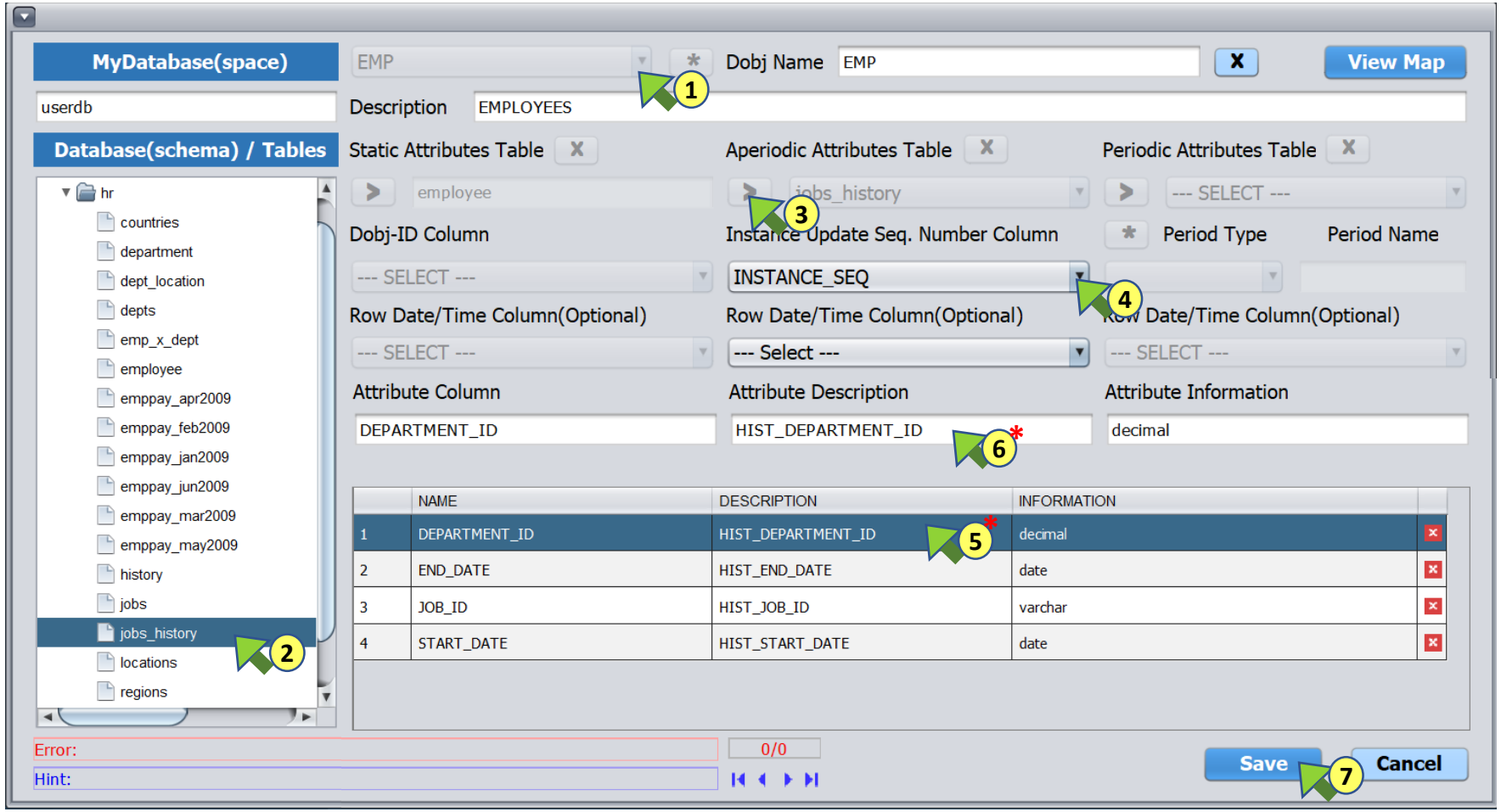
Width / Constraint Enter Width and/or constraint for the column

Execute DDL Create table in the Database

Cancel Cancel table creation

DORM Studio:

- **Edit 'EMP' DOBJ**
- **Add Aperiodic Table**



* To change attribute description and/or information select (5) and edit (6).

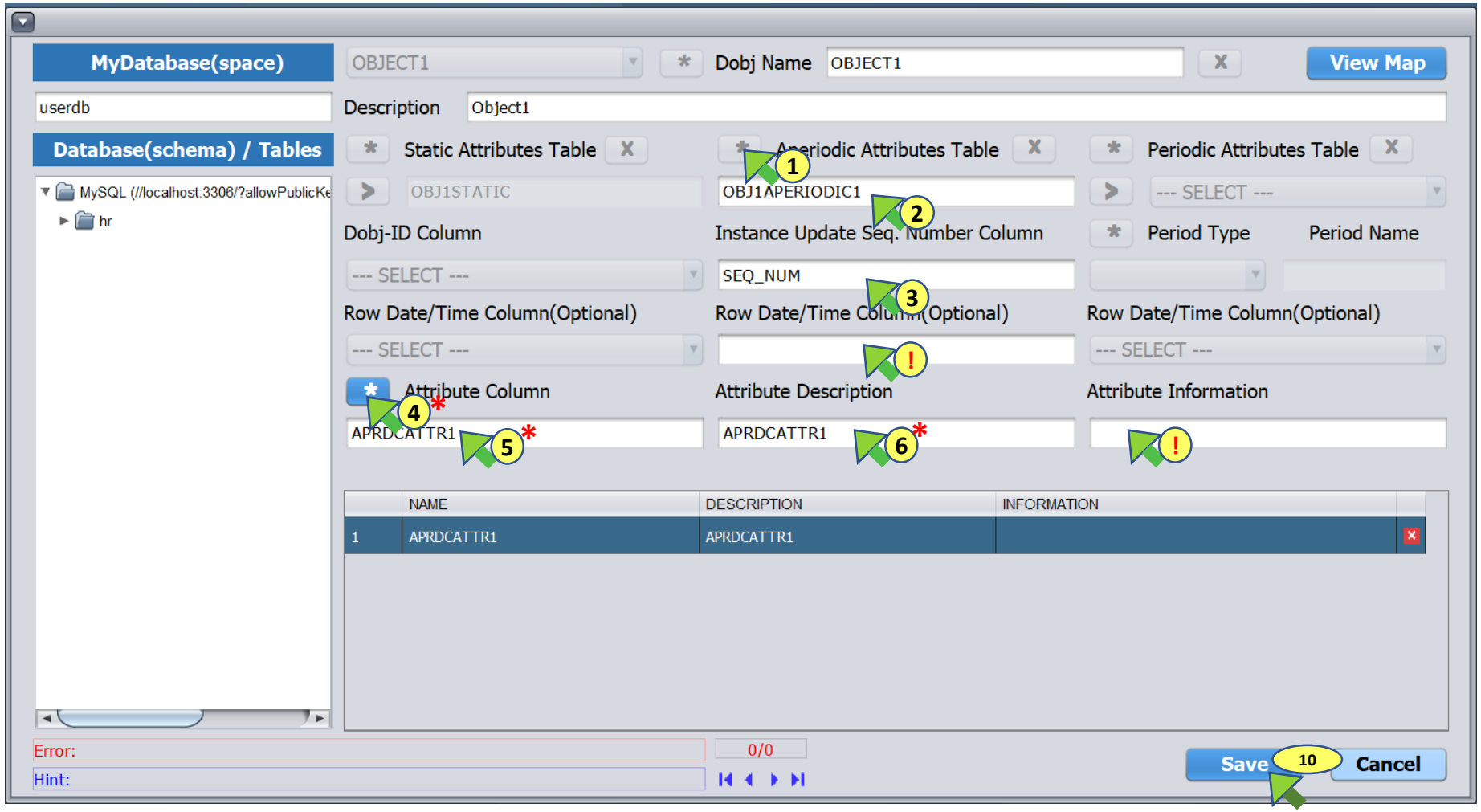
*	Create new.
Dobj Name	Enter name of the Dobj.
Description	Enter small description of the Dobj.
>	Add selected table's info to Dobj.
X	Delete from the map.
x	Exclude attribute from the Dobj.

Static Attributes Table	Select from left and add Static attributes table.
Dobj-ID Column	Select Dobj-ID column from drop down.
Row Date/Time Column	Select row timestamp column from drop down.
Aperiodic Attributes Table	Select from left and add Aperiodic attributes table
Instance Update Seq. Number Column	Select row update seq. column from drop down.
Periodic Attributes Table	Select from left and add Periodic attributes table
Period Type	Create new Period Type(or select from drop down)
Period Name	Enter Period name.
Attribute Description	Description of selected (from table below) attribute (editable).
Attribute Information	Additional info. about selected (from table below) attribute (editable).

Save	Save add/edits.
Cancel	Cancel add/edits.
Done	Close Dobj
Close	Close DOBJ interface.
View Map	View map in a tabular form.

DORM Studio:

- Create Aperiodic Attributes Table



! Optional

* Repeat (4 5 6) for each Attribute.

(**Continued on next page**.)

* Create new.

Dobj Name Name of the Data Object.

Description Description of the Data Object.

X Delete from the map.

Exclude attribute from the Look-Up.

Aperiodic Attributes Table New Aperiodic attributes table name

Instance Update Seq. Number Column New sequence number column name.

Attribute Column New attribute column name.

Attribute Description Description of attribute (editable).

Attribute Information Additional info. about attribute (editable).

Row Date/Time Column(Column for row update date/time.

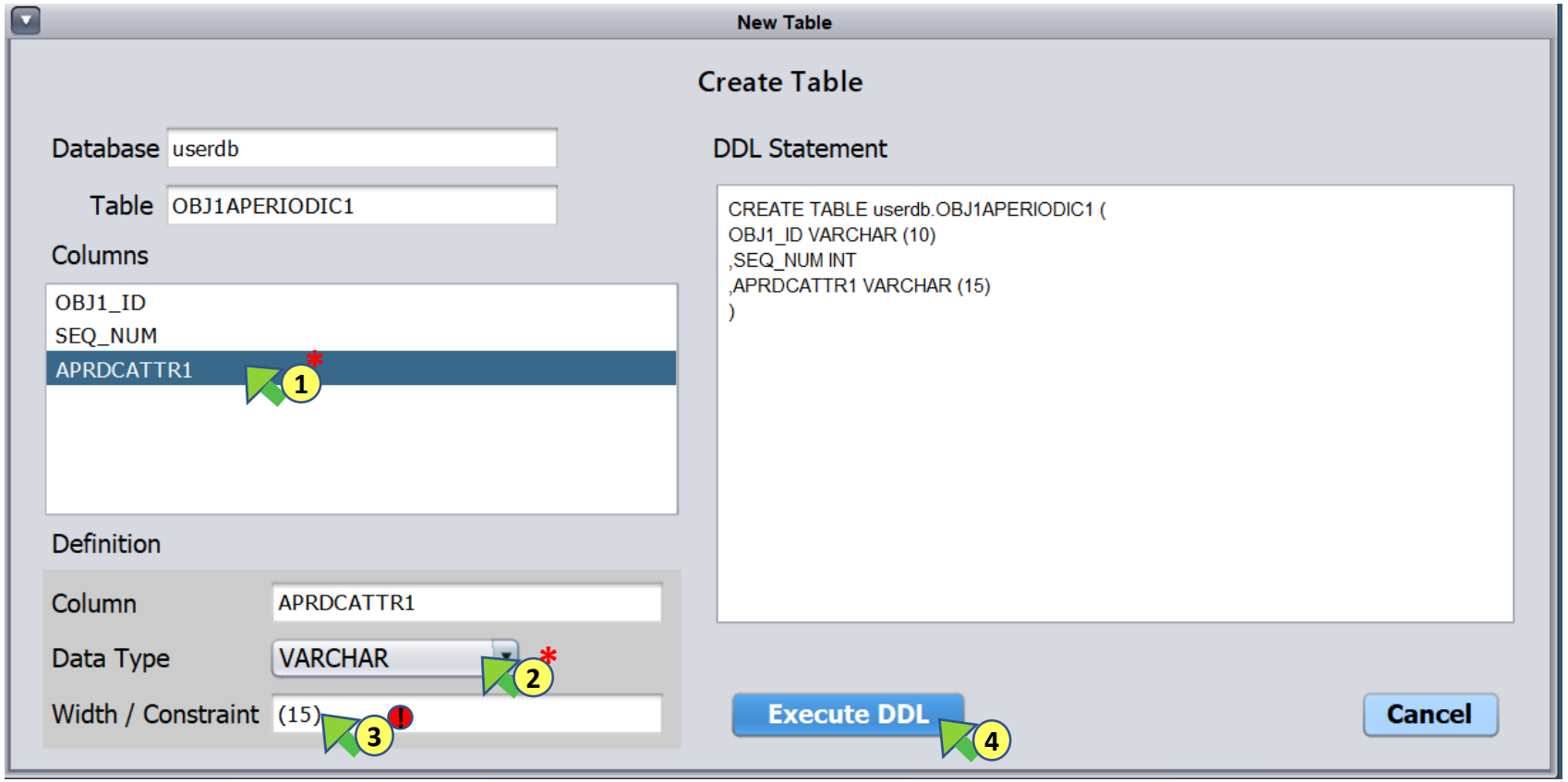
Save Save add/edits.

Cancel Cancel add/edits.

View Map View map in a tabular form.

DORM Studio:

- Create Aperiodic Attributes Table



* For each column repeat (1), (2) and (3) (for some data types such as VARCHAR)

❗ After typing Width (and/or Constraint) press Enter or click in DDL Statement box on the right.

Database MyDatabase (space)

Table Table to be create

Columns Columns to be created

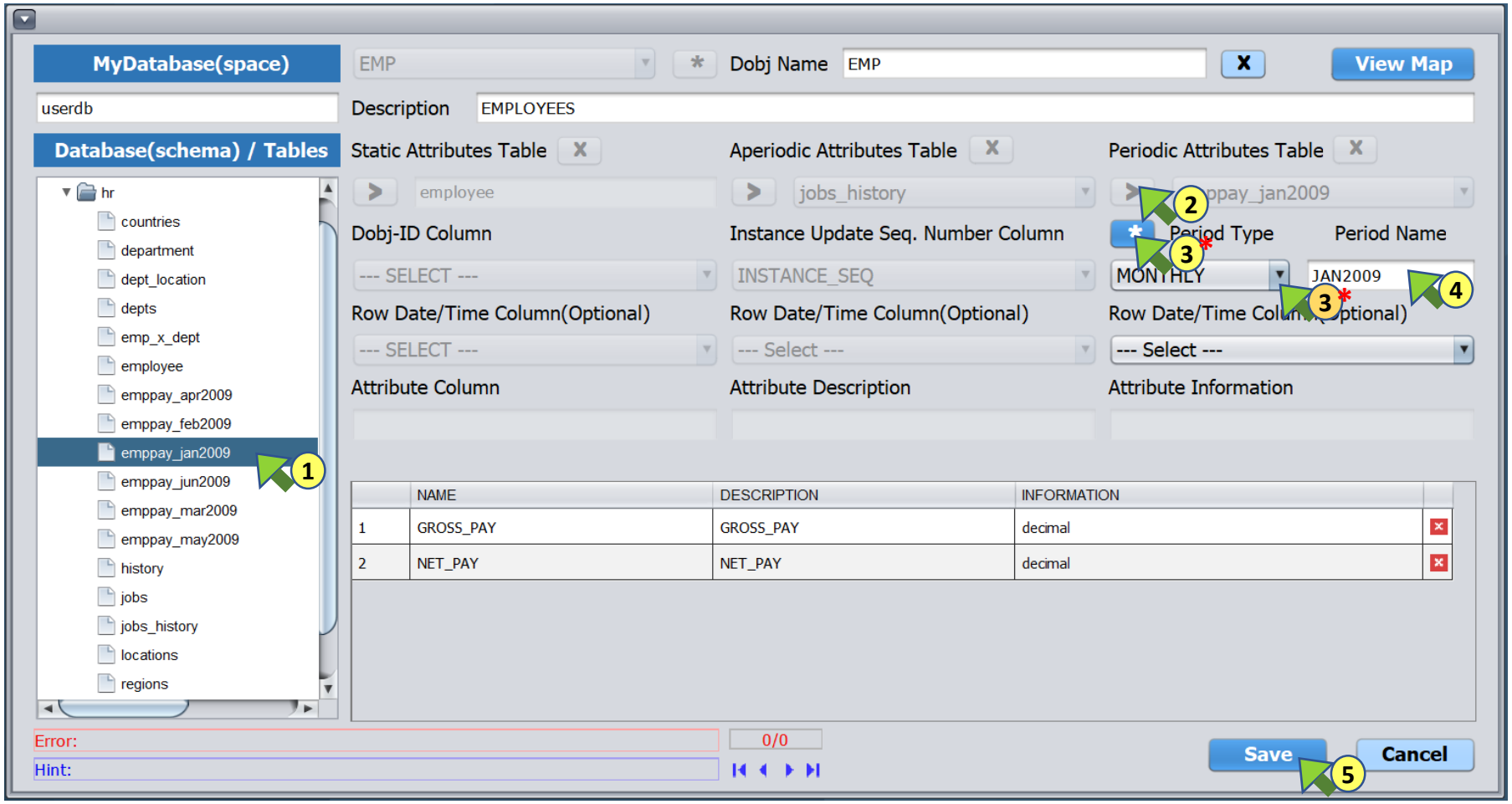
Data Type Select Data Type for the column

Width / Constraint Enter Width and/or constraint for the column

Execute DDL Create table in the Database

Cancel Cancel table creation

DORM Studio: -Add Periodic Tables



* Create New (3) or select (3) Period Type for each Periodic Attributes Table

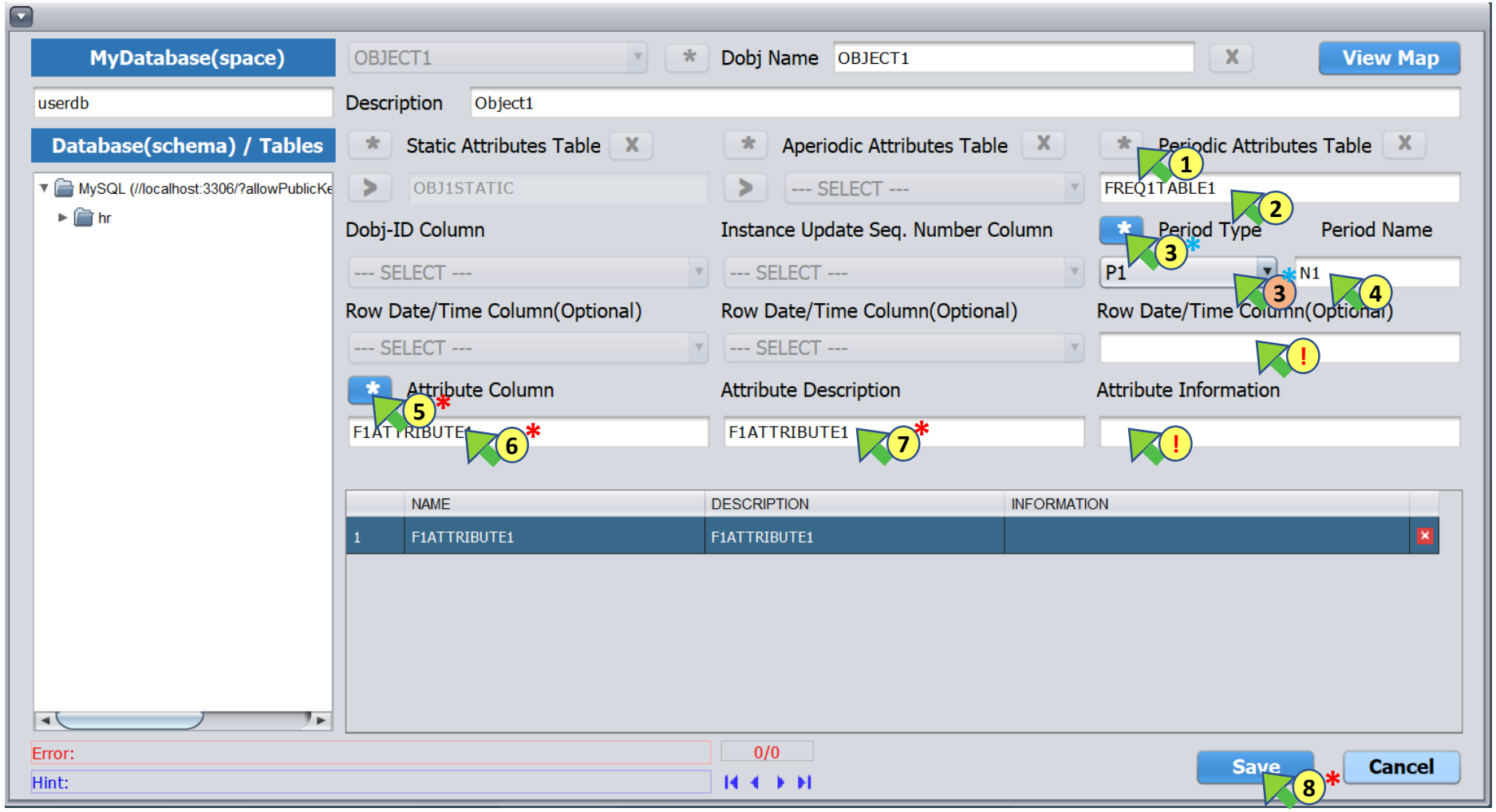
- Create new.
- **Dobj Name** Enter name of the Dobj.
- **Description** Enter small description of the Dobj.
- Add selected table's info to Dobj.
- Delete from the map.
- Exclude attribute from the Dobj.

- **Static Attributes Table** Select from left and add Static attributes table.
- **Dobj-ID Column** Select Dobj-ID column from drop down.
- **Row Date/Time Column** Select row timestamp column from drop down.
- **Aperiodic Attributes Table** Select from left and add Aperiodic attributes table
- **Instance Update Seq. Number Column** Select row update seq. column from drop down.
- **Periodic Attributes Table** Select from left and add Periodic attributes table
- **Period Type** Create new Period Type(or select from drop down)
- **Period Name** Enter Period name.
- **Attribute Description** Description of selected (from table below) attribute (editable).
- **Attribute Information** Additional info. about selected (from table below) attribute (editable).

- **Save** Save add/edits.
- **Cancel** Cancel add/edits.
- **Done** Close Dobj
- **Close** Close DOBJ interface.
- **View Map** View map in a tabular form.

DORM Studio:

- Create Periodic Attributes Table



* Create New (3) or select (3) Period Type for each Periodic Attributes Table

(!) Optional

* Repeat (5 6 7) for each Attribute.

(**Continued on next page**.)

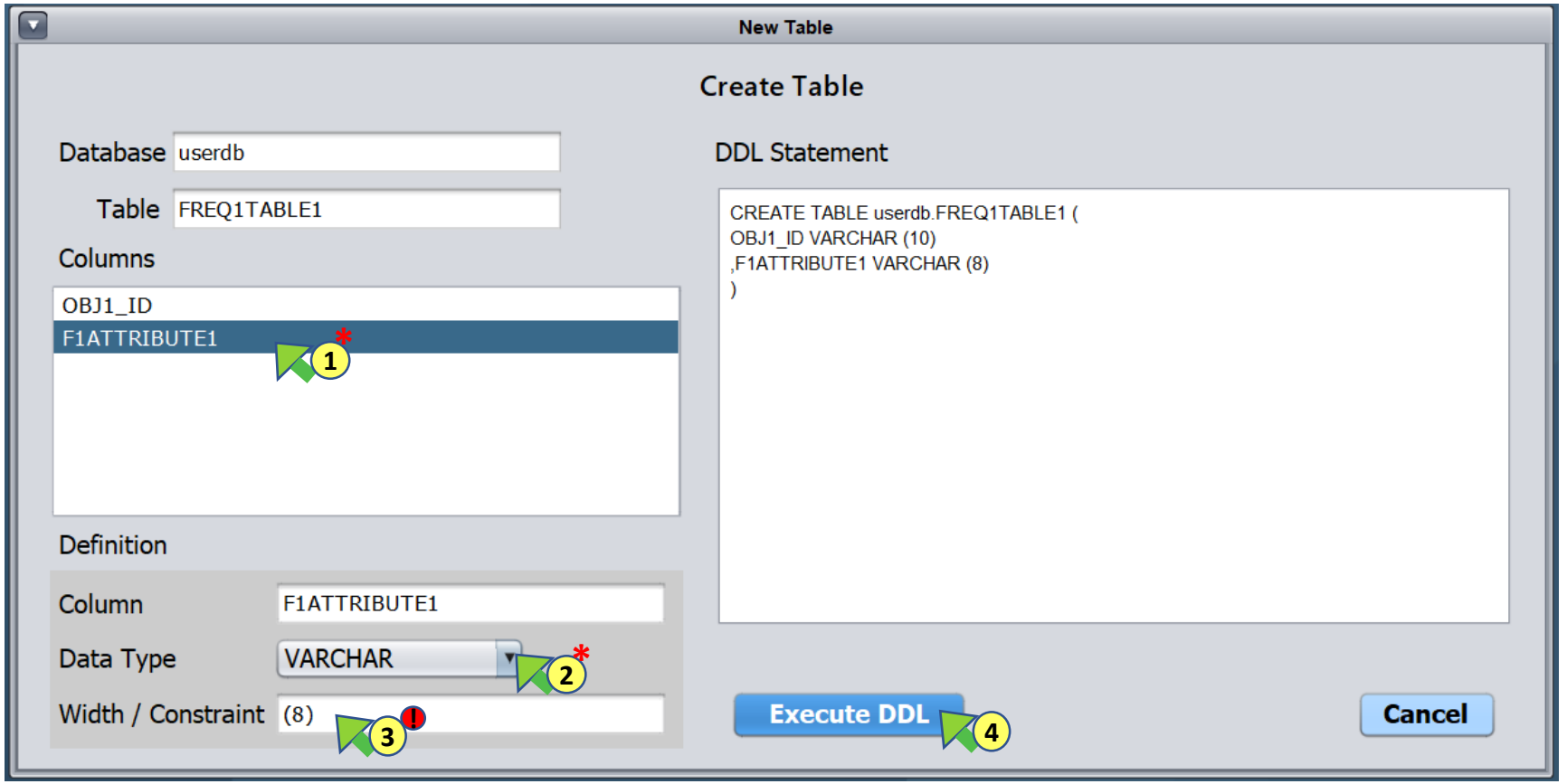
*	Create new.
Dobj Name	Name of the Data Object.
Description	Description of the Data Object.
X	Delete from the map.
	Exclude attribute from the Look-Up.

Periodic Attributes Table	New Periodic attributes table name
Period Type	Type of periodic table
Period Name	Name of this periodic table
Attribute Column	New attribute column name.
Attribute Description	Description of attribute (editable).
Attribute Information	Additional info. about attribute (editable).
Row Date/Time Column(	Column for row update date/time.

Save	Save add/edits.
Cancel	Cancel add/edits.
View Map	View map in a tabular form.

DORM Studio:

- Create Periodic Attributes Table



* For each column repeat (1), (2) and (3) (for some data types such as VARCHAR)

❗ After typing Width (and/or Constraint) press Enter or click in DDL Statement box on the right.

