

Design Your Databases Straight to the Cloud

Heli Helskyaho, Elise Valin-Raki

Introduction, Heli

- * Graduated from University of Helsinki (Master of Science, computer science), currently a doctoral student, researcher and lecturer (databases, Big Data, Multi-model Databases, methods and tools for utilizing semi-structured data for decision making) at University of Helsinki
- * Worked with Oracle products since 1993, worked for IT since 1990
- * Data and Database!
- * CEO for Miracle Finland Oy
- * Oracle ACE Director
- * Ambassador/EOUC (EMEA Oracle Users Group Community)
- * Public speaker and an author
- * Winner of Devvy for Database Design Category, 2015
- * Author of the book Oracle SQL Developer Data Modeler for Database Design Mastery (Oracle Press, 2015), co-author for Real World SQL and PL/SQL: Advice from the Experts (Oracle Press, 2016)



ORACLE

Oracle SQL Developer Data Modeler for Database Design Mastery

Design, Deploy, and Maintain World-Class Databases
on Any Platform

Heli Helskyaho
Oracle ACE Director

Forewords by C.J. Date and Tom Kyte



Oracle
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ORACLE

Real World SQL & PL/SQL

Advice from the Experts

Arup Nanda
Brendan Tierney
Heli Helskyaho
Martin Widlake
Alex Nuijten



Oracle
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Introduction, Heli

- * Been an Oracle Designer user since 1996 and Data Modeler user since 2010
- * Been solving performance problems since 1993
 - * Absolutely convinced that good database *design* and *documentation* will *reduce* this work.
 - * Absolutely convinced that it is *easier* to solve problems on database that has been *documented*

Introduction, Elise

- * Oracle Database Lead for Fennia Insurance Company
- * Master of Science degree from Helsinki High School of Economics (with major in Management Science)
- * IT sector since 1987, different positions
- * OUGF (Oracle User Group Finland):
 - * Exa-SIG founder
- * Oracle ACE Associate
- * DBA

500+ Technical Experts Helping Peers Globally



3 Membership Tiers

- Oracle ACE Director
- Oracle ACE
- Oracle ACE Associate

bit.ly/OracleACEProgram

Connect:

✉ oracle-ace_ww@oracle.com

f Facebook.com/oracleaces

🐦 [@oracleace](https://twitter.com/oracleace)



Nominate yourself or someone you know: acenomination.oracle.com

Why to design?

- * "Data is the most valuable property in our company"
- * "Why do we need to design the database? We already design the application!"

Why is designing the application not enough?

- * Point of view (saving and retrieving data vs. UI)
- * First increment vs. 20 years from now
- * "the whole picture" vs. increments
- * Different goals/targets:
 - * Code tables vs. Code files (how about the data integrity?)
 - * How about analysis, reports, ... everything else but the UI that the data is used for
- * Same terminology, different meaning -> misunderstandings
- * ...

Why to model the data?

- * To facilitate communication about the requirements
- * To find the questions that should be asked
- * To understand the requirements

How is Cloud different?

- * It has a bigger chance to have latency (usually a hybrid solution)
 - * Good reason to add as much business logic to the database as possible!
 - * But you would do that anyway 😊
- * Everything you have learned about database designing still applies....

What is database designing?