Database MyDatabase (space)

Table Table to be create

Columns Columns to be created

Data Type Select Data Type for the column

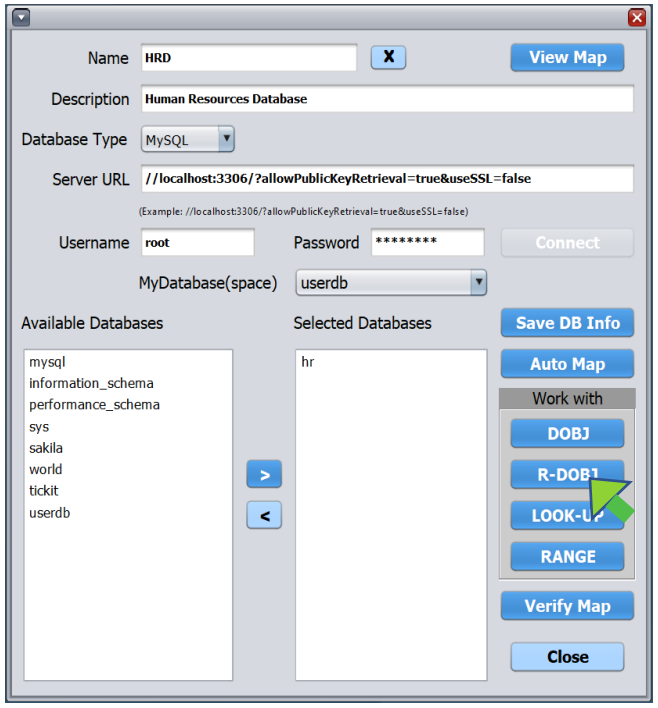
Width / Constraint Enter Width and/or constraint for the column

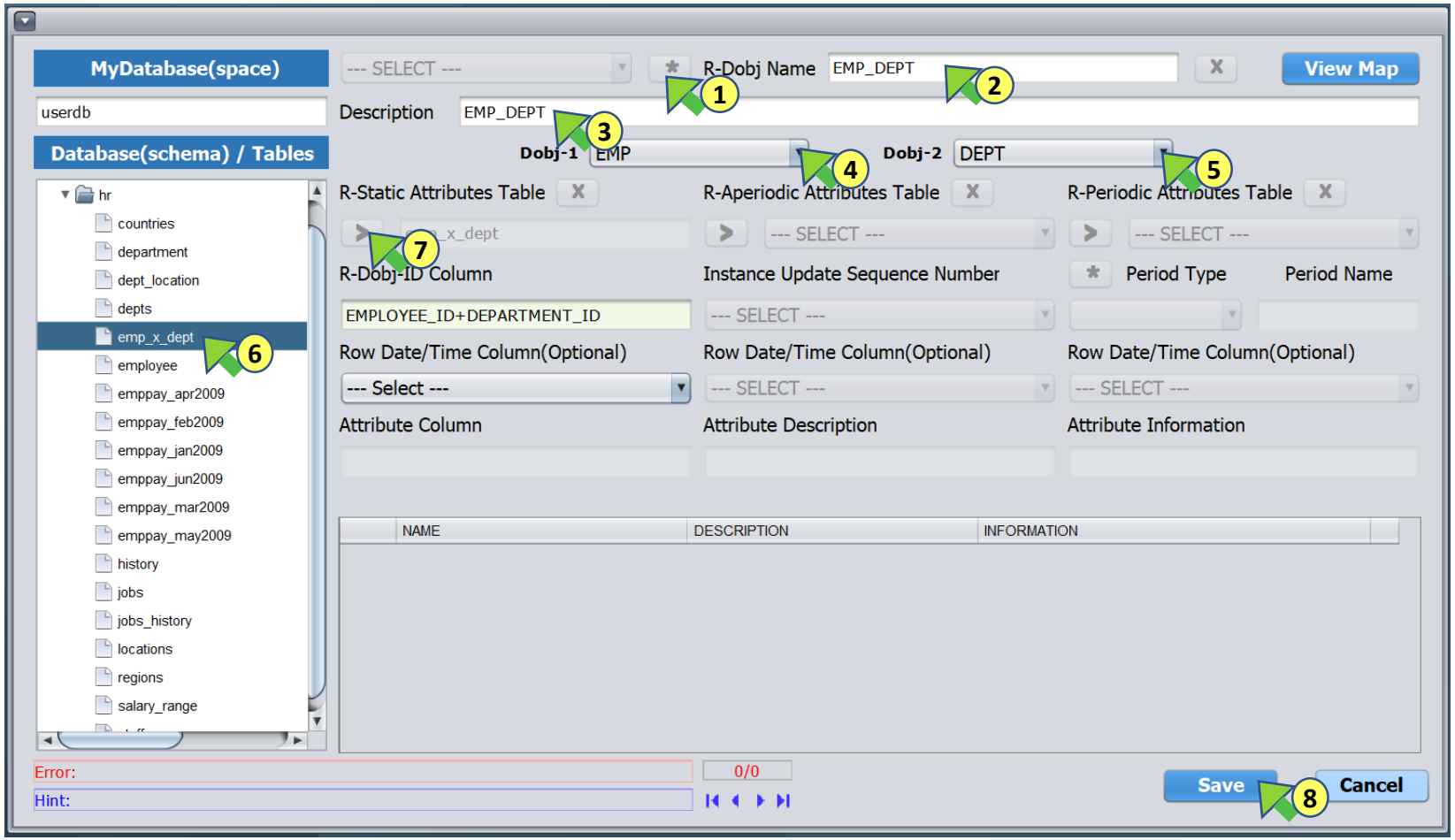
Execute DDL Create table in the Database

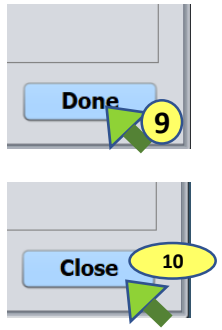
Cancel Cancel table creation

DORM Studio:

- **New R-DOBJ 'EMP_DEPT'**
- **Add R-Static Table**







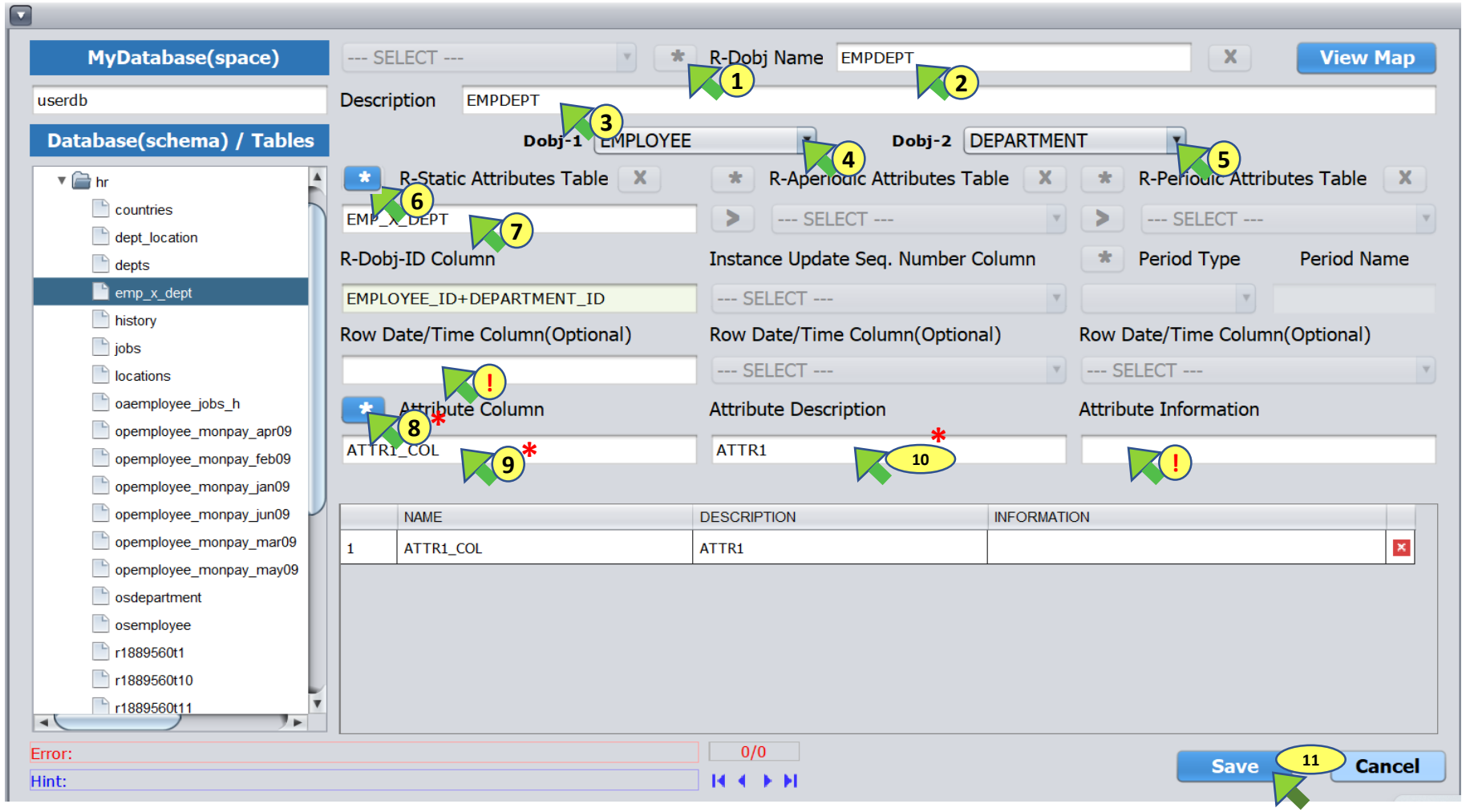
*	Create new.
R-Dobj Name	Enter name of the R-Dobj.
Description	Enter small description of the R-Dobj.
Dobj-1	Select a Dobj.
Dobj-2	Select a Dobj
>	Add selected table's info to R-Dobj.
X	Delete from the map.

R-Static Attributes Table	Select from left and add Static attributes table.
R-Dobj-ID Column	Dobj-ID columns of both Dobjs.
Row Date/Time Column	Select row timestamp column from drop down.
R-Aperiodic Attributes Table	Select from left and add Aperiodic attributes table
Instance Update Seq. Number Column	Select row update seq. column from drop down.
R-Periodic Attributes Table	Select from left and add Periodic attributes table
Period Type	Create new Period Type(or select from drop down)
Period Name	Enter Period name.
Attribute Description	Description of selected (from table below) attribute (editable).
Attribute Information	Additional info. about selected (from table below) attribute (editable).

Save	Save add/edits.
Cancel	Cancel add/edits.
Done	Close R-Dobj
Close	Close R-DOBJ interface.
View Map	View map in a tabular form.

DORM Studio:

- Create R-Static Attributes Table



! Optional

* Repeat (8 9 10) for each Attribute.

(**Continued on next page**.)

* Create new.

Dobj Name Enter name of the Data Object.

Description Enter small description of the Data Object.

X Delete from the map.

Exclude attribute from the Look-Up.

Static Attributes Table New R-Static attributes table name

Attribute Column New attribute column name.

Attribute Description Description of attribute (editable).

Attribute Information Additional info. about attribute (editable).

Row Date/Time Column(Column for row update date/time (optional).

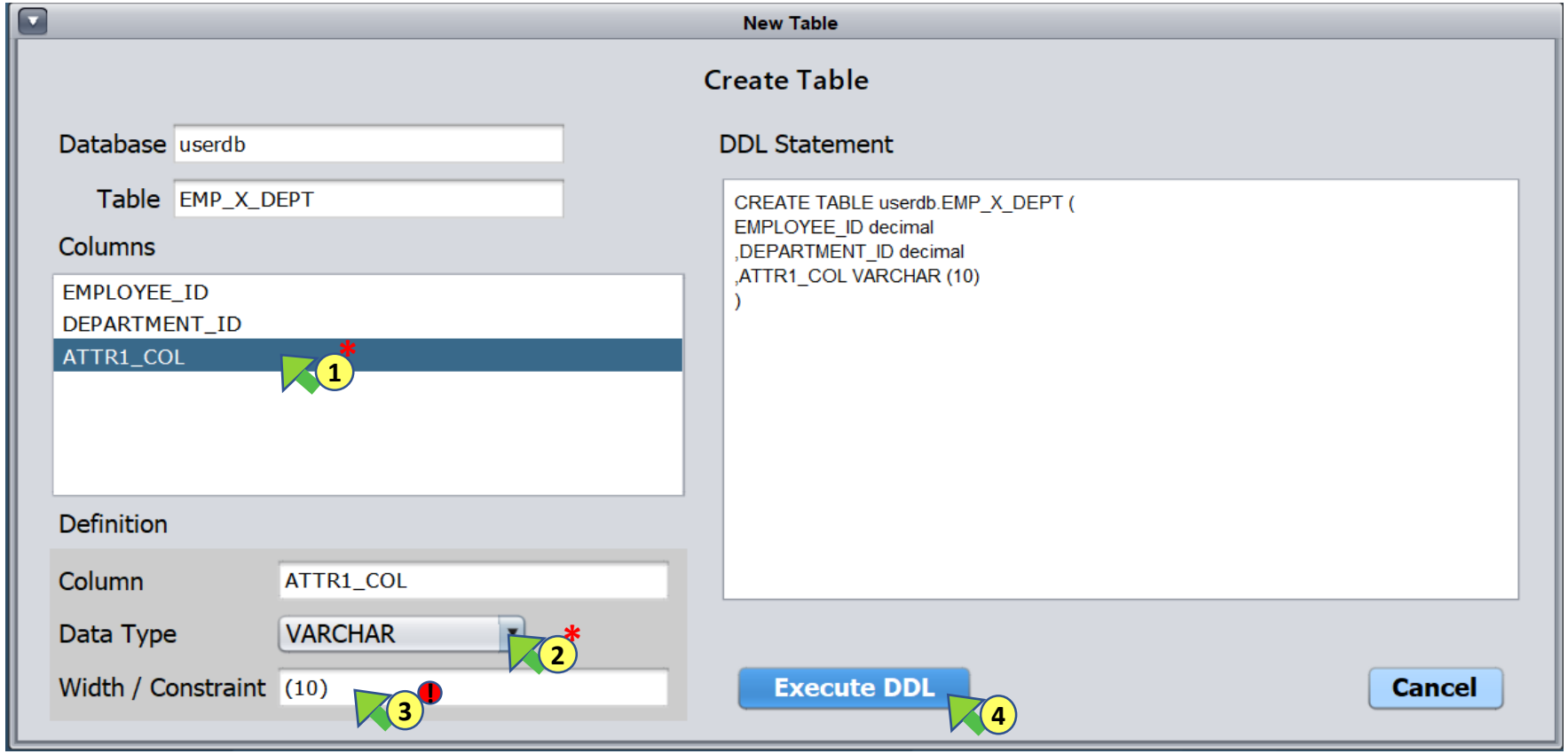
Save Save add/edits.

Cancel Cancel add/edits.

View Map View map in a tabular form.

DORM Studio:

- Create R-Static Attributes Table



* For each column repeat (1), (2) and (3) (for some data types such as VARCHAR)

❗ After typing Width (and/or Constraint) press Enter or click in DDL Statement box on the right.

Database MyDatabase (space)

Table Table to be create

Columns Columns to be created

Data Type Select Data Type for the column

Width / Constraint Enter Width and/or constraint for the column

Execute DDL Create table in the Database

Cancel Cancel table creation

DORM Studio:

- Add R-Aperiodic attributes table: Similar to adding Aperiodic Attributes Table.

See DOBJ: Add/Edit Aperiodic Attributes Table on page 15

DORM Studio:

- Create R-Aperiodic attributes table: Similar to creating Aperiodic Attributes Table

See DOBJ: Create Aperiodic Attributes Table on page 16

DORM Studio:

- Add R-Periodic attributes table: Similar to adding Periodic Attributes Table

See DOBJ: Add/Edit Periodic Attributes Table on page 18

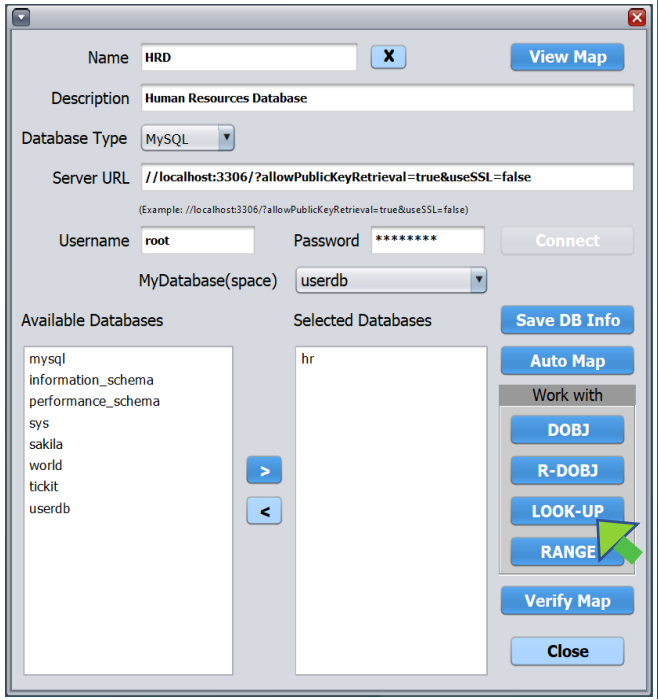
DORM Studio:

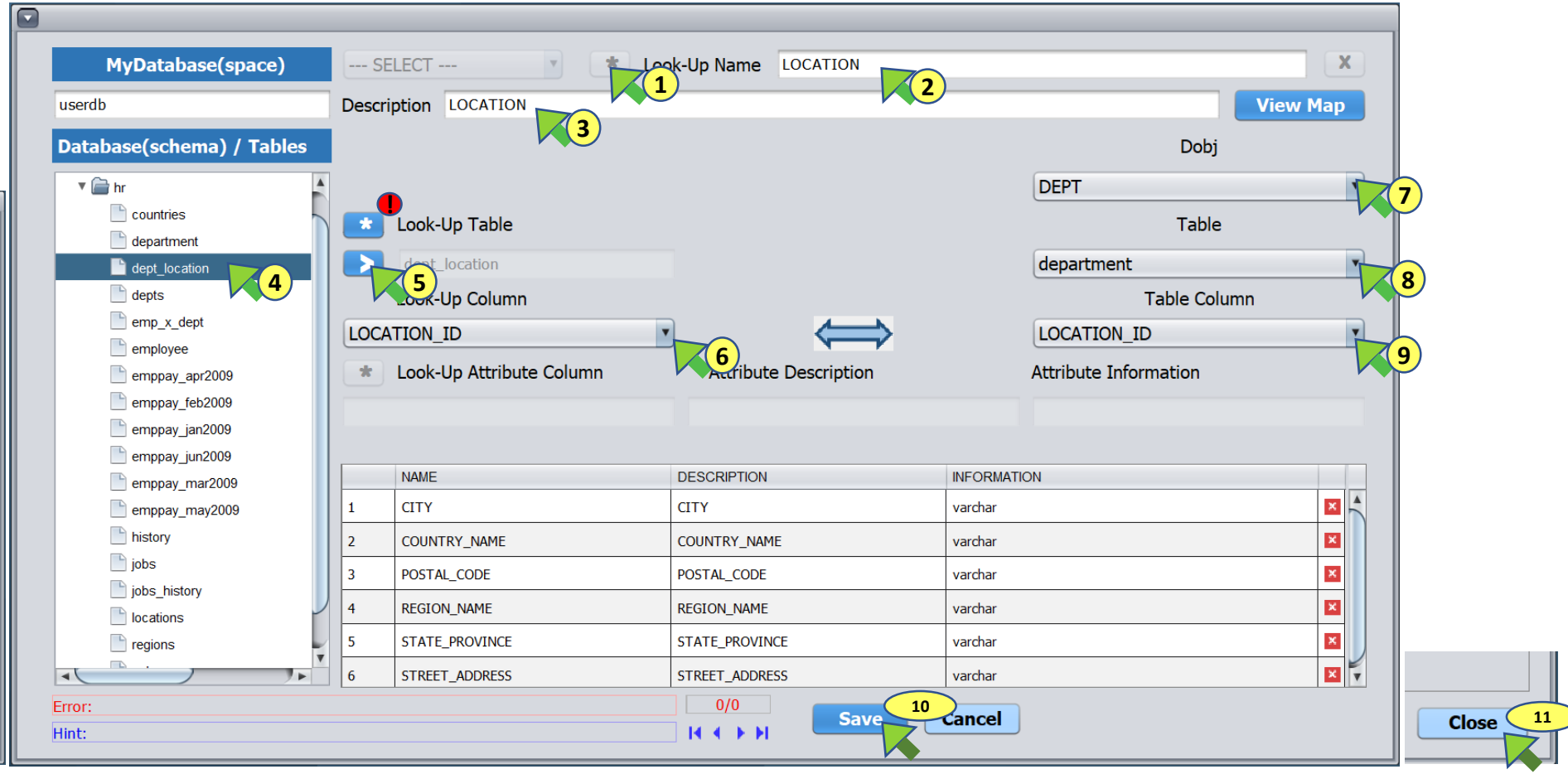
- **Create R-Periodic attributes table: Similar to creating Periodic Attributes Table**

See DOBJ: Create Periodic Attributes Table on page 19

DORM Studio:

- New LOOK-UP 'LOCATION'





See next page for creating a Look-Up table.

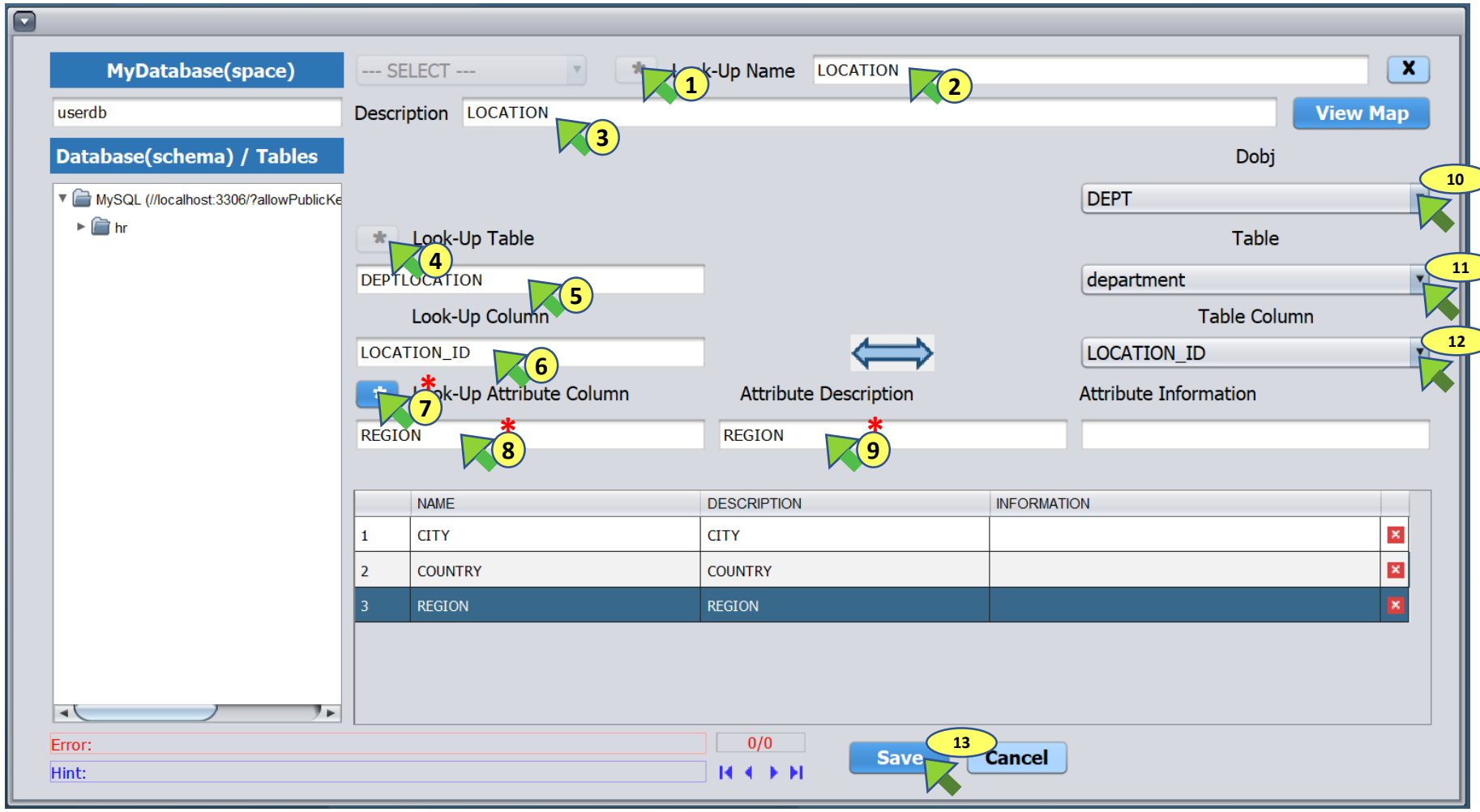
*	Create new.
Look-Up Name	Enter name of the Look-Up.
Description	Enter small description of the Look-Up.
>	Add selected table's info to Look-Up
X	Delete from the map.
	Exclude attribute from the Look-Up.

Look-Up Table	Selected look-up table
Look-Up Column	Select look-up column
Dobj	Select Dobj
Table	Select a Table of selected Dobj
Table Column	Select a column of selected Table
Attribute Description	Description of selected (from table below) attribute (editable).
Attribute Information	Additional info. about selected (from table below) attribute (editable).

Save	Save add/edits.
Cancel	Cancel add/edits.
Close	Close DOBJ interface.
View Map	View map in a tabular form.

DORM Studio:

- Create Look-Up Table



* Repeat (7 8 9) for each Attribute.

(**Continued on next page**.)

* Create new.

Look-Up Name Enter name of the Look-Up.

Description Enter small description of the Look-Up.

Look-Up Table New look-up table name

Look-Up Column New look-up column name

Dobj Select Dobj

Table Select a Table of selected Dobj

Table Column Select a column of selected Table

Look-Up Attribute Column New look-up attribute column name

Attribute Description Description of attribute (editable).

Attribute Information Additional info. about attribute (editable).

Save Save add/edits.

Cancel Cancel add/edits.

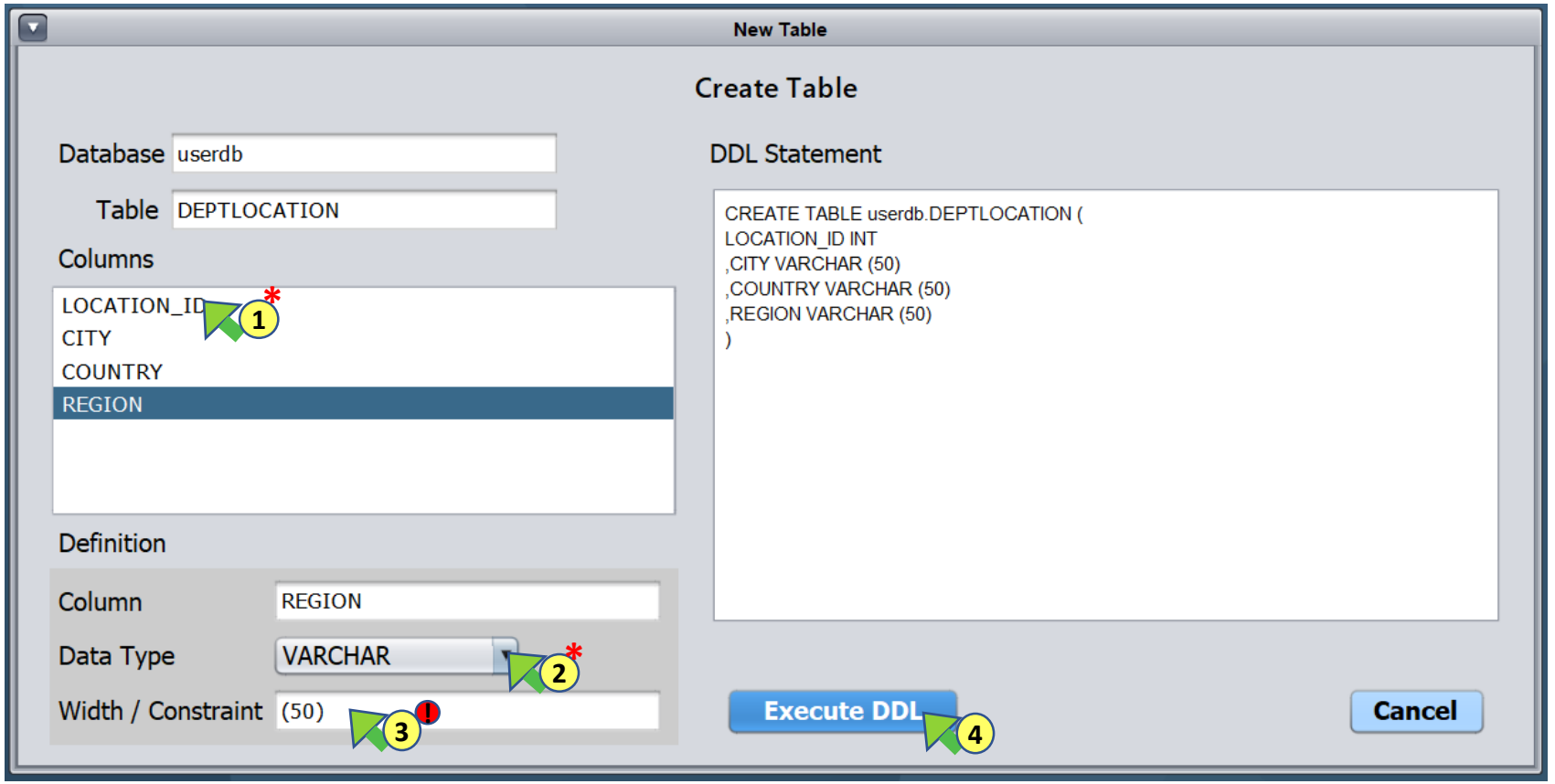
View Map View map in a tabular form.

X Delete from the map.

Exclude attribute

DORM Studio:

- Create Look-Up Table



* For each column repeat (1), (2) and (3) (for some data types such as VARCHAR)

❗ After typing Width (and/or Constraint) press Enter or click in DDL Statement box on the right.

Database MyDatabase (space)

Table Table to be create

Columns Columns to be created

Data Type Select Data Type for the column

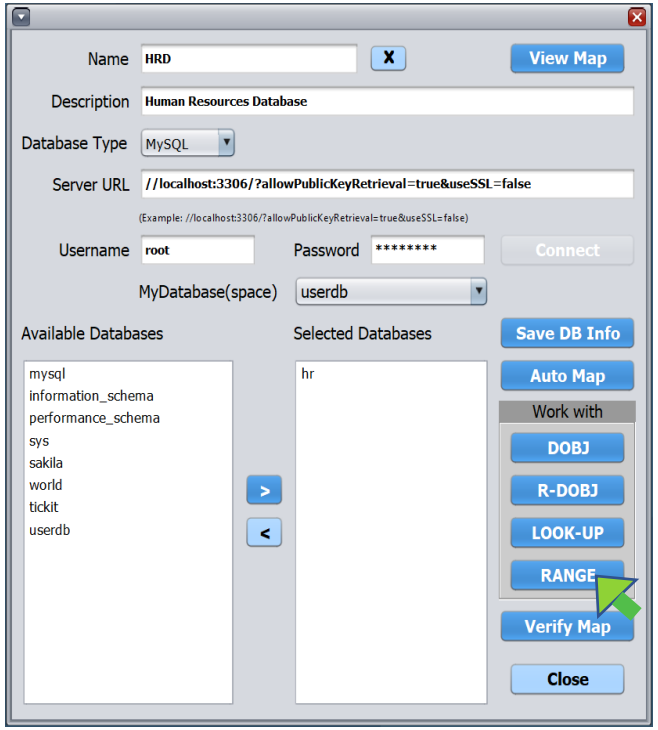
Width / Constraint Enter Width and/or constraint for the column

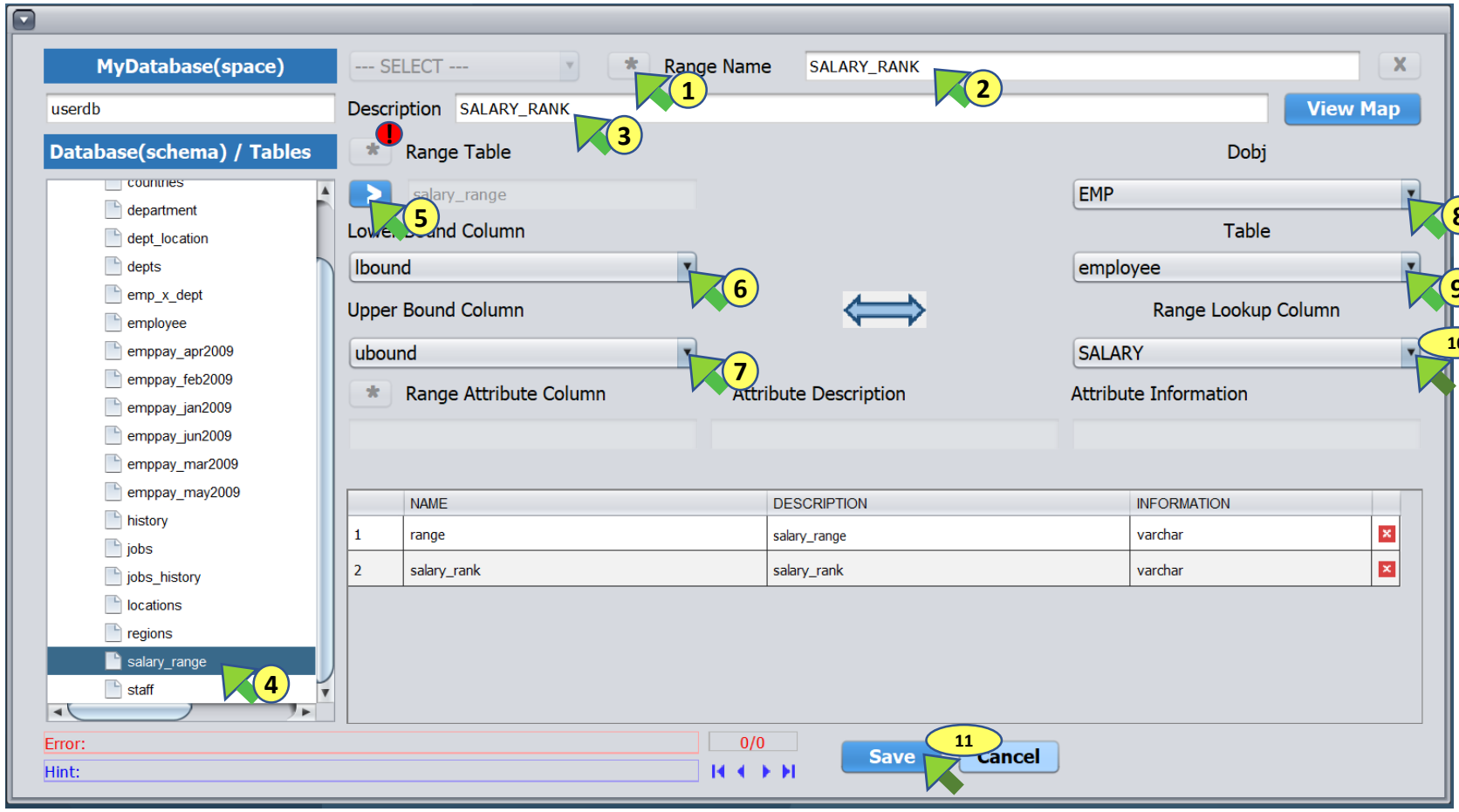
Execute DDL Create table in the Database

Cancel Cancel table creation

DORM Studio:

- New RANGE 'SALARY_RANK'





See next page for creating a Range table.

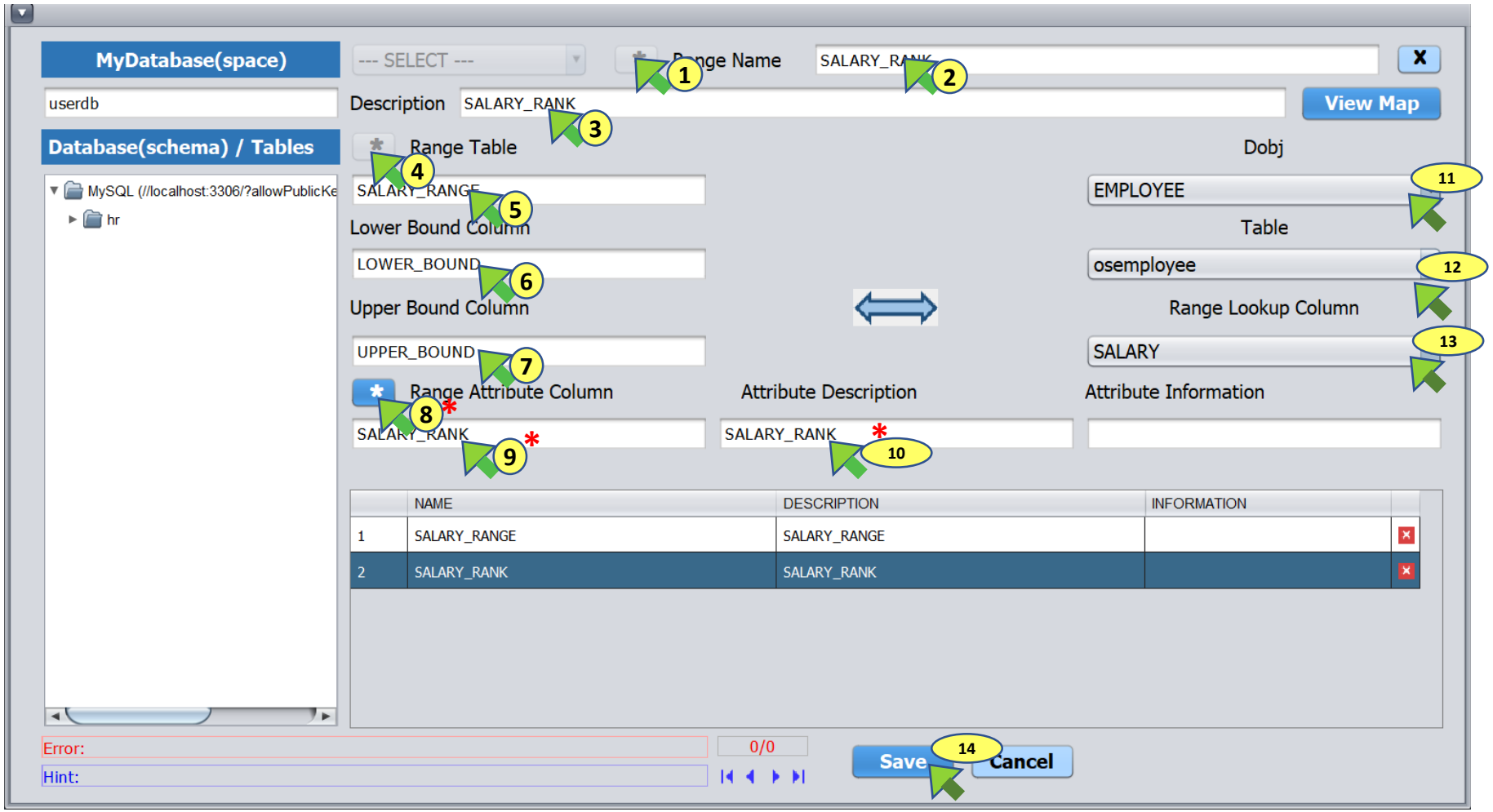
*	Create new.
Look-Up Name	Enter name of the Range.
Description	Enter small description of the Range.
>	Add selected table's info to Range
X	Delete from the map.
	Exclude attribute from the Range.

Look-Up Table	Selected look-up table
Lower Bound Column	Select lower bound column
Upper Bound Column	Select upper bound column
Dobj	Select Dobj
Table	Select a Table of selected Dobj
Table Column	Select a column of selected Table
Attribute Description	Description of selected (from table below) attribute (editable).
Attribute Information	Additional info. about selected (from table below) attribute (editable).

Save	Save add/edits.
Cancel	Cancel add/edits.
Close	Close DOBJ interface.
View Map	View map in a tabular form.

DORM Studio:

- Create Range Table



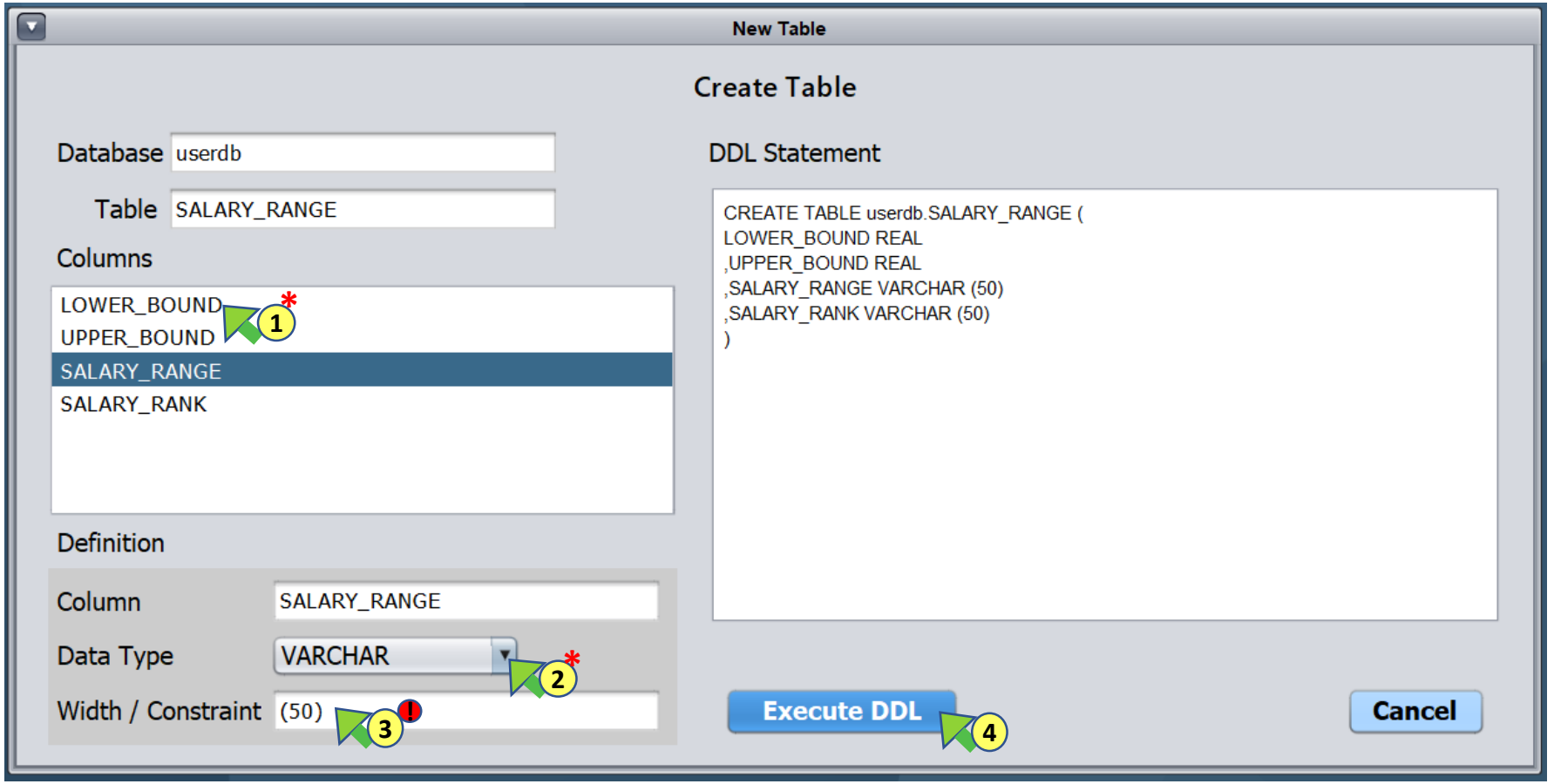
* Repeat (8 9 10) for each Attribute.

(**Continued on next page**.)

*	Create new.
Range Name	Enter name of the Range association.
Description	Enter small description of the range.
Range Table	New range table name
Lower Bound Column	New lower bound column name
Upper Bound Column	New upper bound column name
Dobj	Select Dobj
Table	Select a Table of selected Dobj
Table Column	Select a column of selected Table
Range Attribute Column	New range attribute column name
Attribute Description	Description of attribute (editable).
Attribute Information	Additional info. about attribute (editable).
Save	Save add/edits.
Cancel	Cancel add/edits.
View Map	View map in a tabular form.
X	Delete from the map.
	Exclude attribute.

DORM Studio:

- Create Range Table



* For each column repeat (1), (2) and (3) (for some data types such as VARCHAR)

❗ After typing Width (and/or Constraint) press Enter or click in DDL Statement box on the right.

Database MyDatabase (space)

Table Table to be create

Columns Columns to be created

Data Type Select Data Type for the column

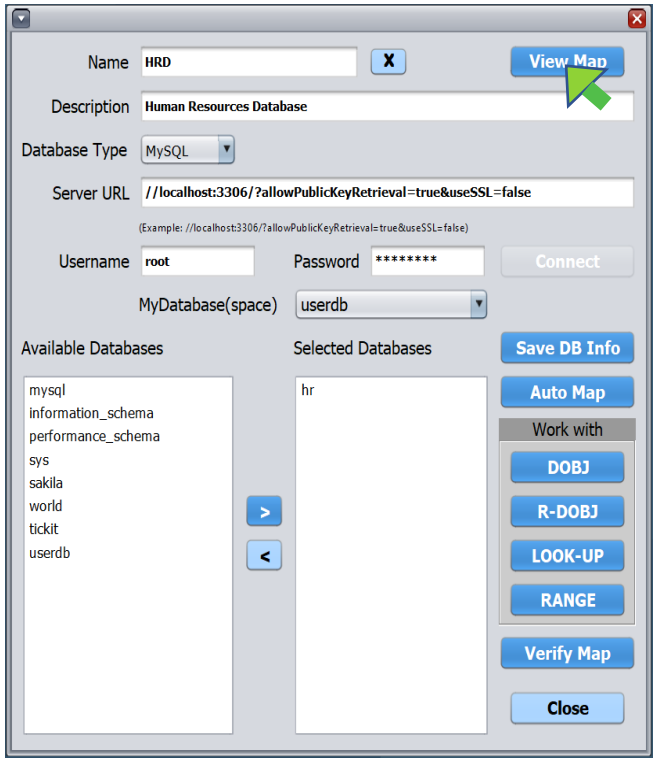
Width / Constraint Enter Width and/or constraint for the column

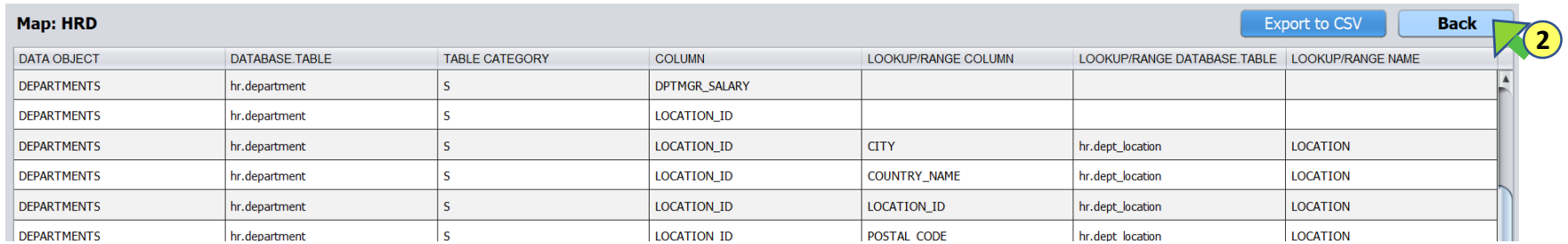
Execute DDL Create table in the Database

Cancel Cancel table creation

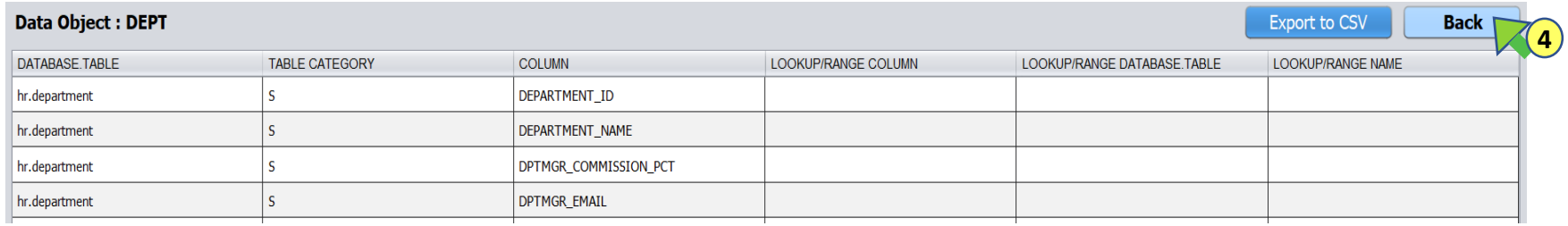
DORM Studio:

- View Map





DATA OBJECT	DATABASE.TABLE	TABLE CATEGORY	COLUMN	LOOKUP/RANGE COLUMN	LOOKUP/RANGE DATABASE.TABLE	LOOKUP/RANGE NAME
DEPARTMENTS	hr.department	S	DPTMGR_SALARY			
DEPARTMENTS	hr.department	S	LOCATION_ID			
DEPARTMENTS	hr.department	S	LOCATION_ID	CITY	hr.dept_location	LOCATION
DEPARTMENTS	hr.department	S	LOCATION_ID	COUNTRY_NAME	hr.dept_location	LOCATION
DEPARTMENTS	hr.department	S	LOCATION_ID	LOCATION_ID	hr.dept_location	LOCATION
DEPARTMENTS	hr.department	S	LOCATION_ID	POSTAL_CODE	hr.dept_location	LOCATION



DATABASE.TABLE	TABLE CATEGORY	COLUMN	LOOKUP/RANGE COLUMN	LOOKUP/RANGE DATABASE.TABLE	LOOKUP/RANGE NAME
hr.department	S	DEPARTMENT_ID			
hr.department	S	DEPARTMENT_NAME			
hr.department	S	DPTMGR_COMMISSION_PCT			
hr.department	S	DPTMGR_EMAIL			

* DOBJs are shown in diagonal sequence (i.e. DEPT and EMP), R-DOBJs are shown at row-column intersection of the two related DOBJs.

! To view details of an object, click on the cell

Details — Show database, tables and columns of all the data objects

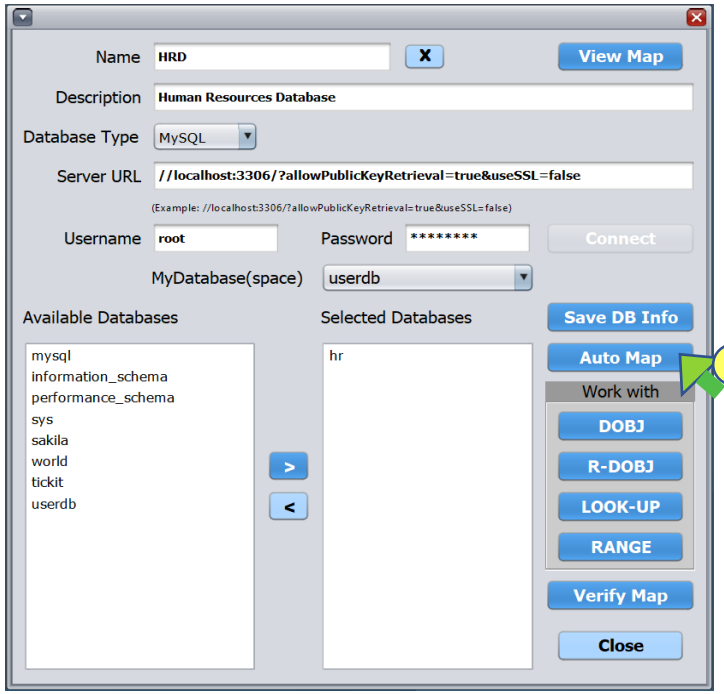
Export to CSV — Export current view to CSV file.

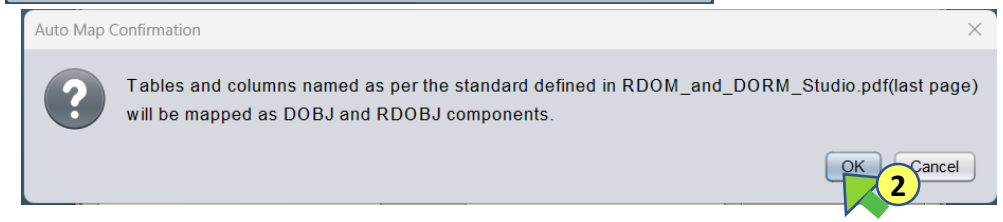
Back — Show map view

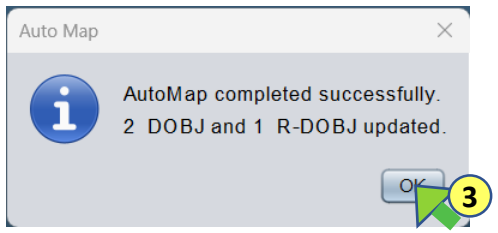
Close — Close map view

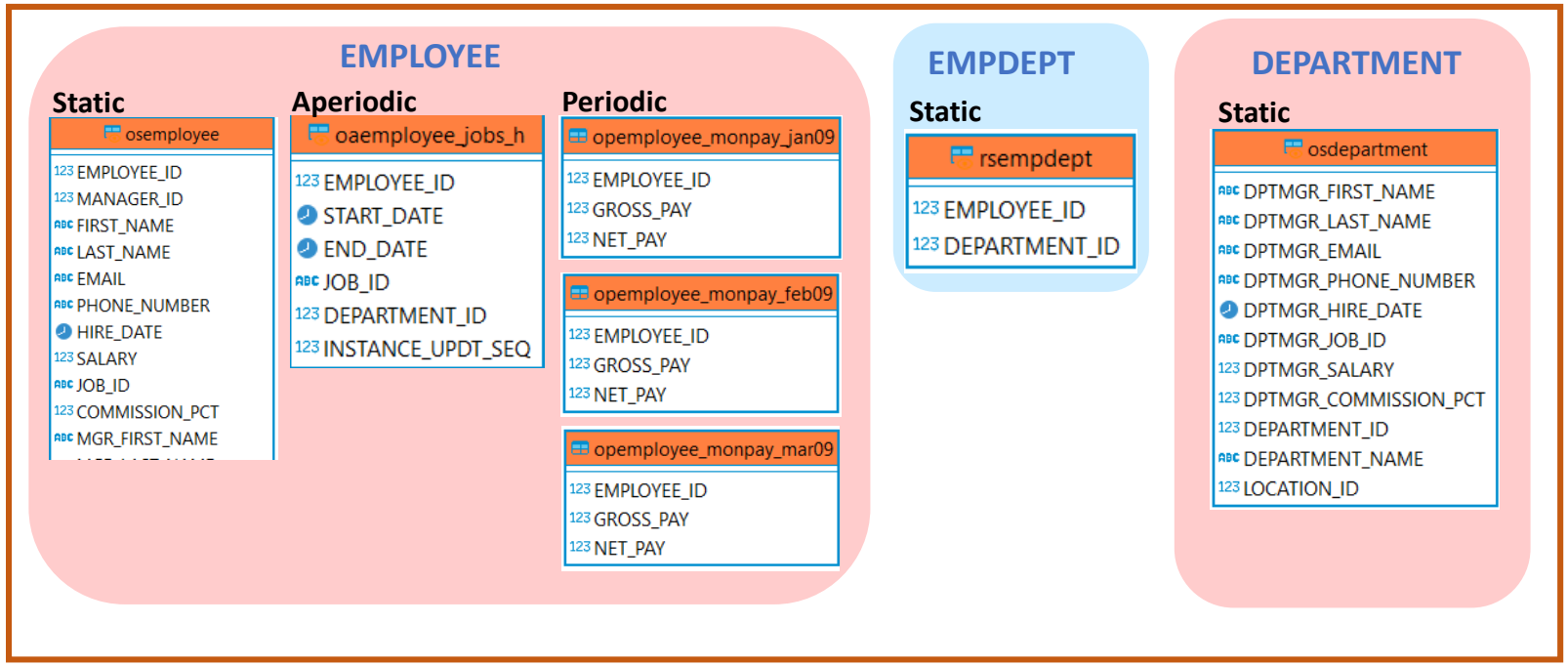
- AutoMap

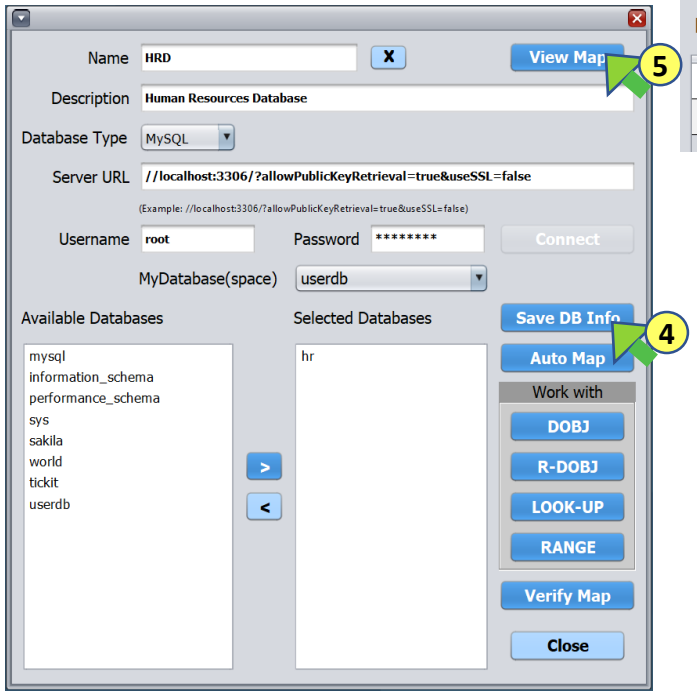
In this example there are two DOBJs (EMPLOYEE and DEPARTMENT) and one R-DOBJ (EMPDEPT). Tables and columns are named as per the standard*.

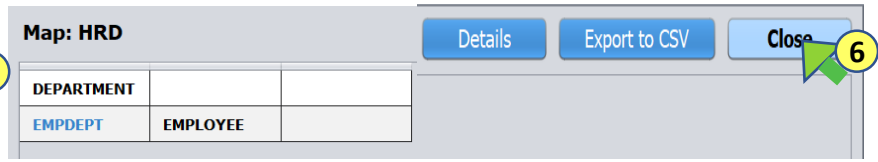








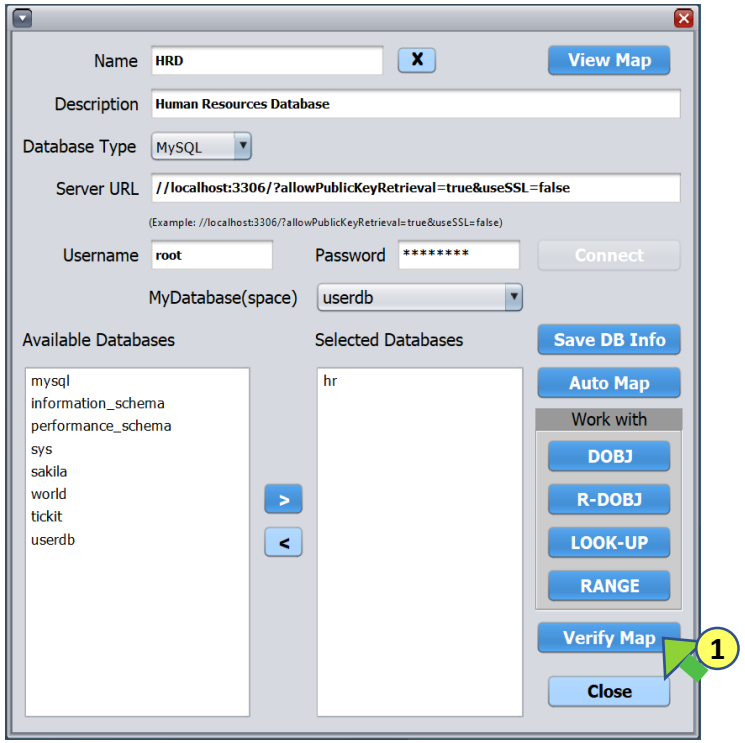


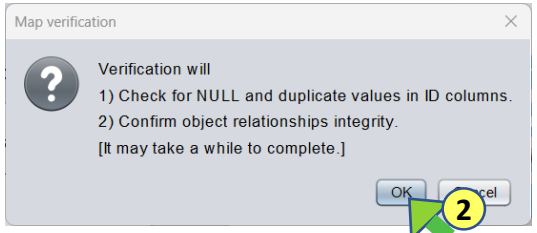


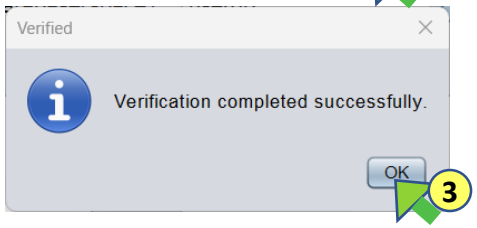
* See '[Standard names for tables and columns](#)' on page 38.

- Verify Map

- Check for NULL values in ID columns of all tables.
- Check for duplicate values in ID columns of all tables.
- Verify integrity of object components relationships.







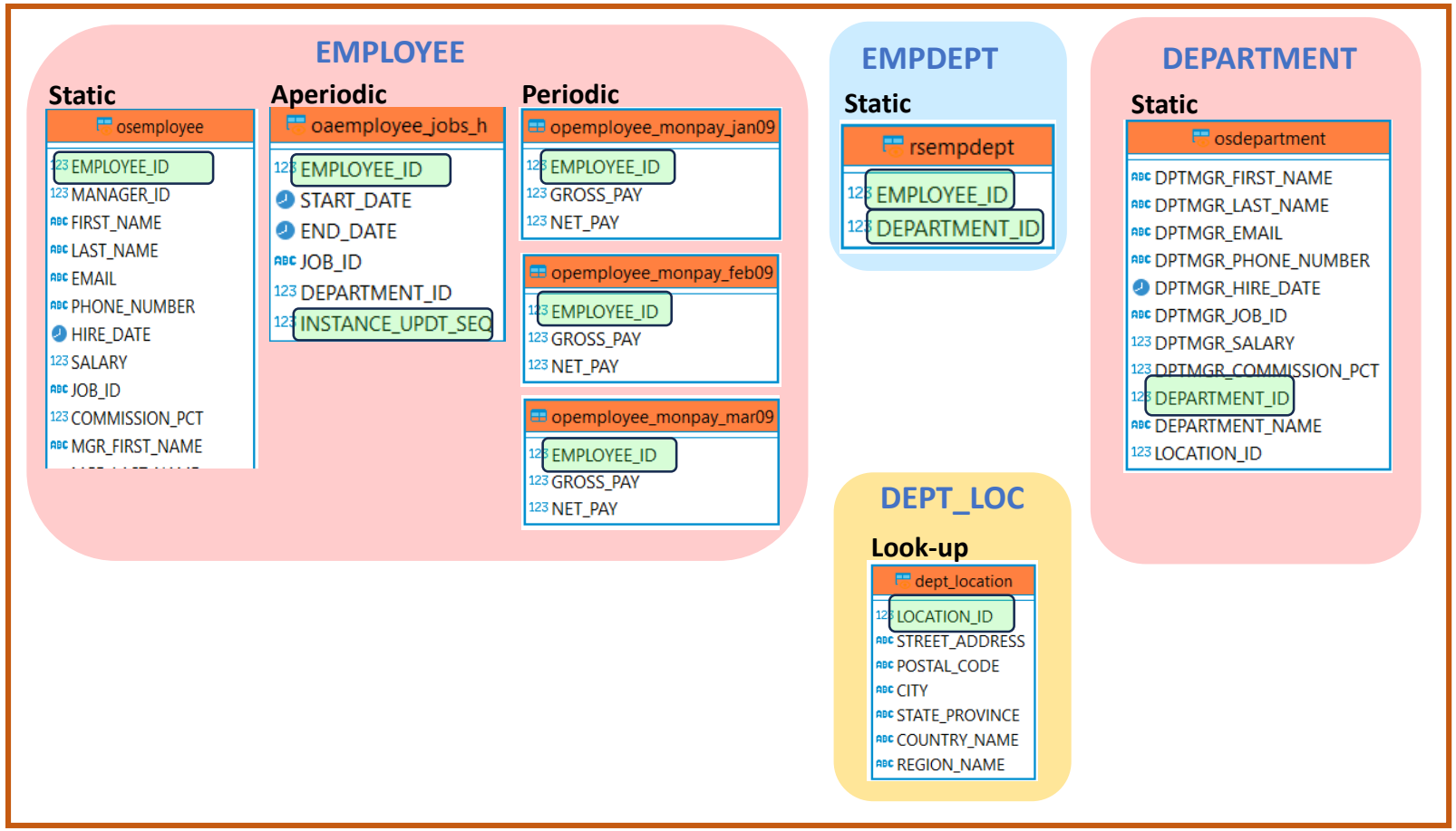
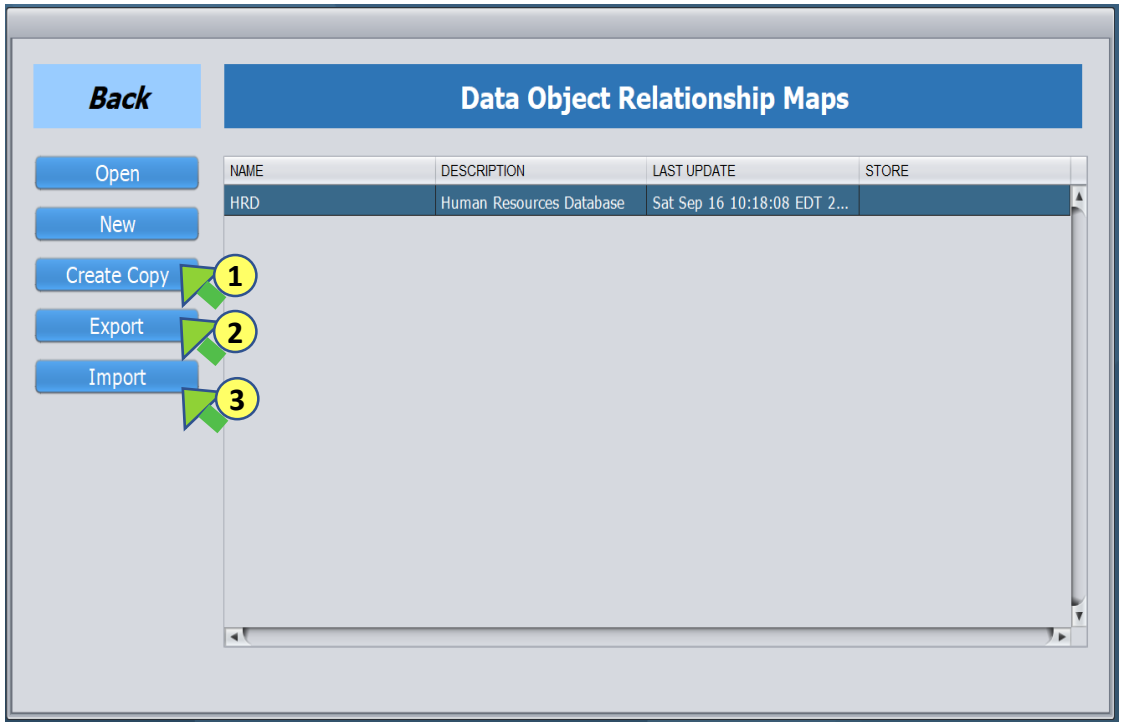


Fig. 1

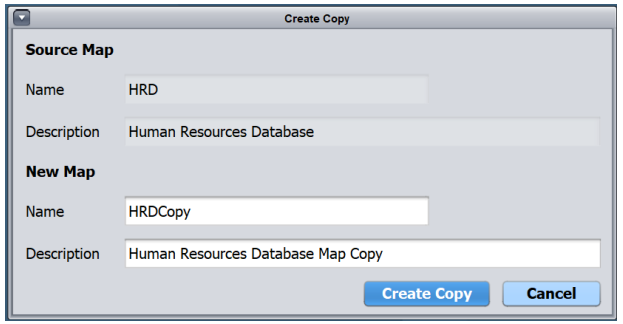
- Verification process:

1) Check for NULL and duplicate values in ID columns (highlighted in green in Fig 1)
2) Check for non-ID values in object components:
   i) EMPLOYEE_ID column of oaemployee_jobs_h table must not have value that does not exists in EMPLOYEE_ID column of osemployee table.
   ii) EMPLOYEE_ID column of opemployee_monpay_jan09, opemployee_monpay_feb09 and opemployee_monpay_mar09 tables must not have value that does not exists in EMPLOYEE_ID column of osemployee table.
   iii) EMPLOYEE_ID and DEPARTMENT_ID columns of rsempdept table must not have value that does not exists in EMPLOYEE_ID and DEPARTMENT_ID columns of osemployee and osdepartment tables respectively.

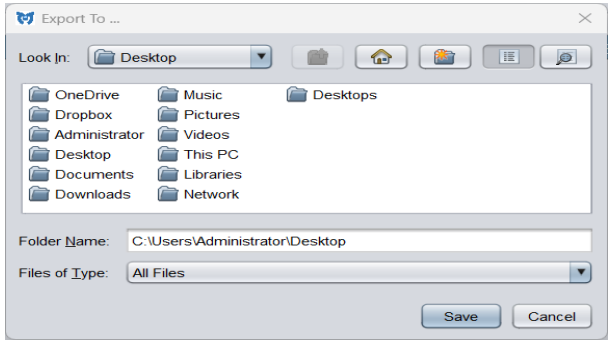
- Export/Import/Copy:



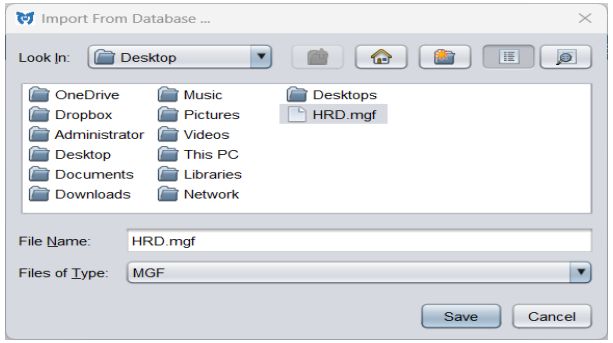
1. Create Copy: Duplicates selected map.



2. Export: Exports selected map as a file.



3. Import: Imports map from a file.



Standard names for tables and columns to auto-map: DORM Studio's AutoMap feature creates map entries for DOBJ and R-DOBJ components from the tables and columns named using following standard (Fig. 5).

DOBJ:

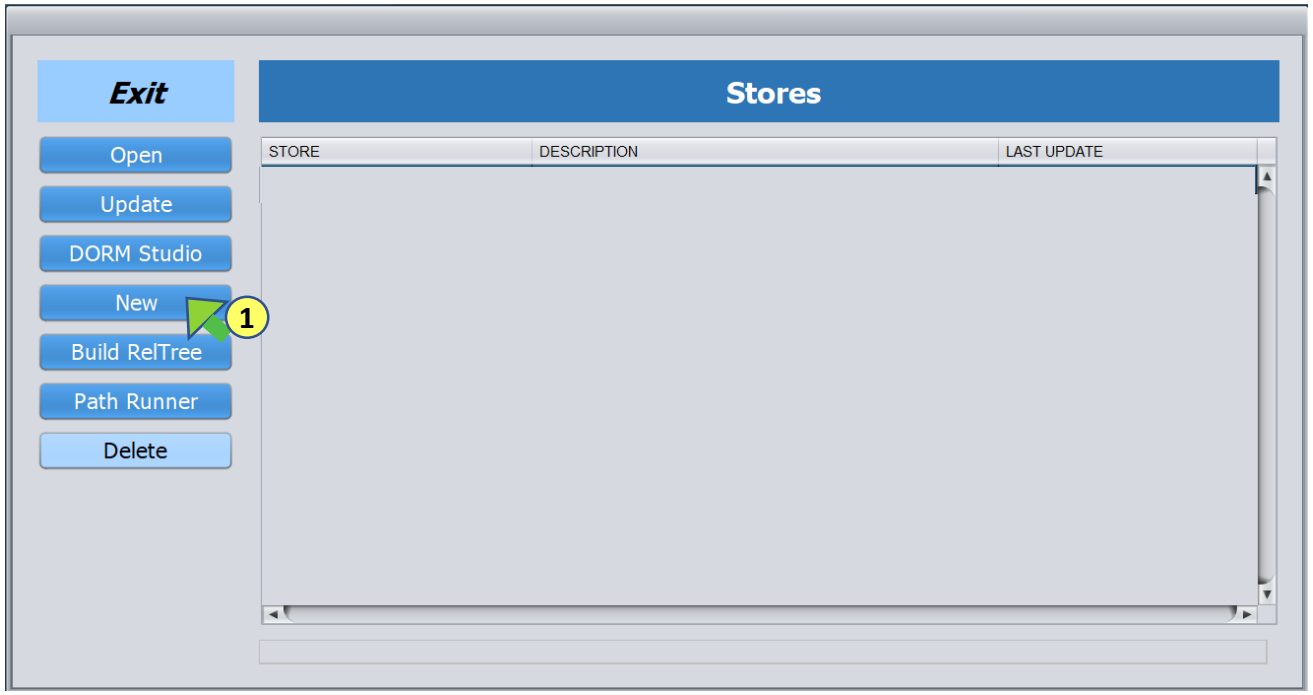
Table Type	Table Name	Column Name	Note
Static	OS<dobj>	<dobj>_ID	<dobj> is user declared DOBJ name. <dobj> must start with a character.
		INSTANCE_UPDT_DTTM	(Optional) Row update time stamp
Aperiodic	OA<dobj>_<string>	<dobj>_ID	<string> can be any set of characters.
		INSTANCE_UPDT_SEQ	Column for instance update sequence number.
		INSTANCE_UPDT_DTTM	(Optional) Row update time stamp
Periodic	OP<dobj>_<p_type>_<p_desc>	<dobj>_ID	<p_type> is user declared period type. <p_desc> is user declared period description. <p_type> and <p_desc> must not contain '_' (underscore character).
		INSTANCE_UPDT_DTTM	(Optional) Row update time-stamp.

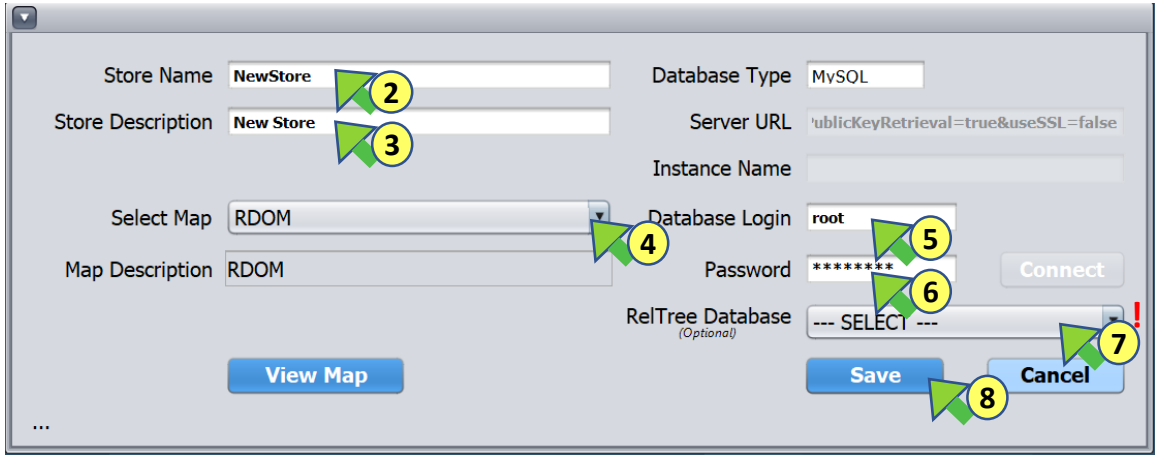
RDOBJ:

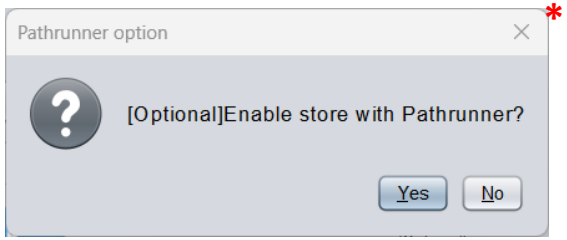
Table Type	Table Name	Column Name	Note
Static	RS<rdobj>	<dobj1id> <dobj2id>	<rdobj> is user declared RDOBJ name. <rdobj> must start with a character. <dobj1id> and <dobj2id> must be respective DOBJs' ID column names.
		INSTANCE_UPDT_DTTM	(Optional) Row update time stamp
Aperiodic	RA<rdobj>_<string>	<dobj1id> <dobj2id>	<string> can be any set of characters.
		INSTANCE_UPDT_SEQ	Column for instance update sequence number.
		INSTANCE_UPDT_DTTM	(Optional) Row update time stamp
Periodic	RP<rdobj>_<p_type>_<p_desc>	<dobj1id> <dobj2id>	<p_type> is user declared period type. <p_desc> is user declared period description. <p_type> and <p_desc> must not contain '_' (underscore character).
		INSTANCE_UPDT_DTTM	(Optional) Row update time-stamp.

Store:

- Create new.







! Database(or Schema) where RelTree tables are to be created. If this database/schema is selected then 'Build RelTree' button, on main menu, will get activated.

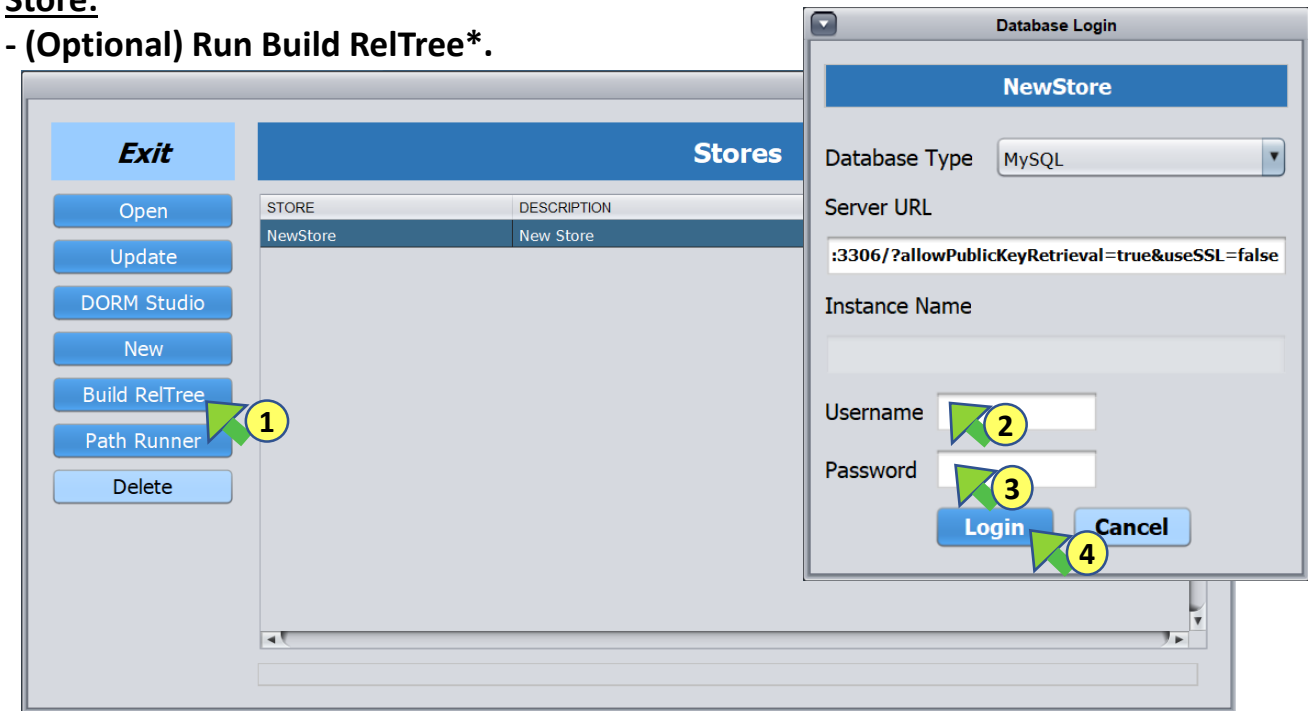
* The prompt for Pathrunner will appear if the map contains more then two Relationship Data Objects (RDOBJ) and all Static attribute tables of RDOBJs are tables (not views).

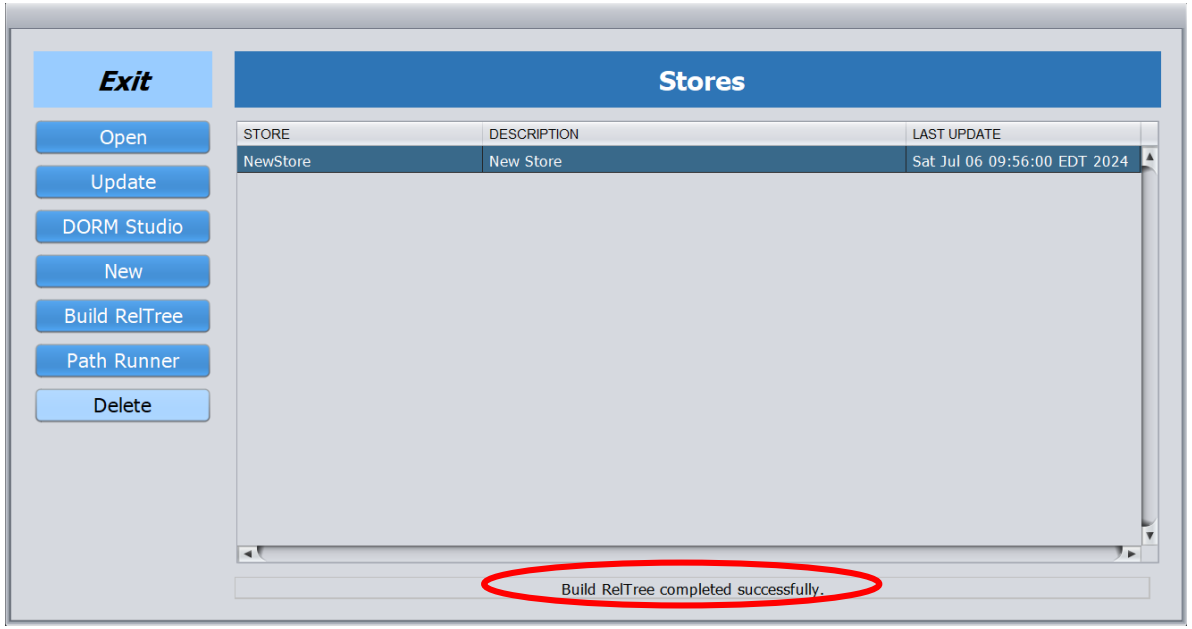
Open	Open selected store.
Update	Update selected store after associated map update.
DORM Studio	Open DORM Studio.
New	Create new store.
Build RelTree	Create/update RelTree tables in RelTree database/schema.
Path Runner	Run PathRunner to update RDOBJ Static tables.
Delete	Delete selected store.
Exit	Exit application.

Store Name	Enter name of the store to be created.
Store Description	Enter brief description of the store.
Select Map	Select map to be associated with the store.
Database Type	Type of the database. (FYI)
Instance Name	MS SQL Server Instance name. (FYI)
RelTree Database	(Optionally) Select RelTree Database/schema.
Server URL	Network address of the database.(FYI)
Save	Create store.
Cancel	Cancel store creation

Store:

- (Optional) Run Build RelTree*.





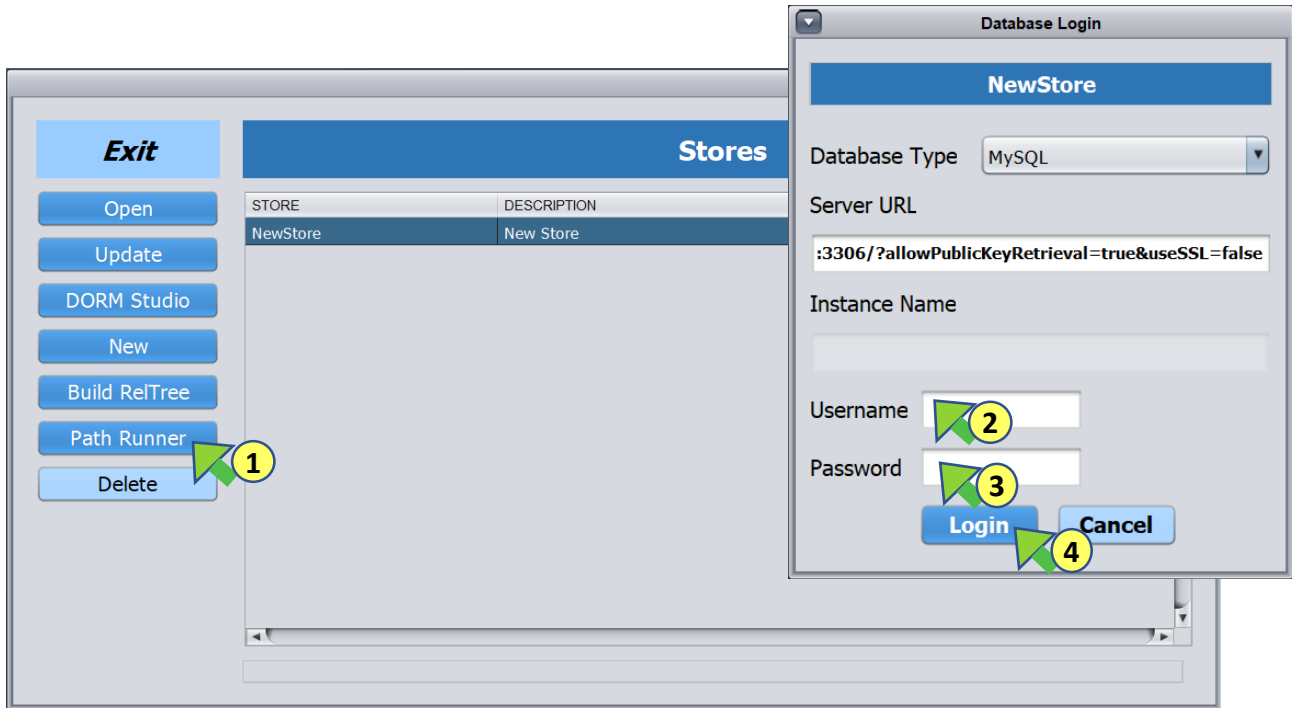
Open	Open selected store.
Update	Update selected store after associated map update.
DORM Studio	Open DORM Studio.
New	Create new store.
Build RelTree	Create/update RelTree tables in RelTree database/schema.
Path Runner	Run PathRunner to update RDOBJ Static tables.

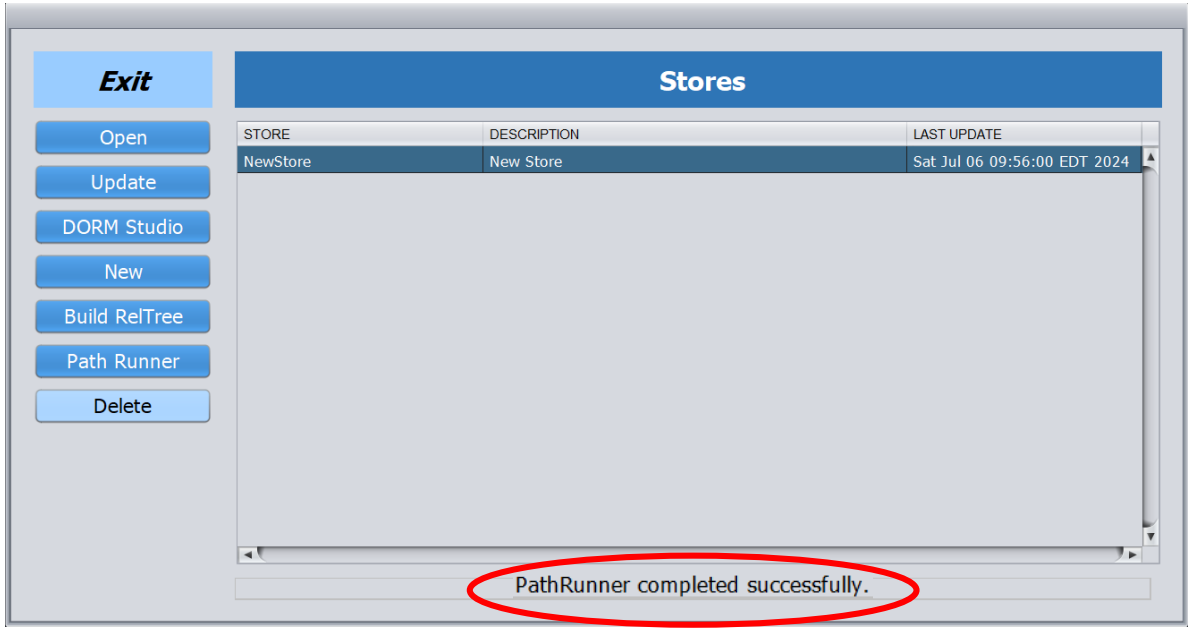
Login	Login and start Build RelTree
Cancel	Cancel Build RelTree run.
Delete	Delete selected store.
Exit	Exit application.

* See 'Appendix-2: Build RelTree' for what/how/why RelTree.

Store:

- (Optional) Run PathRunner*.





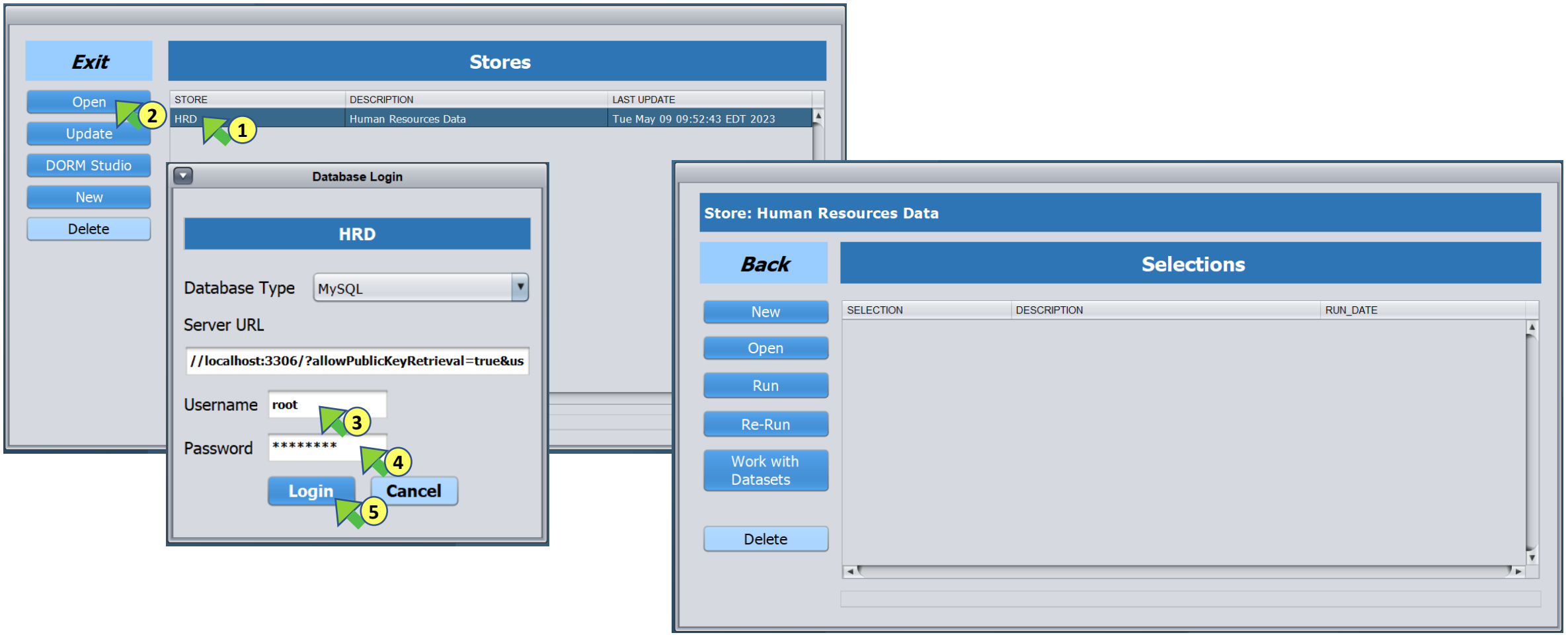
Open	Open selected store.
Update	Update selected store after associated map update.
DORM Studio	Open DORM Studio.
New	Create new store.
Build RelTree	Create/update RelTree tables in RelTree database/schema.
Path Runner	Run PathRunner to update RDOBJ Static Attributes tables.

Login	Login and start PathRunner
Cancel	Cancel Build RelTree run.
Delete	Delete selected store.
Exit	Exit application.

* See 'Appendix-3: Pathrunner' for what/how/why PathRunner.

Store:

- Open



Database Type Type of the database associated with the store.

Server URL Network address of the database.

Username Enter database username

Password Enter database password

Login Login to the database

Cancel Cancel login

New Create new Selection.

Open Open selected Selection.

Run Run selected Selection.

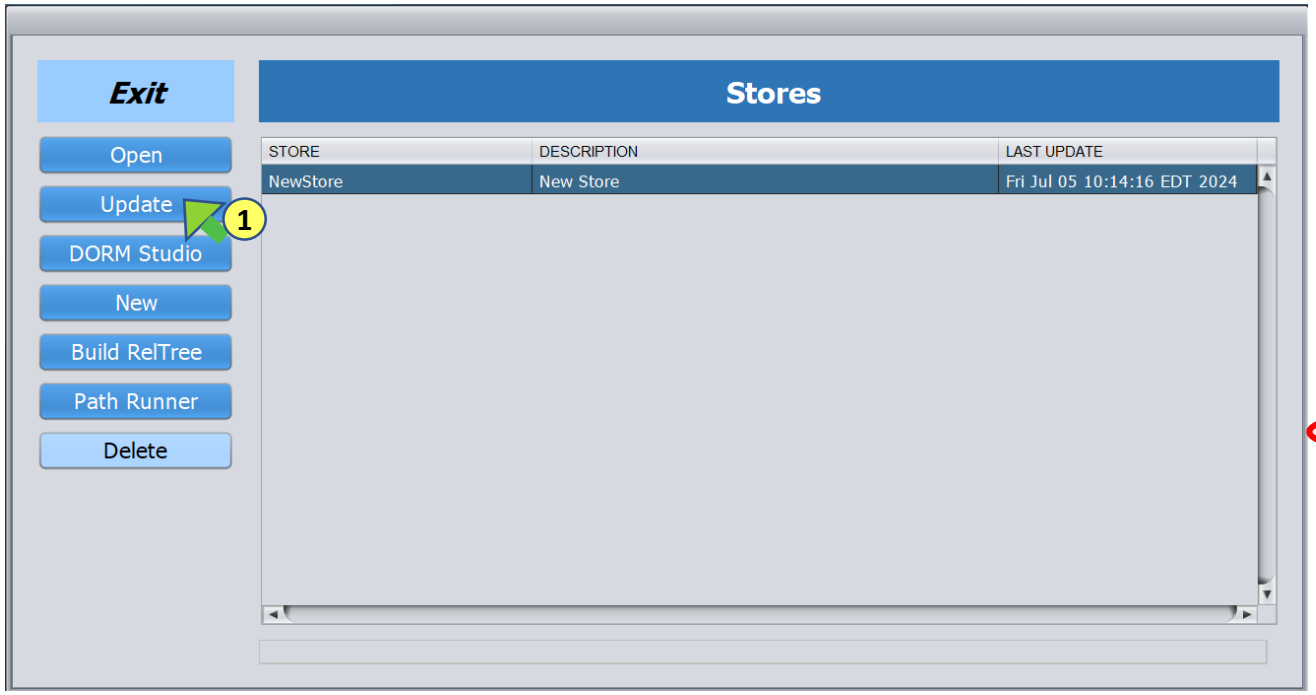
Re-Run Re-Run selected Selection including associated analysis and subsetting.

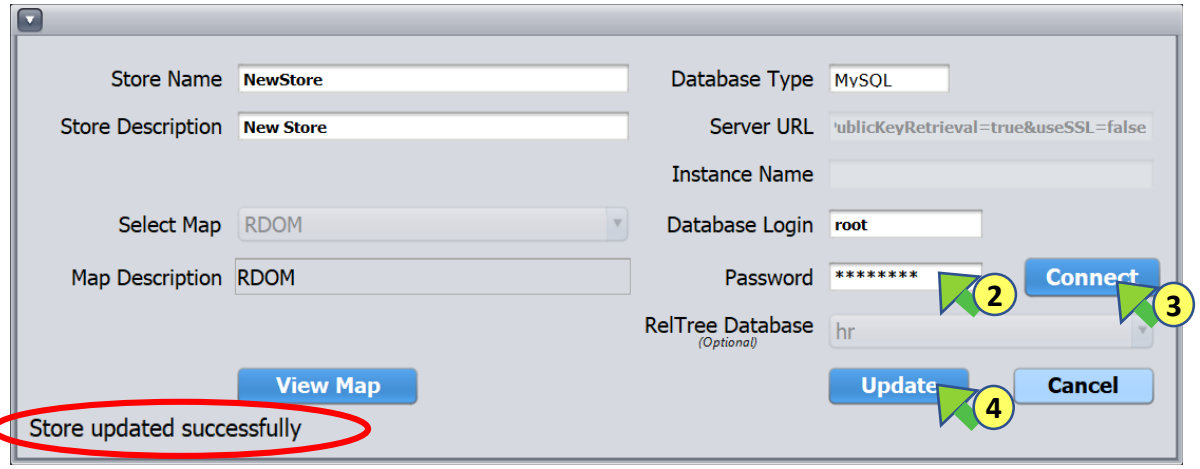
Work with Datasets Open list of dataset/s created by the Selection Run (or Re-Run)

Delete Delete selected Selection and associated analysis and subsets.

Store:

- Update Store.



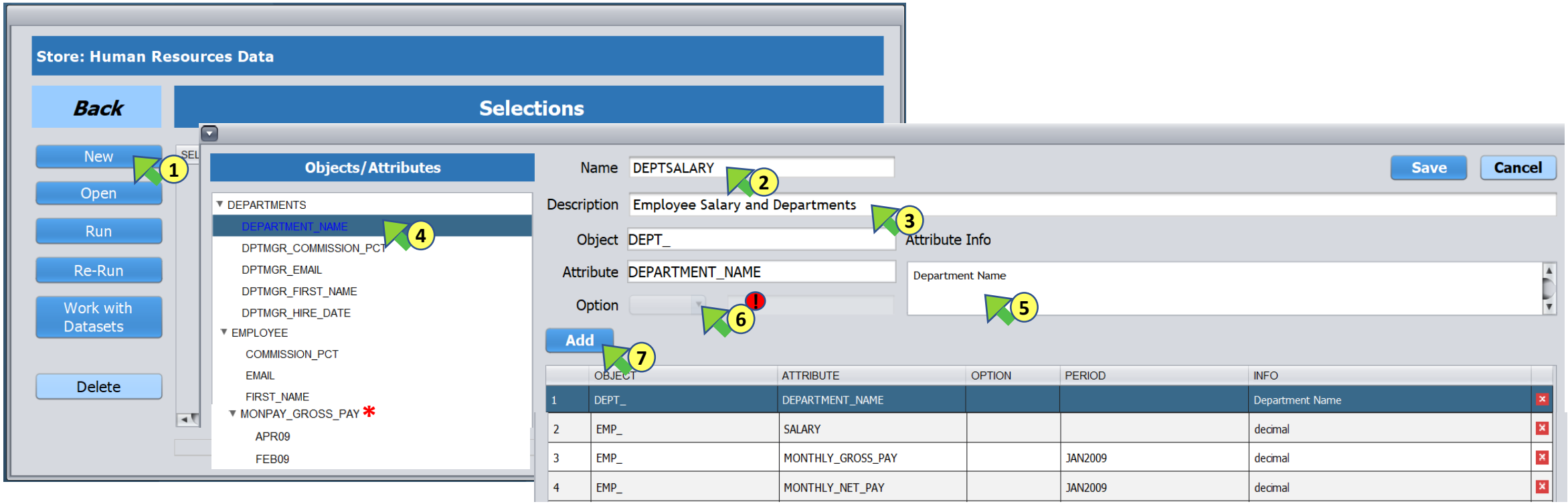


Open	Open selected store.
Update	Update selected store after associated map update.
DORM Studio	Open DORM Studio.
New	Create new store.
Build RelTree	Create/update RelTree tables in RelTree database/schema.
Path Runner	Run PathRunner to update RDOBJ Static tables.
Delete	Delete selected store.
Exit	Exit application.

Store Name	Name of the store.
Store Description	Description of the store.
Select Map	Map associated with the store.
Database Type	Type of the database. (FYI)
Instance Name	MS SQL Server Instance name. (FYI)
RelTree Database	RelTree Database/schema(FYI).
Server URL	Network address of the database.(FYI)
Update	Update Store based on map update/s.
Cancel	Cancel update.

Store:

- Create New Selection: Select attribute/s.



! In case of aperiodic attribute, four options(ALL, CURRENT, ORIGINAL or PICK) will be available to choose from.

* Periodic attributes are shown as <period_type>_<attribute_name) with list of periods as sub-menu.

New — Create new Selection.

Open — Open selected Selection.

Run — Run selected Selection.

Re-Run — Re-Run selected Selection including analysis and subsets.

Work with Datasets — Open the list of dataset/s created by the Selection Run (or Re-Run)

Delete — Delete selected Selection and associated analysis and subsets.

Name — Enter name of the selection.

Description — Enter brief description of the selection.

Object — Object of the selected attribute.

Attribute — Selected attribute.

Option — Select option for aperiodic attribute.

Attribute Info — (optional) Enter additional information about the attribute.

Add — Add selected attribute to selection.

Remove attribute from the selection.

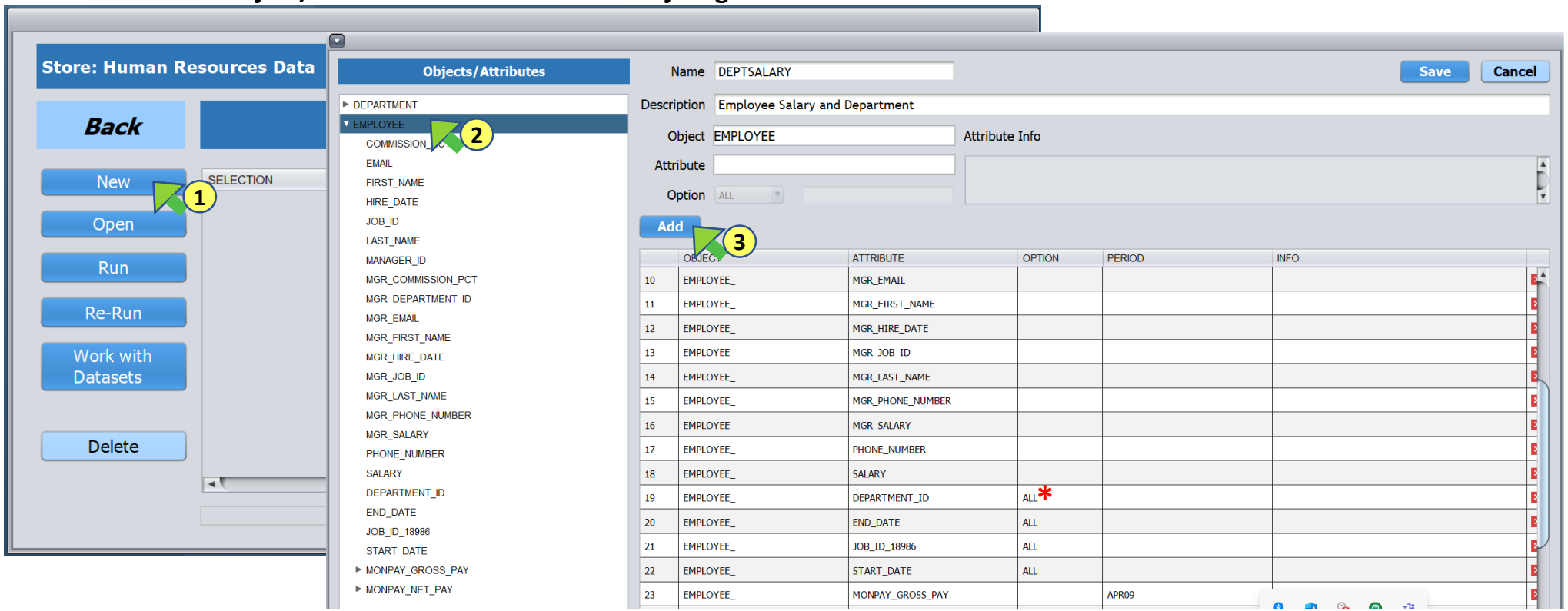
Save — Save the selection.

Close — Close selection interface.

CURRENT: Most recently added instance/s(row/s). For example, CURRENT 2 (i.e. select most recent two instances).
ORIGINAL: Initially added instance/s(row/s). For example, ORIGINAL 3 (i.e. select 1st, 2nd and 3rd instances).
ALL: All instances(rows).
PICK: Specific instance/s (rows). For example, PICK 3 5 (i.e. select 3rd and 5th instances).

Store:

- Create New Selection: Select Object/s. All attributes of selected object gets added to selection.



* All aperiodic attributes get added with 'ALL' option.

New Create new Selection.

Open Open selected Selection.

Run Run selected Selection.

Re-Run Re-Run selected Selection including analysis and subsets.

Work with Datasets Open the list of dataset/s created by the Selection Run (or Re-Run)

Delete Delete selected Selection and associated analysis and subsets.

Name Enter name of the selection.

Description Enter brief description of the selection.

Object Object of the selected attribute.

Attribute Selected attribute.

Option Select option for aperiodic attribute.

Attribute Info (optional) Enter additional information about the attribute.

Add Add selected attribute to selection.

Remove attribute from the selection.

Save Save the selection.

Close Close selection interface.

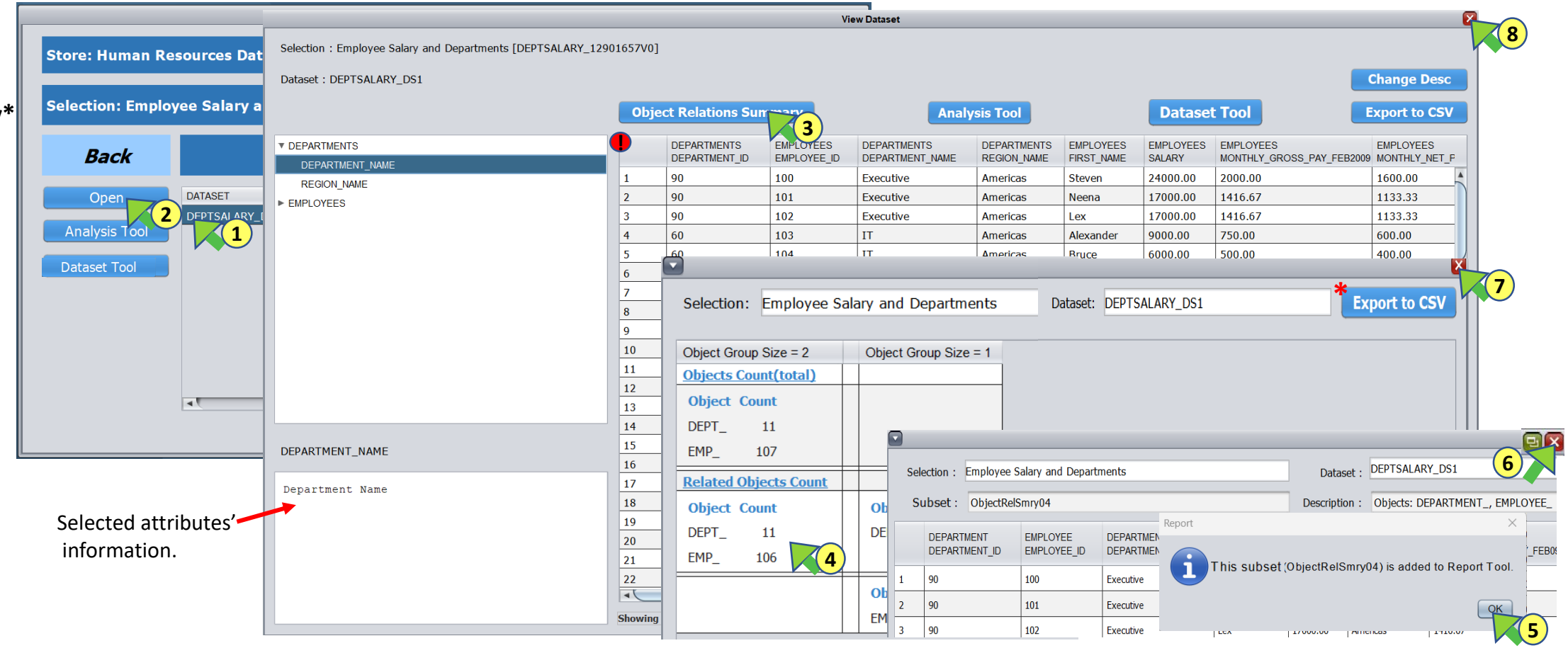
Store:

- Run Selection.

New	Create new Selection.
Open	Open selected Selection.
Run	Run selected Selection.
Re-Run	Re-Run selected Selection including analysis and subsets.
Work with Datasets	Open the list of dataset/s created by the Selection Run (or Re-Run)
Delete	Delete selected Selection and associated analysis and subsets.

Work with Datasets:

- Open Dataset*.
- View Object Relations Summary*



Selected attributes' information.

❗ Table (dataset) includes selected attributes plus data object IDs. Column header includes data-object names at top and attribute names.

Object Relations Summary View data-objects and exclusively related instances' count.

Object Group Size Data-object groups (combinations) in descending order(from left to right columns).

Objects Count(total) Total number of object instances

Related Objects Count Total number of related object instances

Analysis Tool Open Analysis Tool.

Dataset Tool Open Dataset Tool.

Change Desc Change dataset description.

Export to CSV Export dataset as two CSV files. (Data file and Metadata file)

* **Export to CSV** Export relationship summary as CSV file.

View first page (first 1000 rows).

View previous page.

View next page.

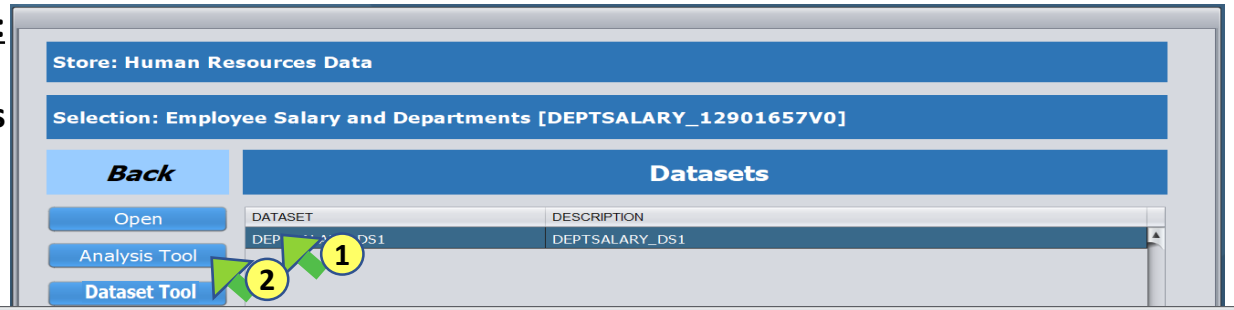
View last page.

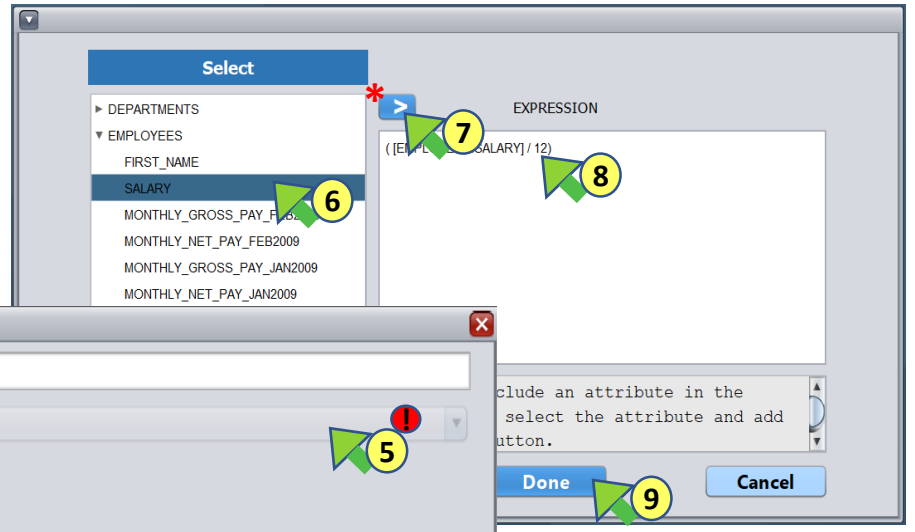
Close window.

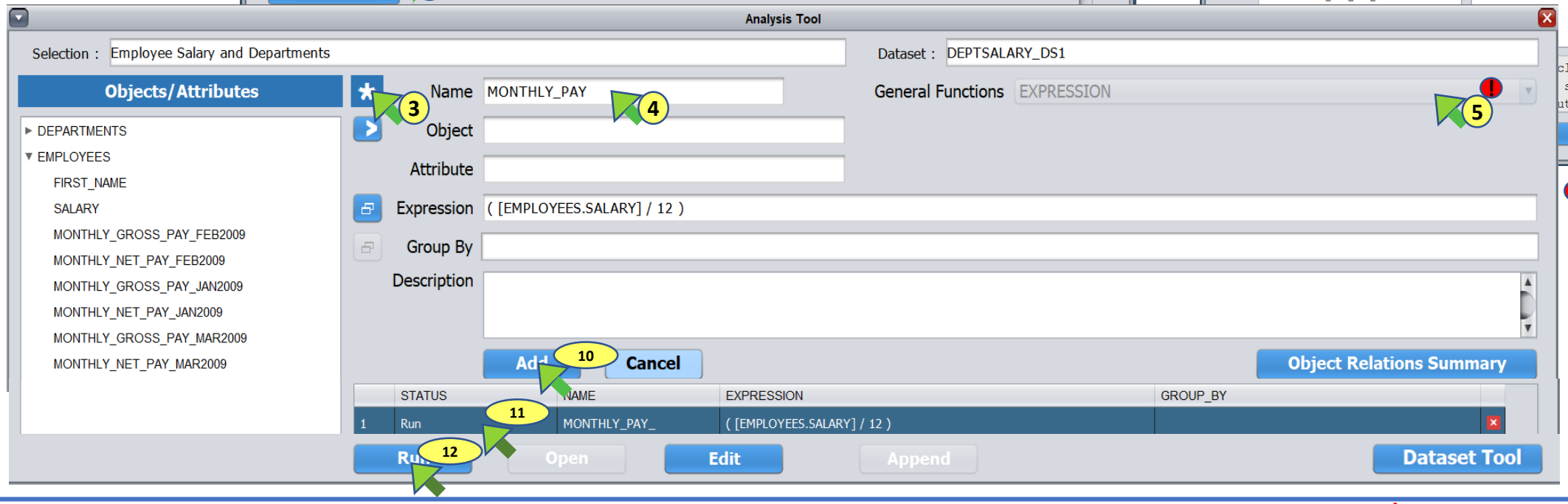
* See 'Appendix-4: Create Dataset' and 'Appendix-5: Object Relations Summary' for details. For metadata details see Metadata section.

Work with Datasets:

- Analysis Tool
  - General Functions
    - EXPRESSION







Select 'EXPRESSION'

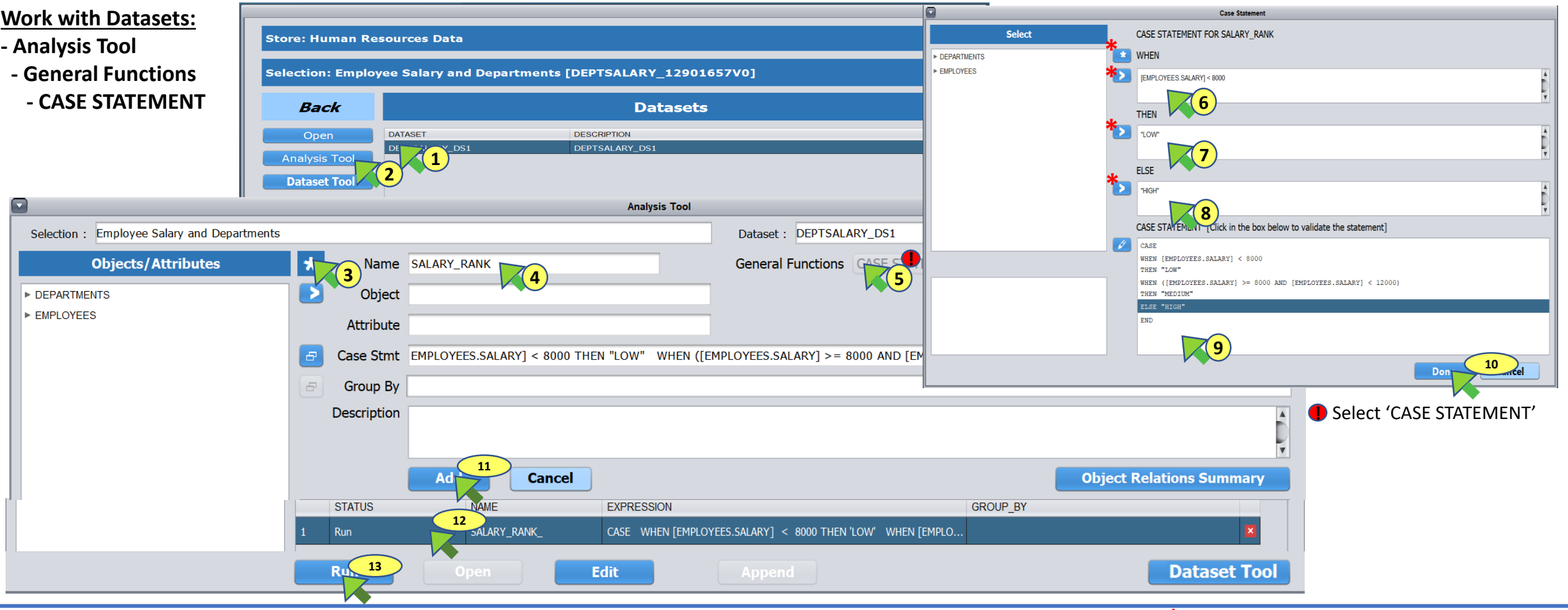
- Create new analysis.
- Name — Enter name.
- General Functions — Select a function.
- Add object/attribute to analysis.
- Object — Selected object.
- Attribute — Selected attribute.
- Expression — Edit expression.
- Group By — Edit Group By.

- Description — Add/Edit analysis description.
- Add — Add analysis to the list.
- Cancel — Cancel entry/edits.
- Run — Run selected analysis.
- Open — Open selected analysis result.
- Edit — Edit selected analysis.
- Append — Append statistic to the dataset.
- Delete selected analysis (in 'Run' or 'Saved' state).

- * Add selected attribute to Expression.
- Done — Finish entry.
- Object Relations Summary — View data-objects and their relations count.
- Dataset Tool — Open Dataset Tool.

Work with Datasets:

- Analysis Tool
  - General Functions
    - CASE STATEMENT



Select 'CASE STATEMENT'

Create new analysis.

Name Enter name.

General Functions Select a function.

Add object/attribute to analysis.

Object Selected object.

Attribute Selected attribute.

Case Stmt Edit Case Statement.

Group By Edit Group By.

Description Add/Edit analysis description.

Add Add analysis to the list.

Cancel Cancel entry/edits.

Run Run selected analysis.

Open Open selected analysis result.

Edit Edit selected analysis.

Append Append statistic to the dataset.

Delete selected analysis (in 'Run' or 'Saved' state).

* Add selected attribute to statement.

* Add a WHEN/THEN clause.

Edit selected clause (i.e. from statement)

Done Finish entry.

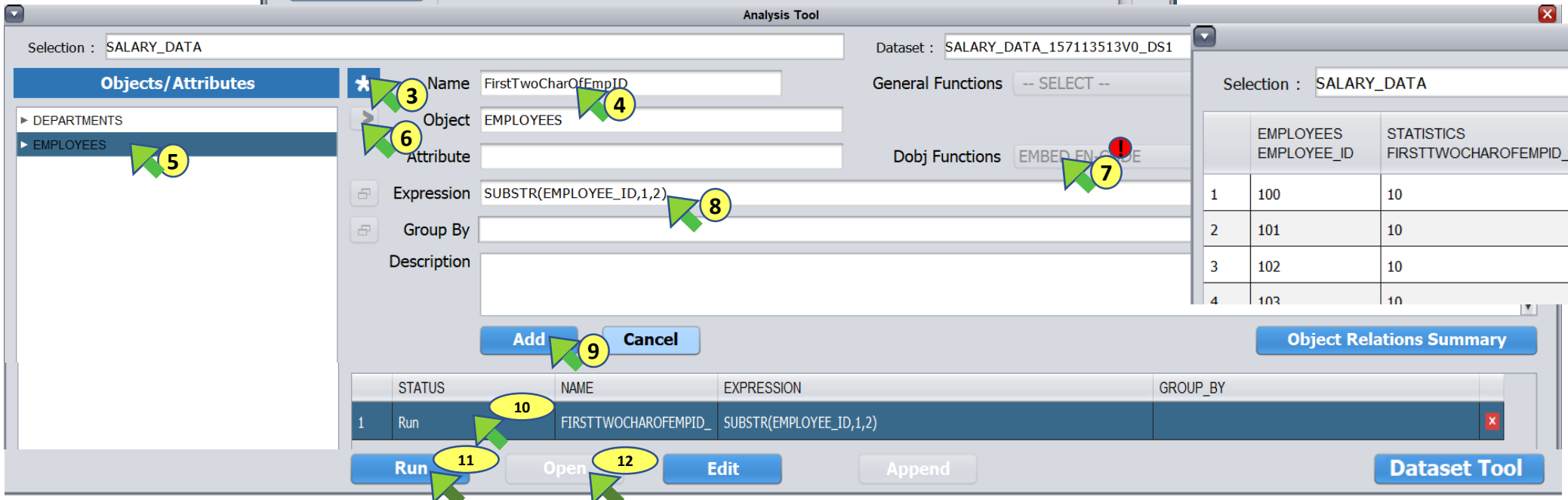
Object Relations Summary View data-objects and their relations count.

Dataset Tool Open Dataset Tool.

Work with Datasets:

- Analysis Tool
  - Dobj Functions
    - EMBED FN-CODE

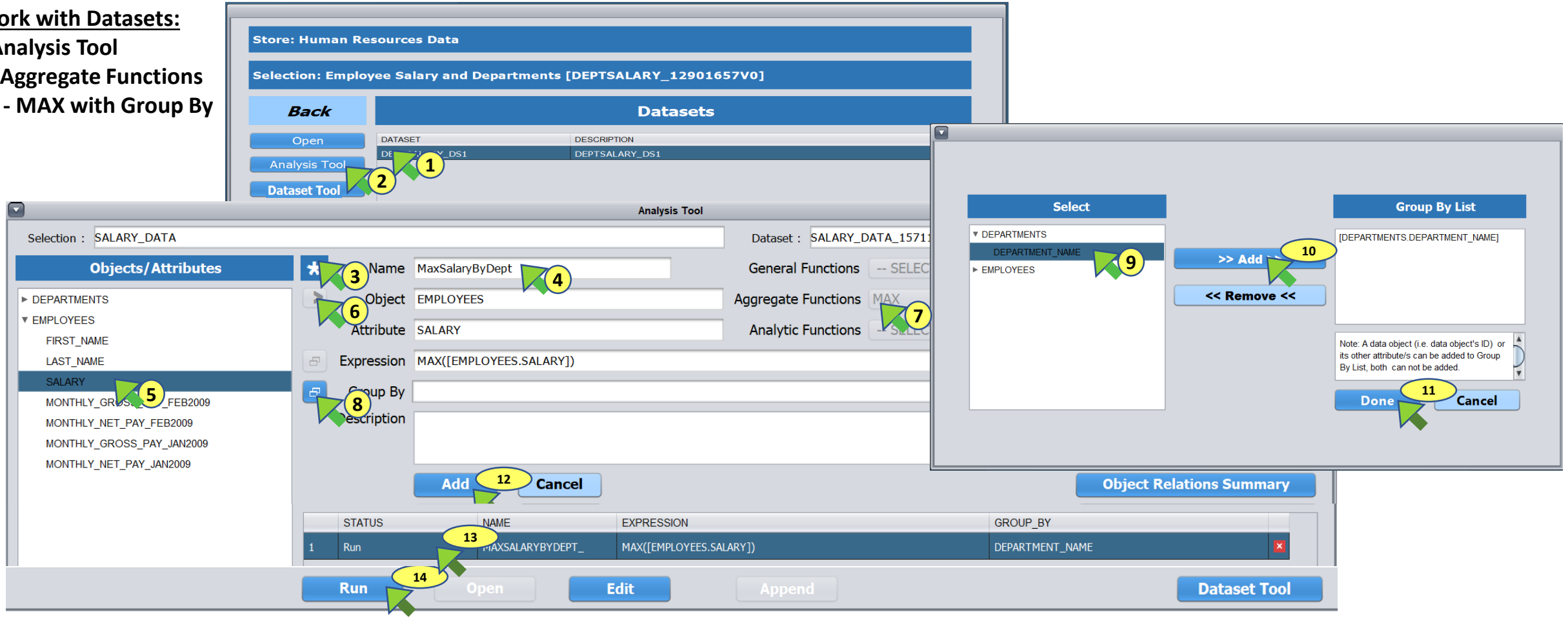
Select 'EMBED FN-CODE'



- ✱ Create new analysis.
- Name Enter name.
- Dobj Functions Select a function.
- > Add object/attribute to analysis.
- Object Selected object.
- Attribute Selected attribute.
- Group By Edit Group By.
- Description Add/Edit analysis description.
- Add Add analysis to the list.
- Cancel Cancel entry/edits.
- Run Run selected analysis.
- Open Open selected analysis result.
- Edit Edit selected analysis.
- Append Append statistic to the dataset.
- ✕ Delete selected analysis (in 'Run' or 'Saved' state).
- Object Relations Summary View data-objects and their relations count.
- Dataset Tool Open Dataset Tool.

Work with Datasets:

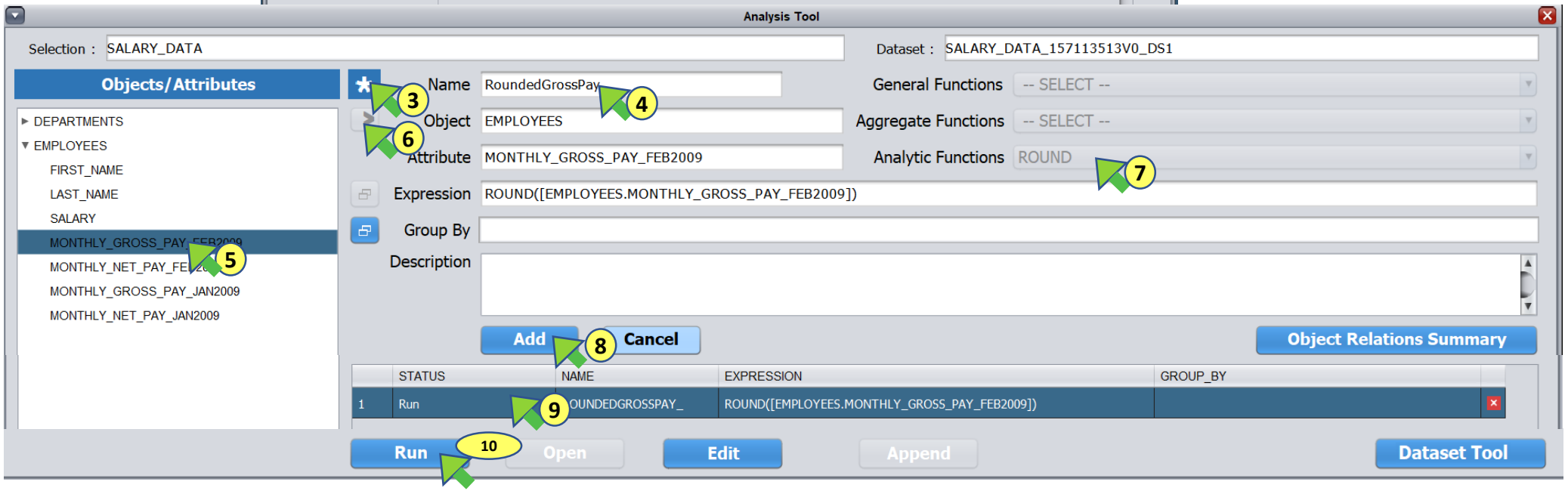
- Analysis Tool
  - Aggregate Functions
    - MAX with Group By



- ✱ Create new analysis.
- Name Enter name.
- Dobj Functions Select a function.
- > Add object/attribute to analysis.
- Object Selected object.
- Attribute Selected attribute.
- Group By Edit Group By.
- Description Add/Edit analysis description.
- Add Add analysis to the list.
- Cancel Cancel entry/edits.
- Run Run selected analysis.
- Open Open selected analysis result.
- Edit Edit selected analysis.
- Append Append statistic to the dataset.
- ✕ Delete selected analysis (in 'Run' or 'Saved' state).
- Object Relations Summary View data-objects and their relations count.
- Dataset Tool Open Dataset Tool.

Work with Datasets:

- Analysis Tool
  - Analytic Functions
    - ROUND



Create new analysis.

Name Enter name.

Dobj Functions Select a function.

Add object/attribute to analysis.

Object Selected object.

Attribute Selected attribute.

Description Add/Edit analysis description.

Add Add analysis to the list.

Cancel Cancel entry/edits.

Run Run selected analysis.

Open Open selected analysis result.

Edit Edit selected analysis.

Append Append statistic to the dataset.

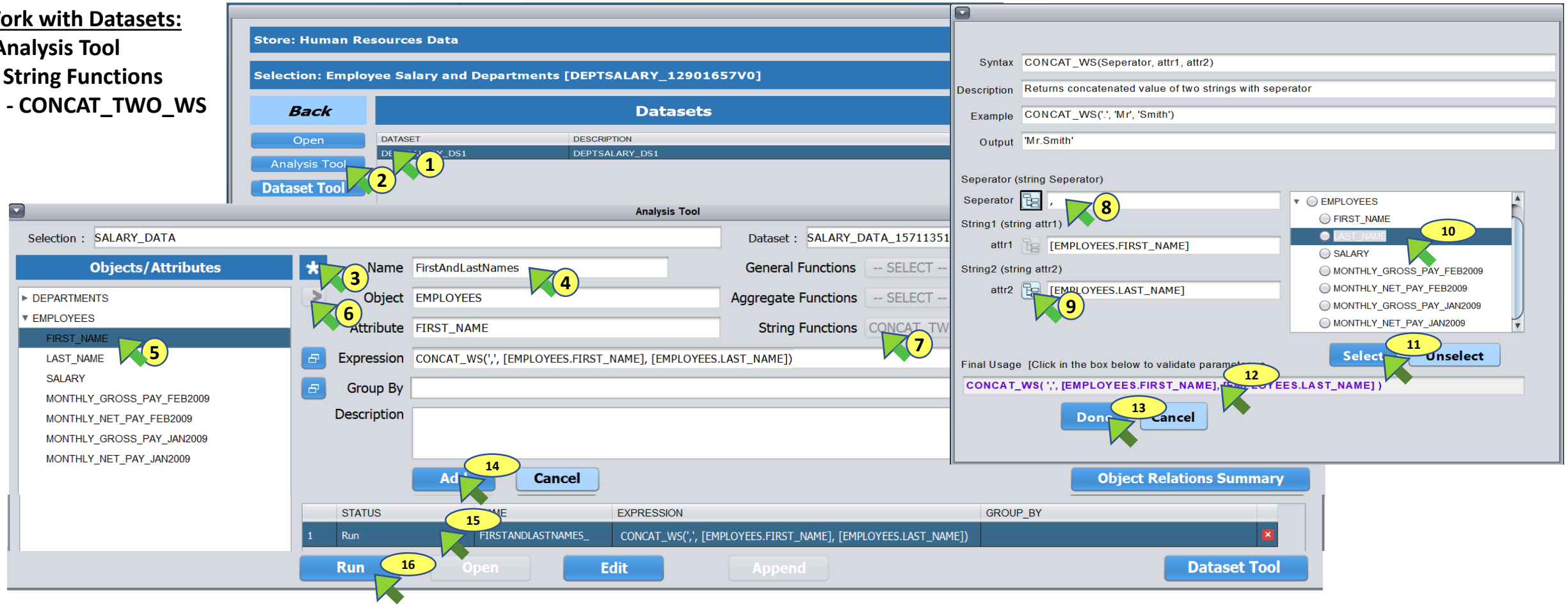
Delete selected analysis (in 'Run' or 'Saved' state).

Object Relations Summary View data-objects and their relations count.

Dataset Tool Open Dataset Tool.

Work with Datasets:

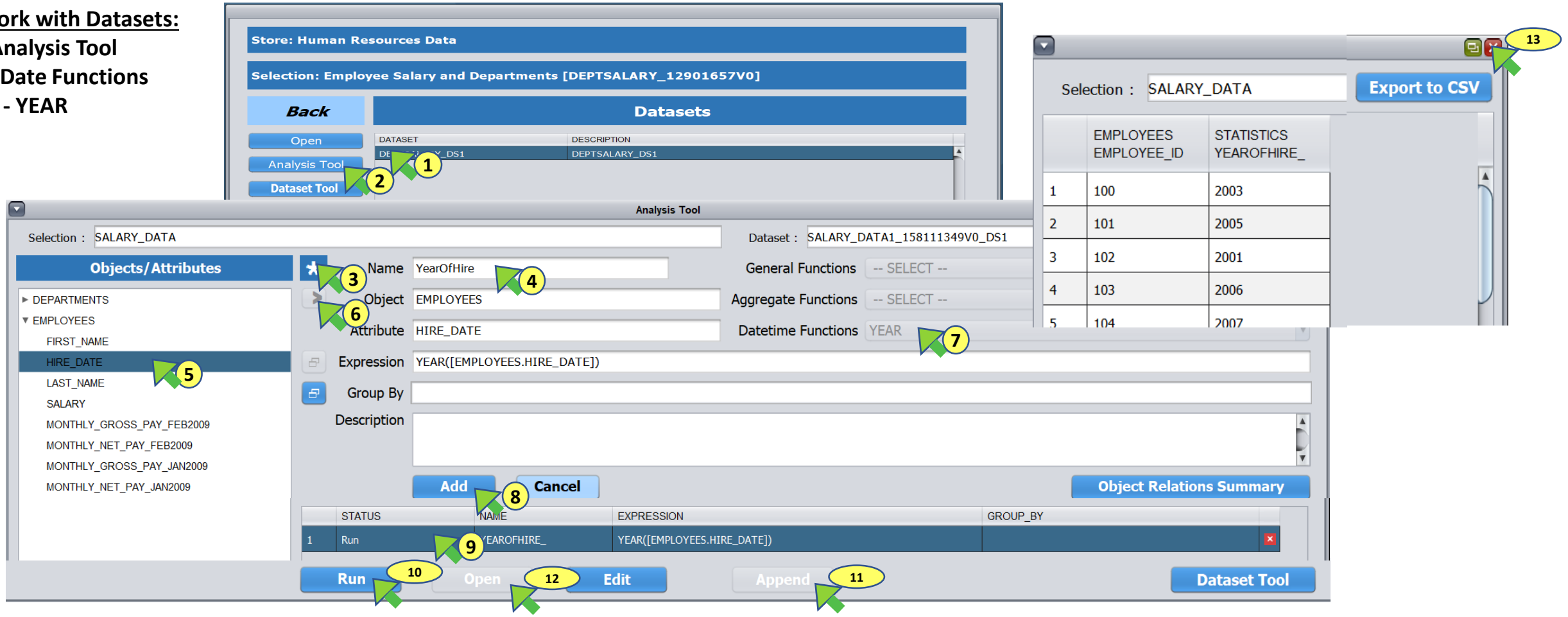
- Analysis Tool
  - String Functions
    - CONCAT_TWO_WS



- ✱ Create new analysis.
- Name Enter name.
- Dobj Functions Select a function.
- > Add object/attribute to analysis.
- Object Selected object.
- Attribute Selected attribute.
- Group By Edit Group By.
- Description Add/Edit analysis description.
- Add Add analysis to the list.
- Cancel Cancel entry/edits.
- Run Run selected analysis.
- Open Open selected analysis result.
- Edit Edit selected analysis.
- Append Append statistic to the dataset.
- ✕ Delete selected analysis (in 'Run' or 'Saved' state).
- Object Relations Summary View data-objects and their relations count.
- Dataset Tool Open Dataset Tool.

Work with Datasets:

- Analysis Tool
  - Date Functions
    - YEAR



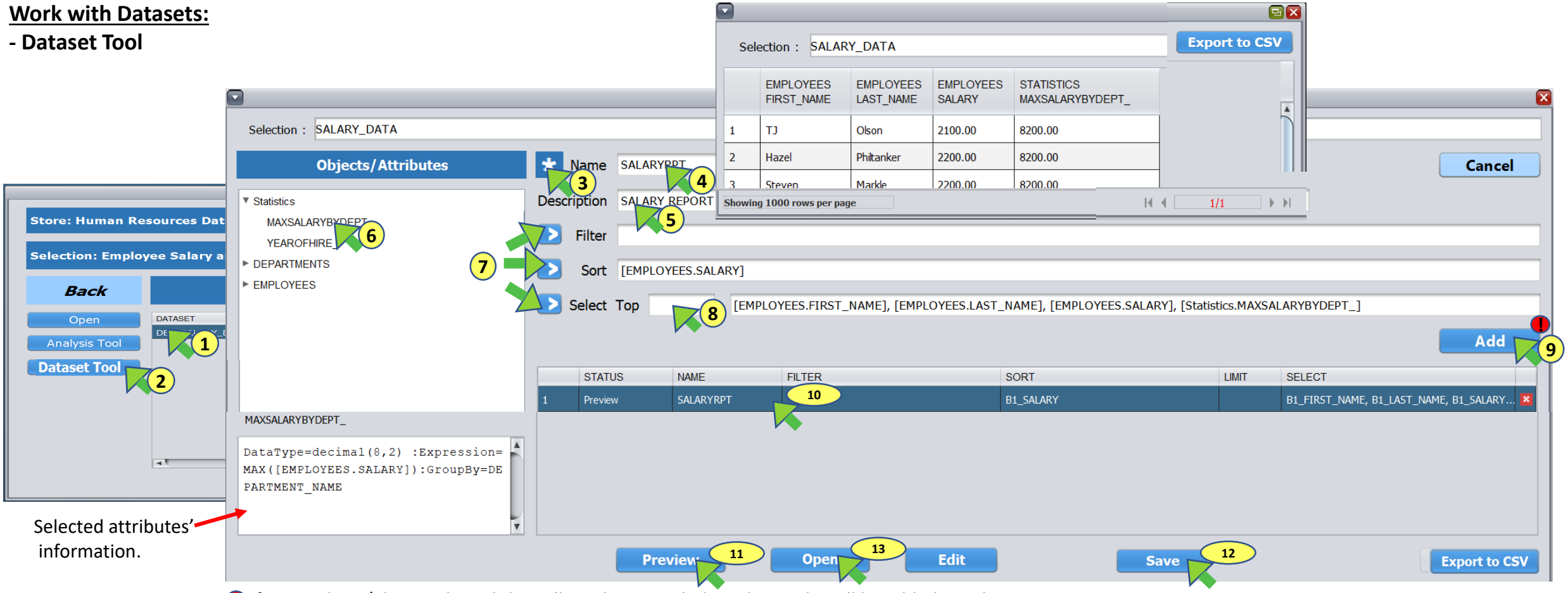
- ✱ Create new analysis.
- Name Enter name.
- Dobj Functions Select a function.
- > Add object/attribute to analysis.
- Object Selected object.
- Attribute Selected attribute.

- Description Add/Edit analysis description.
- Add Add analysis to the list.
- Cancel Cancel entry/edits.
- Run Run selected analysis.
- Open Open selected analysis result.
- Edit Edit selected analysis.
- Append Append statistic to the dataset.
- ✕ Delete selected analysis (in 'Run' or 'Saved' state).

- Object Relations Summary View data-objects and their relations count.
- Dataset Tool Open Dataset Tool.

Work with Datasets:

- Dataset Tool



Selected attributes' information.

❗ If no attribute/object selected then all attributes, including object-ids, will be added to selection.

- ✱ Create new subset.
- Name Enter name.
- Description Add/Edit subset description.
- Filter Add object/attribute to WHERE clause.
- Sort Add object/attribute to ORDER BY clause.
- Select Add object/attribute to SELECT clause.
- Top Enter number of rows to limit the subset.

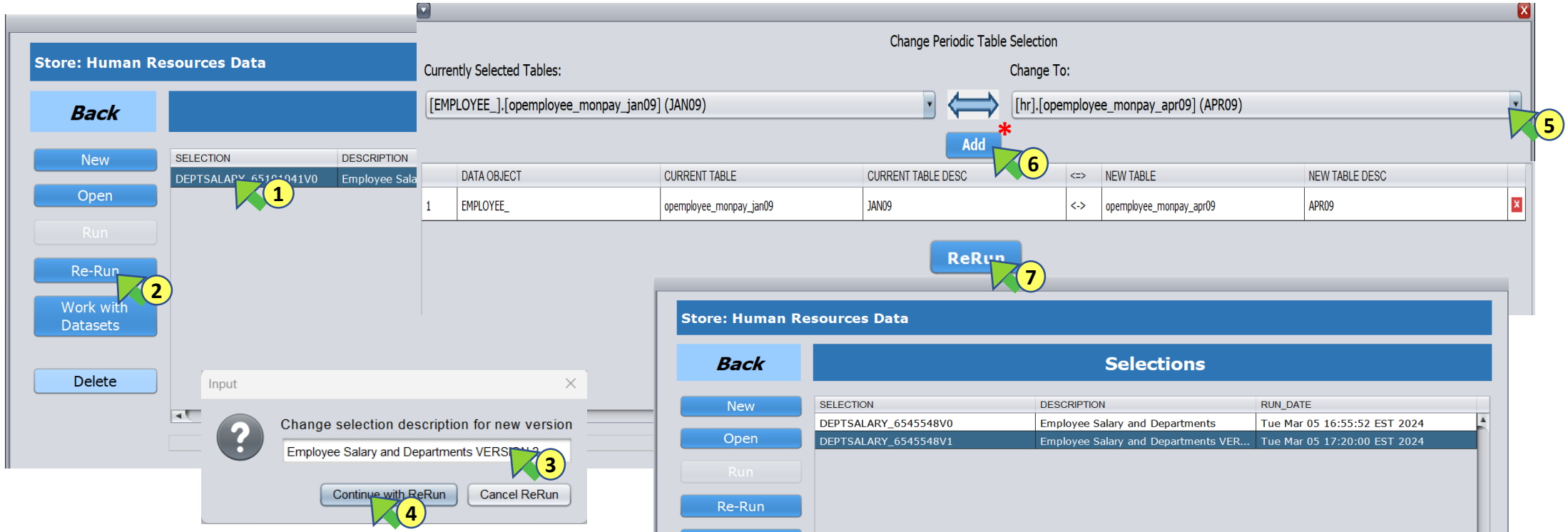
- Add Add subset definition to the list.
- Cancel Cancel entry/edits.
- ✖ Delete selected subset.
- Preview Preview selected subset.
- Edit Edit selected subset (in Preview state).
- Save Save selected subset as database table.
- Open Open selected (Saved) subset.

- Export to CSV Export selected (Saved) subset to CSV files.
- ⏮ View first page (first 1000 rows).
- ◀ View previous page.
- ▶ View next page.
- ⏭ View last page.
- ✖ Close window.

Store:

- Re-Run Selection.

(i.e. re-create dataset/s, run and append statistics; and re-create subset/s)



* (Optionally) change selected periodic table/s to different periodic table/s of the same type. The Re-Run will use the newly selected table/s, in place of originally selected tables, in creating dataset/s and subsequently in analysis as well as subset creation.
Note: Prompt to change periodic table/s selection will only appear if periodic attribute/s were in original selection.

New	Create new Selection.
Open	Open selected Selection.
Run	Run selected Selection.
Re-Run	Re-Run selected Selection including analysis and subsets.
Work with Datasets	Open the list of dataset/s created by the Selection Run (or Re-Run)
Delete	Delete selected Selection and associated analysis and subsets.

Dataset Metadata: Each dataset is created with two tables, a data table and a metadata table. Dataset table name/s are **<selection>_DS<num>**. Metadata table name/s are **<selection>_DS<num>_DM**. Following table contains metadata table's column names and descriptions. Metadata for appended statistic is identified by ATTR_DOBJ column's value of 'STATDOBJ'.

Name	Description	STATISTIC Description*
IQ_ATTR_NAME	Column name in dataset's table	Column name in dataset's table
RESULTSET	Dataset's table name	Dataset's table name
ATTR_DB	Database/schema of the selection attribute(column)	'STAT_DB'
ATTR_TABLE	Table of the selection attribute(column)	'STAT_TBL'
ATTR_DBTYPE	Data type of the selection attribute(column)	Data type of the statistic attribute(column)
ATTR_DOBJ	Data-object of the selection attribute	'STATDOBJ'
ATTR_DOBJ_DESC	Data-object description of the selection attribute	'Statistics'
ATTR_CATGRY	Selection attribute category (i.e. Static, Aperiodic or Periodic). Null if ID attribute.	'S'
ATTR_NAME	Selection attribute name (i.e. column name). Look-up value if LKPRNG_ATTR not NULL	Data-object/s of selection attribute/s included in the statistic's formula
ATTR_DESC	Selection attribute description. Look-Up or Range attribute description if LKPRNG_ATTR not NULL	Column name in dataset(table)
C_CATGRY_OCAP_OPTION	For selection attribute category = 'C' or 'RC' (i.e. DOBJ or R-DOBJ Aperiodic attribute)	NULL
SEQ_NUM	For selection attribute category = 'C' or 'RC' instance update sequence number.	NULL
P_CATGRY_TABLE_DESC	For selection attribute category = 'P' or 'RP' (i.e. DOBJ or R-DOBJ Periodic attribute)	NULL
LKPRNG_ATTR	Look-Up or Range attribute (column)	NULL
LKPRNG_DB	Database of the Look-Up or Range attribute	NULL
LKPRNG_TABLE	Table of the Look-Up or Range attribute	NULL
LKPRNG_ATTR_DBTYPE	Data type of the Look-Up or Range attribute	NULL
ATTR_AUX_META	I = ID Attribute, L = Look-Up attribute, R = Range attribute	ID attribute/s of the data-object/s included in the statistic's formula
ATTR_AUX_INFO	Additional selection attribute information added by user. Otherwise attribute(column) data type.	Statistic type, formula, Group By (if any) of the statistic
FROM_DOBJ	Dobj1 of the selection attribute, if ATTR_CATGRY = 'R','RC','RP' otherwise data-object of the attribute	NULL
TO_DOBJ	Dobj2 of the selection attribute, if ATTR_CATGRY = 'R','RC','RP' otherwise data-object of the attribute	NULL
VIEW_ID	NULL	NULL

* If ATTR_DOBJ = 'STATDOBJ' (i.e. Metadata for appended statistics)

Statistic Metadata: Statistic table does not get created with metadata table. When a statistic table is exported, a metadata file is created together with statistic data file in CSV format. Statistic table (and exported data file) name is **<selection>_DS<num>_AN<num>**. Statistic metadata file name is **<selection>_DS<num>_AN<num>_ANMETA.csv.** Statistic metadata file contains one row for the statistic metadata and rows for dataset metadata for the other attributes of statistic table. Following table contains statistic metadata file columns and descriptions.

Name	Description
QINST_ID	Selection name
RESULTSET	Dataset(table) name
ANID	Statistic table name
STATUS	Statistic status in Analysis Tool (i.e. 'Saved' or 'Appended')
STATISTIC	Statistical function name
NAME	Statistic attribute name
DESC	NULL
DOBJATTR	Selected attribute (or NULL if General Function is selected)
GROUPBY	Group By attribute/s.
EXPRESSION	Syntactical expression
ANSQL	SQL statement to create statistic table
DSSQL	SQL statement to create dataset(table) input to compute the statistic. (experimental metadata, not generated for all statistics)
APNDSQL	SQL statement to append statistic (column) to dataset.
ANLEVEL	(For internal use)
USERDB	NULL
SSID	NULL
SSRMID	NULL
DOBJS	Data objects of the attributes included in the statistic
DOBJIDS	Data objects IDs of the attributes included in the statistic
ATTRLIST	Attributes included in the statistic
USEREXPR	Syntactical user expression (i.e. attributes expressed as '[<data-object>.<attribute>]')
COMPEXPR	Syntactical user expression in case of complex syntax. Parameters expressed as '{<name> = <value>}'
VIEW_ID	NULL

Subset Metadata: Each saved subset is created with a data and a metadata tables. Subset table name/s are **<selection>_DS<num>_RP<num>**. Metadata table name/s are **<selection>_DS<num>_RP<num>_DM**. Metadata for appended statistic is identified by ATTR_DOBJ column's value of 'STATDOBJ'. Following table contains metadata table column names and descriptions.

Name	Description	STATISTIC Description*
IQ_ATTR_NAME	Column name in dataset's table	Column name in dataset's table
RESULTSET	Dataset's table name	Dataset's table name
ATTR_DB	Database/schema of the selection attribute(column)	'STAT_DB'
ATTR_TABLE	Table of the selection attribute(column)	'STAT_TBL'
ATTR_DBTYPE	Data type of the selection attribute(column)	Data type of the statistic attribute(column)
ATTR_DOBJ	Data-object of the selection attribute	'STATDOBJ'
ATTR_DOBJ_DESC	Data-object description of the selection attribute	'Statistics'
ATTR_CATGRY	Selection attribute category (i.e. Static, Aperiodic or Periodic). Null if ID attribute.	'S'
ATTR_NAME	Selection attribute name (i.e. column name). Look-up value if LKPRNG_ATTR not NULL	Data-object/s of selection attribute/s included in the statistic's formula
ATTR_DESC	Selection attribute description. Look-Up or Range attribute description if LKPRNG_ATTR not NULL	Column name in dataset(table)
C_CATGRY_OCAP_OPTION	For selection attribute category = 'C' or 'RC' (i.e. DOBJ or R-DOBJ Aperiodic attribute)	NULL
SEQ_NUM	For selection attribute category = 'C' or 'RC' instance update sequence number.	NULL
P_CATGRY_TABLE_DESC	For selection attribute category = 'P' or 'RP' (i.e. DOBJ or R-DOBJ Periodic attribute)	NULL
LKPRNG_ATTR	Look-Up or Range attribute (column)	NULL
LKPRNG_DB	Database of the Look-Up or Range attribute	NULL
LKPRNG_TABLE	Table of the Look-Up or Range attribute	NULL
LKPRNG_ATTR_DBTYPE	Data type of the Look-Up or Range attribute	NULL
ATTR_AUX_META	I = ID Attribute, L = Look-Up attribute, R = Range attribute	ID attribute/s of the data-object/s included in the statistic's formula
ATTR_AUX_INFO	Additional selection attribute information added by user. Otherwise attribute(column) data type.	Statistic type, formula, Group By (if any) of the statistic
FROM_DOBJ	Dobj1 of the selection attribute, if ATTR_CATGRY = 'R','RC','RP' otherwise data-object of the attribute	NULL
TO_DOBJ	Dobj2 of the selection attribute, if ATTR_CATGRY = 'R','RC','RP' otherwise data-object of the attribute	NULL
VIEW_ID	NULL	NULL
RP_ID	Subset's table name	Subset's table name
RP_NAME	Subset name	Subset name
RP_DESC	Subset description	Subset description

* If ATTR_DOBJ = 'STATDOBJ' (i.e. Metadata for appended statistics)

Appendix:

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, Rdobj2-4, RDobj4-1 and RDobj3-4.

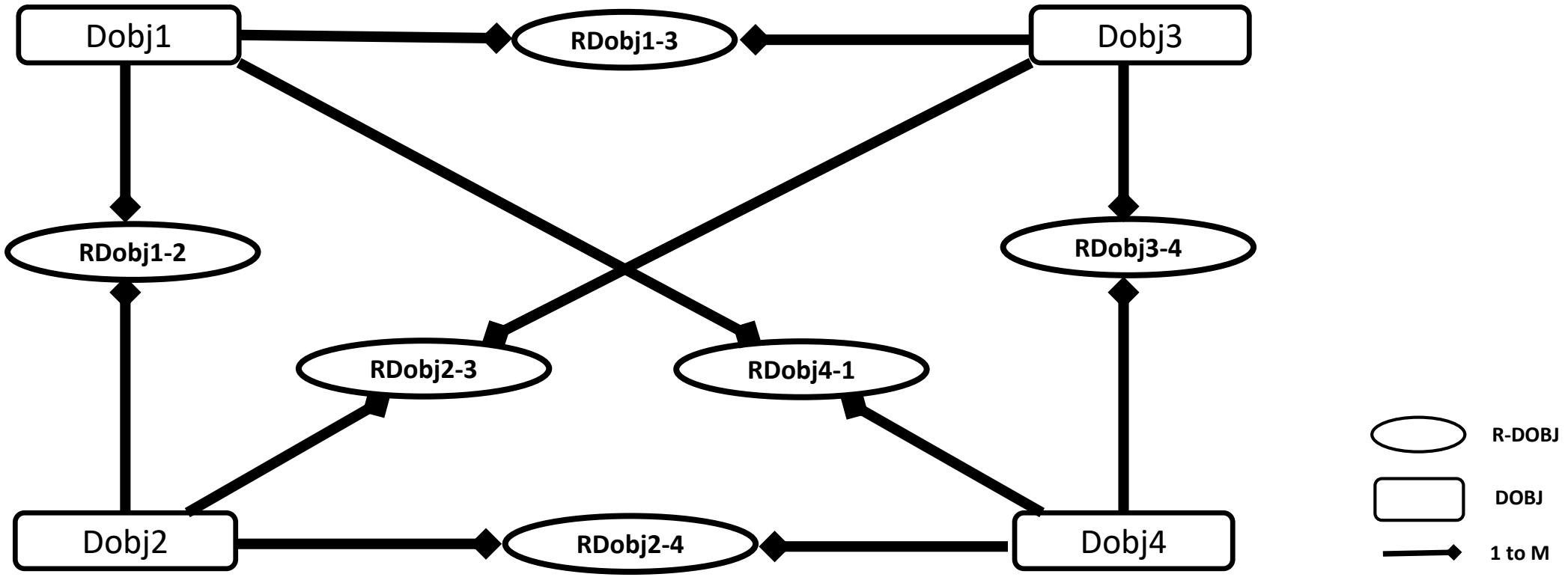


Fig. 1

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 recorded periodically – 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.

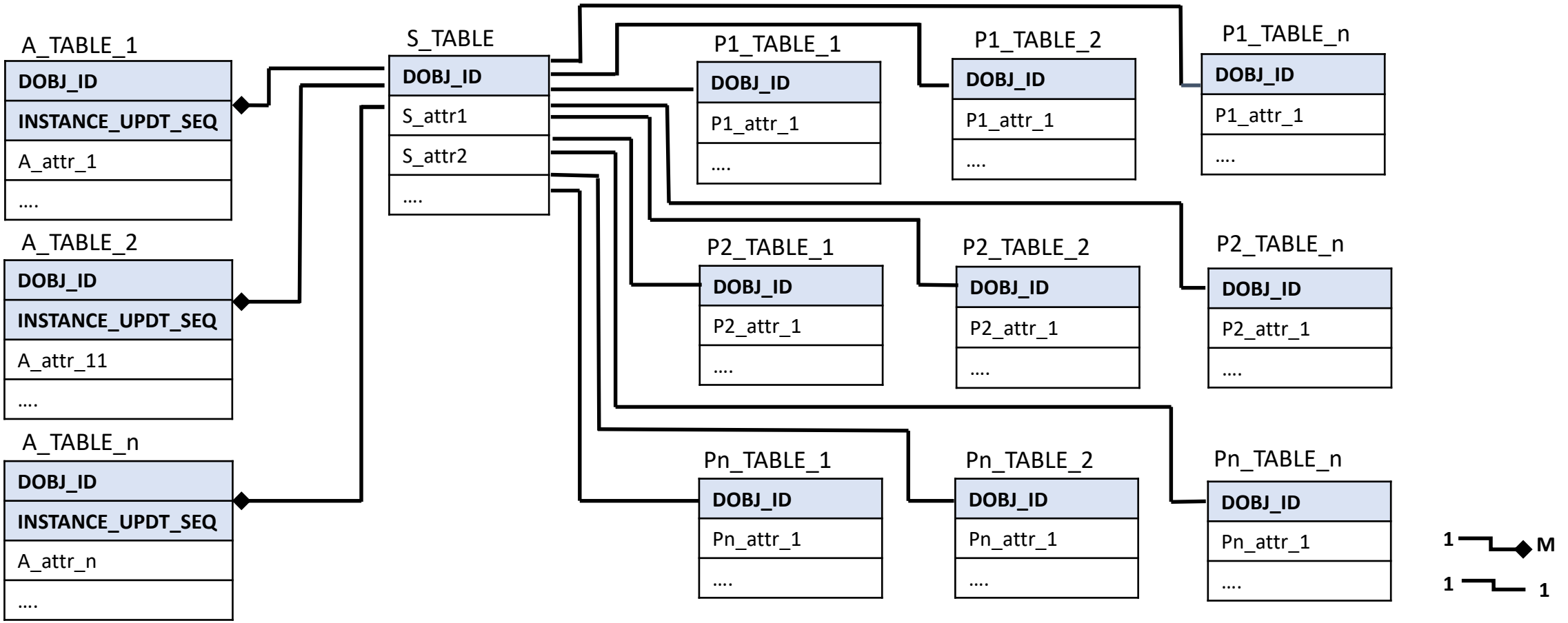


Fig. 2

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.

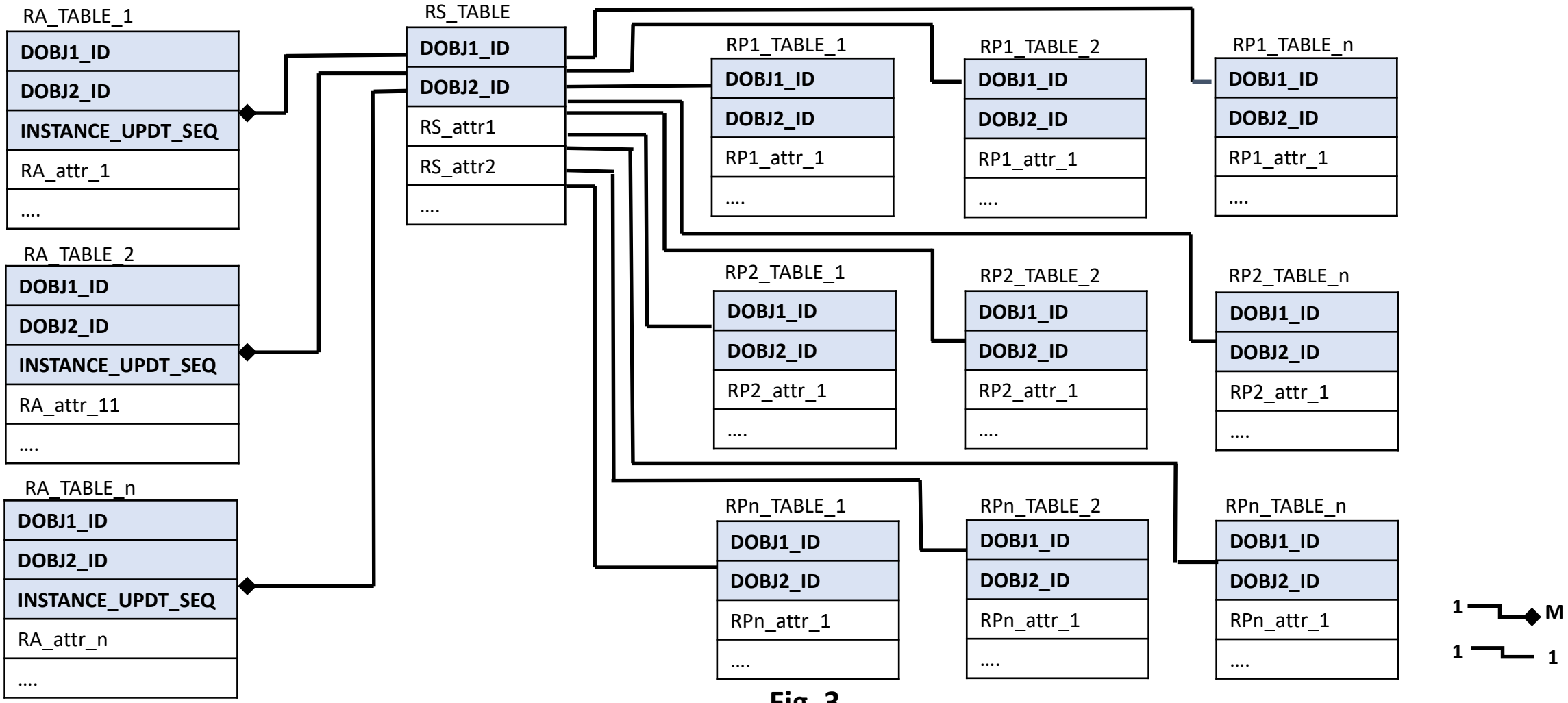


Fig. 3

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.

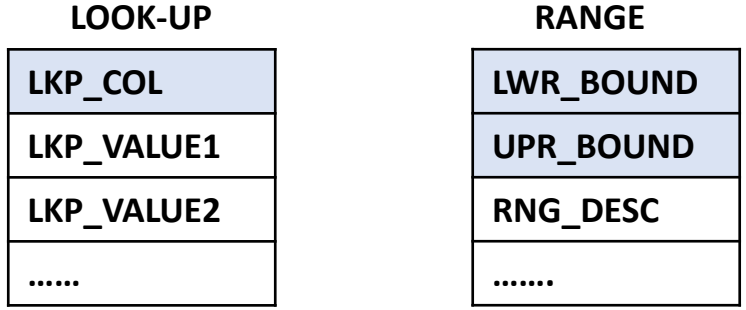


Fig. 4

- 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 exists 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 exists 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 exists in DOBJ1_ID and DOBJ2_ID columns of Static table.

RDOM as Super Model

In practice, it may be required that existing relational database structure is kept as it is . In such cases, RDOM can 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 together 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.

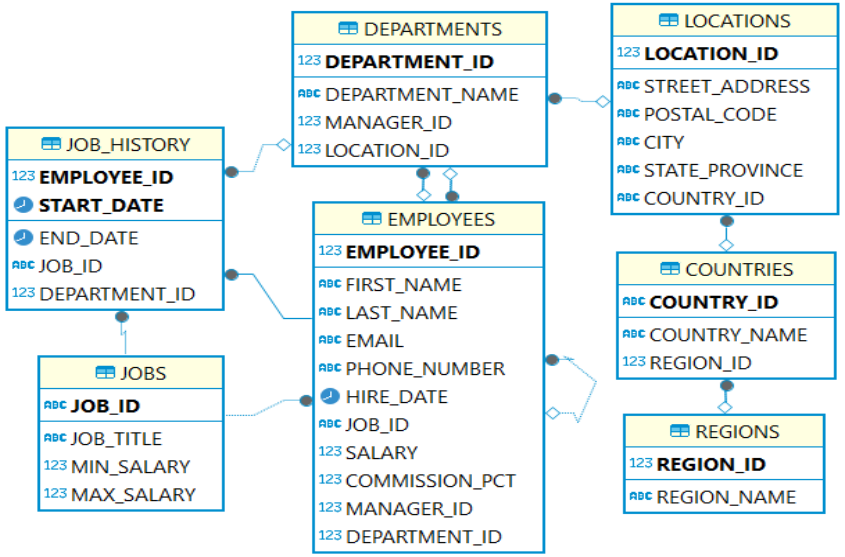


Fig. 5

Example (continued)

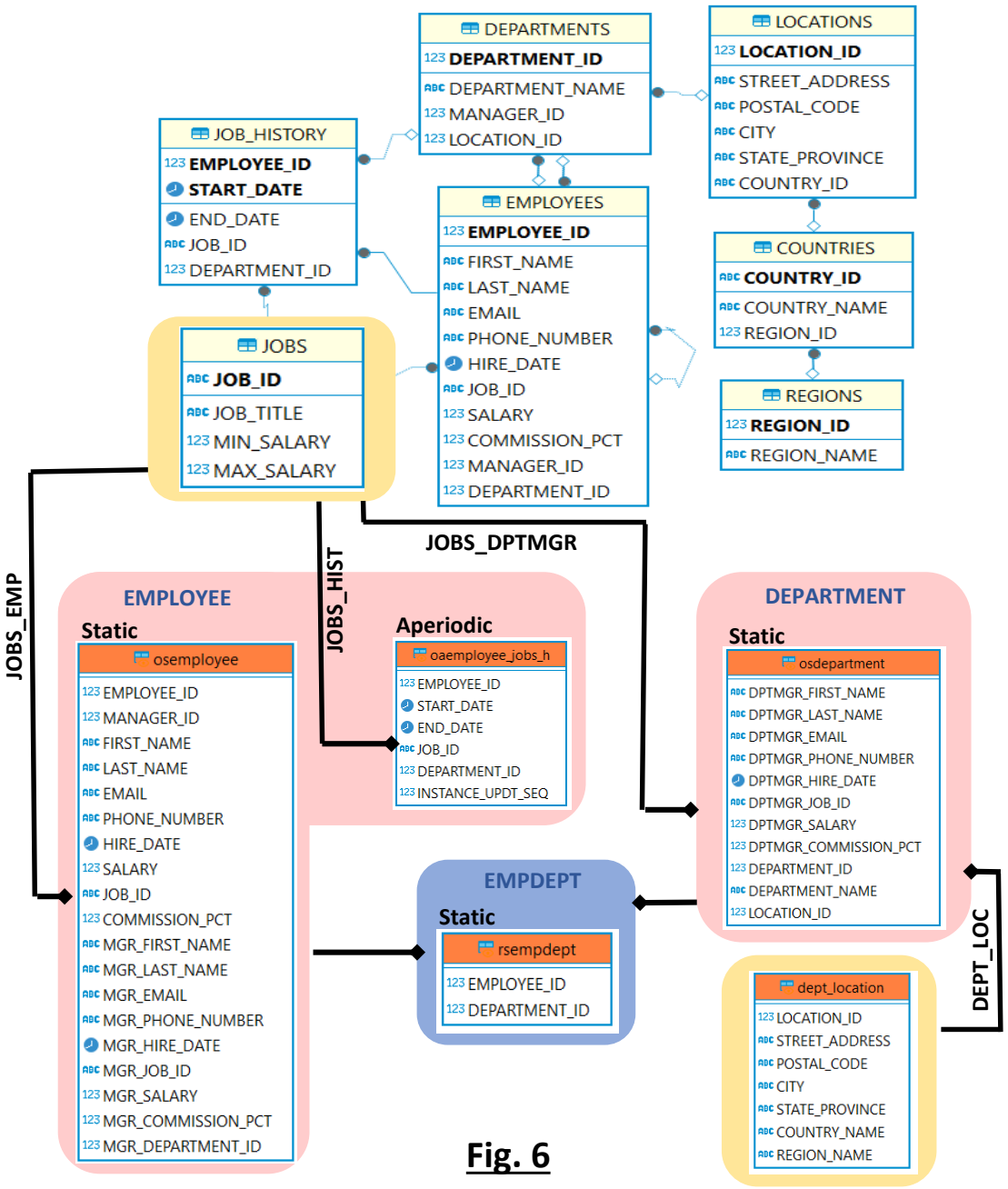


Fig. 6

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.

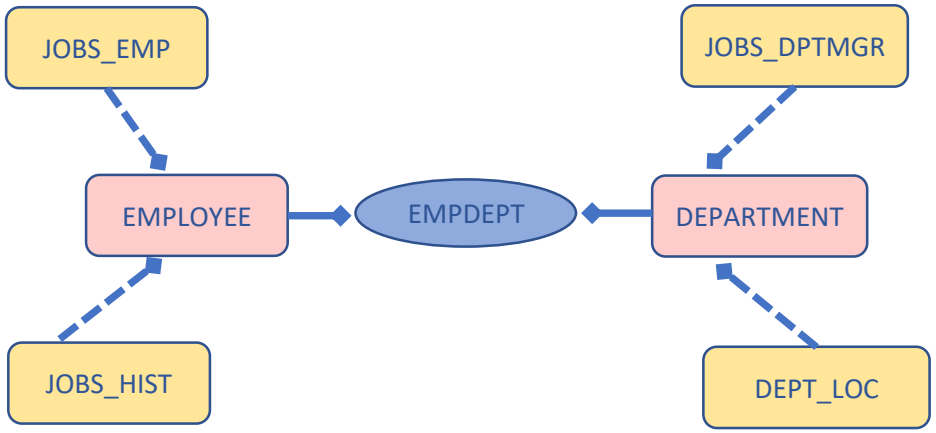


Fig. 6(a) RDOM diagram

Appendix-2:

Build RelTree:

The process of creating dataset/s of selected attributes is of two steps. First, corresponding SQL UNIONs of SQL JOINs of ID attribute columns of Static attribute tables of all combinations, from largest to smallest, of RDOBJs and DOBJs is created; than with that result set (of IDs) selected DOBJs are LEFT JOINed. The result set created from first step is called RelTree (Relation Tree). In a scenario where the database is updated periodically, for all combinations of related objects RelTree tables can be pre-built after every database update. This way for every instance of dataset creation, only second step will need to be performed. In short, pre-built RelTree tables enhances efficiency of dataset creation.

Example: Two attributes of OBJ_A, one attribute of OBJ_B and two attributes of OBJ_D are selected. When the selection is ran the application used pre-built RelTree table (Fig.2 encircled in red) and LEFT JOINed it with each of the three data objects with their selected attributes.

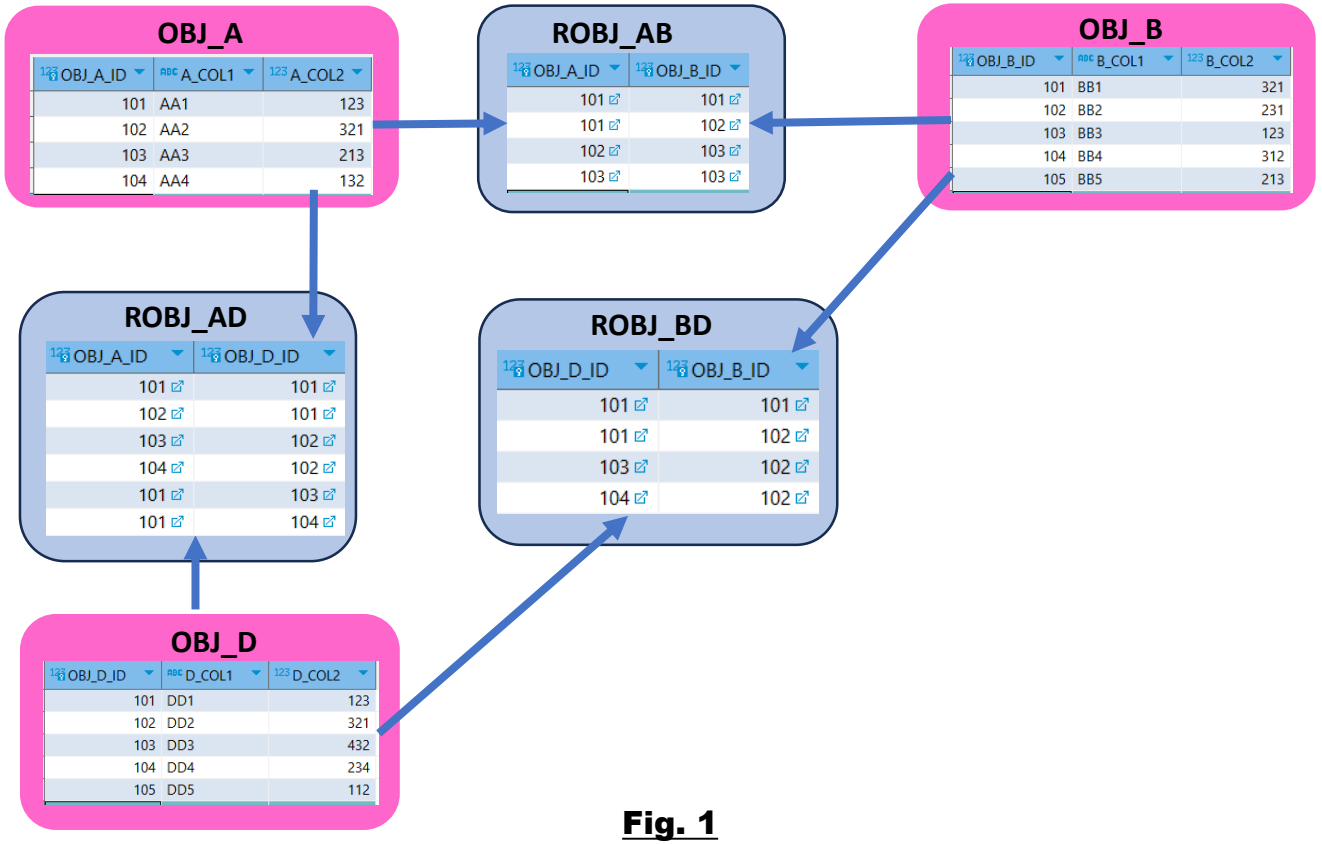


Fig. 1

	OBJ_A OBJ_A_ID	OBJ_B OBJ_B_ID	OBJ_D OBJ_D_ID	OBJ_A A_COL1	OBJ_A A_COL2	OBJ_B B_COL1	OBJ_D D_COL1	OBJ_D D_COL2
1	101	101	101	AA1	123	BB1	DD1	123
2	101	102	101	AA1	123	BB2	DD1	123
3	101	102	103	AA1	123	BB2	DD3	432
4	101	102	104	AA1	123	BB2	DD4	234
5	102	103		AA2	321	BB3		
6	103	103		AA3	213	BB3		
7	102		101	AA2	321		DD1	123
8	103		102	AA3	213		DD2	321
9	104		102	AA4	132		DD2	321
10		104				BB4		
11		105				BB5		
12			105				DD5	112

Fig. 2

Appendix-3:

PathRunner:

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In practice, data object tables may get loaded from different source systems and at different frequency. In such scenario, running PathRunner will derive and update relationship data objects with any additional instances found, by iteratively and bi-directionally traversing alternate paths between each pair of related data objects.

Example: Original state of the database containing tables for objects Obj_A, Obj_B, Obj_C, Obj_D and relationship objects relating the four objects (Fig.1). In this state the table for relationship object Robj_AC has two ID columns representing relationship between two objects Obj_A and Obj_C; the table has one row representing relation between instances of Obj_A and Obj_C (A_ID = 102 <-> C_ID = 101). Alternate paths between Obj_A and Obj_C are 1) Robj_AB <-> Robj_BC, 2) Robj_AD <-> Robj_DC , 3) Robj_AB <-> Robj_BC <-> Robj_CD and 4) Robj_AD <-> Robj_BD <-> Robj_BC. After PathRunner run is completed, state of the database is as shown in Fig.2. In this state table for Robj_AC contains additional rows representing derived relations (A_ID = 101 <-> C_ID = 101, A_ID = 101 <-> C_ID = 102, A_ID = 101 <-> C_ID = 103, A_ID = 101 <-> C_ID = 104). Similarly tables for Robj_AD and Robj_CD has additional rows (encircled in red) representing derived relations between respective pairs of objects.

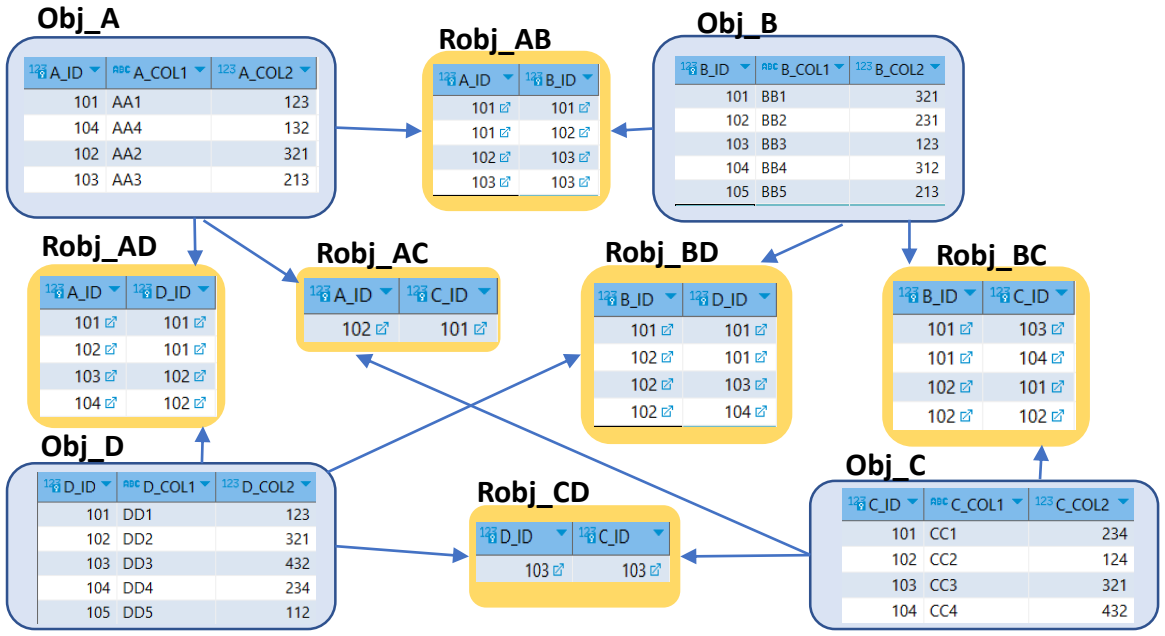

Fig. 1

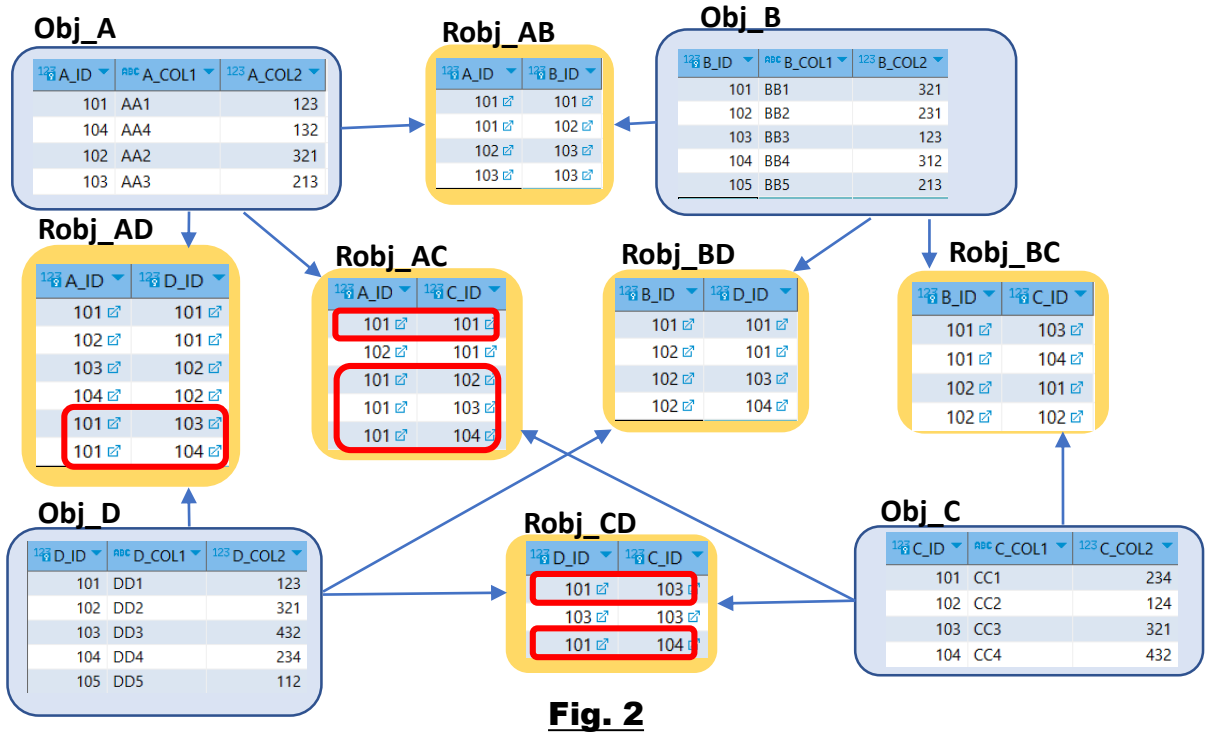

Fig. 2

Appendix-4:

Create Dataset:

Dataset is created by performing corresponding SQL UNION of SQL JOINs of all combinations, from largest to smallest combination, of ID attribute columns of Static attribute tables of relationship data objects and selected data objects; and then performing LEFT JOIN/s of selected data object attribute columns. In the following example, five attributes (A_COL1, A_COL2, B_COL1, D_COL1 and D_COL2) are selected from three data objects (OBJ_A, OBJ_B and OBJ_D).The dataset (Fig.2) is created by performing corresponding SQL UNION of SQL JOINS of ID columns from the three relationship data objects (ROBJ_AB, ROBJ_AD and ROBJ_BD), each combination of two R-DOBJs and three data objects (OBJ_A, OBJ_B and OBJ_D); and then performing LEFT JOIN of selected attribute columns from the three data object.

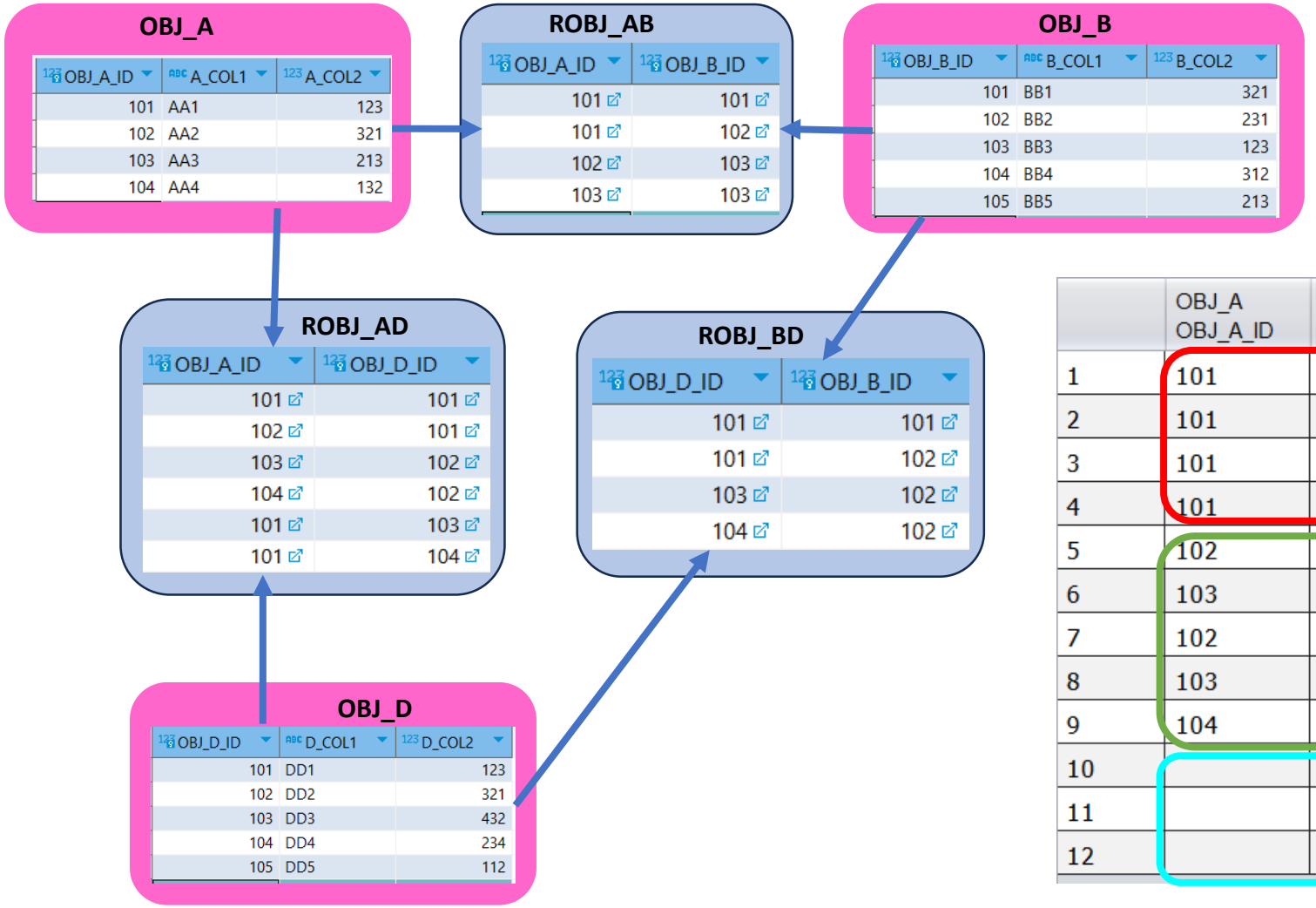

Fig. 1

	OBJ_A OBJ_A_ID	OBJ_B OBJ_B_ID	OBJ_D OBJ_D_ID	OBJ_A A_COL1	OBJ_A A_COL2	OBJ_B B_COL1	OBJ_D D_COL1	OBJ_D D_COL2
1	101	101	101	AA1	123	BB1	DD1	123
2	101	102	101	AA1	123	BB2	DD1	123
3	101	102	103	AA1	123	BB2	DD3	432
4	101	102	104	AA1	123	BB2	DD4	234
5	102	103		AA2	321	BB3		
6	103	103		AA3	213	BB3		
7	102		101	AA2	321		DD1	123
8	103		102	AA3	213		DD2	321
9	104		102	AA4	132		DD2	321
10		104				BB4		
11		105				BB5		
12			105				DD5	112

Fig. 2

Appendix-5:

Object Relations Summary:

The summary represents counts of object instances and related object instances in an interactive form.

Example: The dataset table (Fig.1) contains columns for three object IDs (i.e. A_ID, B_ID and D_ID) and attributes of the objects.

Object relations summary (Fig. 3) shows, in the area (i.e. box) at the top, total number of objects' instances in the dataset. Boxes starting from second row and first column, shows counts for exclusively related instances of all combinations of objects in descending order of the size of object combination starting from first column on the left. In this example, the box in the first column (and second row) shows 3 instances of OBJ_D, 1 instance of OBJ_A and 2 instances of OBJ_B are related to each other; similarly second column boxes shows counts for exclusively related instances among each combination of two objects; and the third column shows non-related instance counts for each object.

Selecting (clicking) the box (at 2nd column and 2nd row) shows dataset rows and columns of the exclusively related instances (Fig. 3) in the form of a table.

	OBJ_A A_ID	OBJ_B B_ID	OBJ_D D_ID	OBJ_A A_COL1	OBJ_B B_COL1	OBJ_B B_COL2	OBJ_D D_COL1
1	101	101	101	AA1	BB1	321	DD1
2	101	102	101	AA1	BB2	231	DD1
3	101	102	103	AA1	BB2	231	DD3
4	101	102	104	AA1	BB2	231	DD4
5	102	103		AA2	BB3	123	
6	103	103		AA3	BB3	123	
7	102		101	AA2			DD1
8	103		102	AA3			DD2
9	104		102	AA4			DD2
10		104			BB4	312	
11		105			BB5	213	
12			105				DD5

Fig. 7

Object Group Size = 3	Object Group Size = 2	Object Group Size = 1
Objects Count(total)		
Object Count OBJ_D_ 5 OBJ_A_ 4 OBJ_B_ 5		
Related Objects Count		
Object Count OBJ_D_ 3 OBJ_A_ 1 OBJ_B_ 2	Object Count OBJ_A_ 2 OBJ_B_ 1	Object Count OBJ_A_ 0
	Object Count OBJ_D_ 2 OBJ_A_ 3	Object Count OBJ_B_ 2
	Object Count OBJ_D_ 0 OBJ_B_ 0	Object Count OBJ_D_ 1

Fig. 8

	OBJ_A A_ID	OBJ_B B_ID	OBJ_A A_COL1	OBJ_B B_COL1	OBJ_B B_COL2
1	102	103	AA2	BB3	123
2	103	103	AA3	BB3	123

Fig. 9

Appendix-6:

Create and Append Statistic:

Creating statistic is creating a table containing results of running a statistical function by means of SQL statement. The SQL statement is of two parts, inner SQL is to create a subset containing ID columns and selected attribute columns of the objects included in the defined statistic; outer SQL is to run the selected statistical function on the subset. Appending statistic to the dataset is to create a SQL LEFT JOIN of the dataset and table containing statistic, on ID and other attributes of selected objects. Aggregate statistic is appended to the entire dataset, aggregate statistic with GROUP BY is appended by LEFT JOINing with the dataset on the GROUP BY columns, scalar statistic is appended by LEFT JOINing with dataset on the ID columns of the selected object/s.

Example: A dataset table (Fig. 1) contains selection from three objects (OBJ_A, OBJ_B and OBJ_D). The dataset contains three ID columns (OBJ_A_ID, OBJ_B_ID and OBJ_D_ID) and four attribute columns (A_COL1, B_COL1, B_COL2 and D_COL1). A statistic table for AVG(B_COL2) with GROUP BY A_COL1 is created (Fig.2) by generating and running a SQL statement that creates a subset containing four columns and six rows (Fig.1 encircled in orange) and then calculates AVG(B_COL2) with GROUP BY A_COL1. The statistic is then appended to the dataset (Fig. 3 encircled in green) by generating and running a SQL statement that performs LEFT JOIN of the dataset with statistic table on A_COL1 (Fig.3 encircled in orange) with condition (OBJ_A_ID IS NOT NULL AND OBJ_B_ID IS NOT NULL). Metadata about the appended statistic is added to the metadata table for the dataset (see Dataset Metadata for details).

	OBJ_A OBJ_A_ID	OBJ_B OBJ_B_ID	OBJ_D OBJ_D_ID	OBJ_A A_COL1	OBJ_B B_COL1	OBJ_B B_COL2	OBJ_D D_COL1
1	101	101	101	AA1	BB1	321	DD1
2	101	102	101	AA1	BB2	231	DD1
3	101	102	103	AA1	BB2	231	DD3
4	101	102	104	AA1	BB2	231	DD4
5	102	103		AA2	BB3	123	
6	103	103		AA3	BB3	123	
7	102		101	AA2			DD1
8	103		102	AA3			DD2
9	104		102	AA4			DD2
10		104			BB4	312	
11		105			BB5	213	
12			105				DD5

Fig. 1

	STATISTICS AVG_B_COL2_	OBJ_A A_COL1
1	276.0000	AA1
2	123.0000	AA2
3	123.0000	AA3

Fig. 2

	OBJ_A OBJ_A_ID	OBJ_B OBJ_B_ID	OBJ_D OBJ_D_ID	OBJ_A A_COL1	OBJ_B B_COL1	OBJ_B B_COL2	OBJ_D D_COL1	STATISTICS AVG_B_COL2_
1	101	101	101	AA1	BB1	321	DD1	276.0000
2	101	102	101	AA1	BB2	231	DD1	276.0000
3	101	102	103	AA1	BB2	231	DD3	276.0000
4	101	102	104	AA1	BB2	231	DD4	276.0000
5	102	103		AA2	BB3	123		123.0000
6	103	103		AA3	BB3	123		123.0000
7	102		101	AA2			DD1	
8	103		102	AA3			DD2	
9	104		102	AA4			DD2	
10		104			BB4	312		
11		105			BB5	213		
12			105				DD5	

Fig. 3