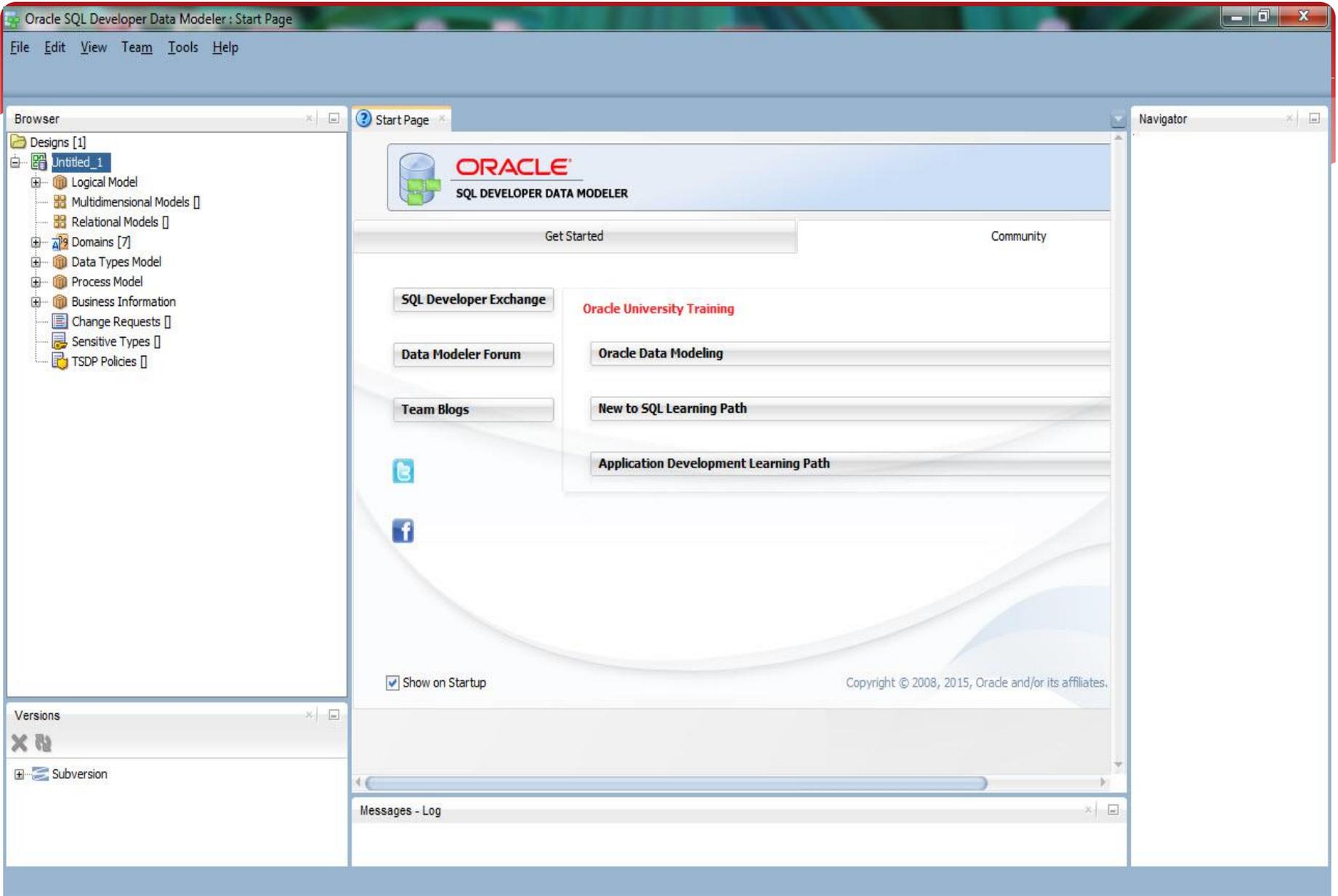
- * 4 (5) phases, over and over again
 - * Requirement analysis (DM: logical)
 - * Conceptual design (DM: logical)
 - * Logical design (DM: relational)
 - * Physical design (DM: physical)
 - * (Transaction design) (DM: process)

It would be crazy...

- * ...to design databases without a tool!

Oracle SQL Developer Data Modeler

- * To be efficient in designing you need a tool: my recommendation is Data Modeler
 - * Free of charge
 - * Support for many different databases (Oracle, MS SQL Server, DB2,...)
 - * Support for both documenting the existing databases and designing a new one (and maintaining that)
 - * Support for reporting, naming standards, glossaries, design rules, ...
 - * Support for version control and multiuser environment
 - * Support for everything you need for database design plus more



Designing the database

1. **Requirement analysis:** finding and analysing the requirements the future end users have

Result: specification of user requirements

- **data** requirements
- **functional** requirements

Also requirements for security, performance, ...

Designing the database

2. **Conceptual design.** "Interpretation" of all the requirements to a formal presentation (conceptual model).

Result: conceptual schema, also textual documentation is possible/recommended (to make sure all the knowledge is documented)

This is a tool for communication with end users.

Requirement analysis and Conceptual design

- * Collecting requirements and analyzing them
- * Fact-finding: interviews, questionnaires, existing documentation,... (recordings)
- * Requirements specifications
 - * data requirements
 - * functional requirements (performance, security, backup/recovery,..)
- * Completely neutral to any technology

Requirement analysis and Conceptual design

- * Why entity-relationship model (ER)
 - * Defining the tables directly based on requirements can be too difficult and lead to a wrong db schema.
 - * Based on a good ER it is easy to generate the relational model (which is at least on 3NF)
- * Data Flow Diagrams (DFD)

Conceptual design

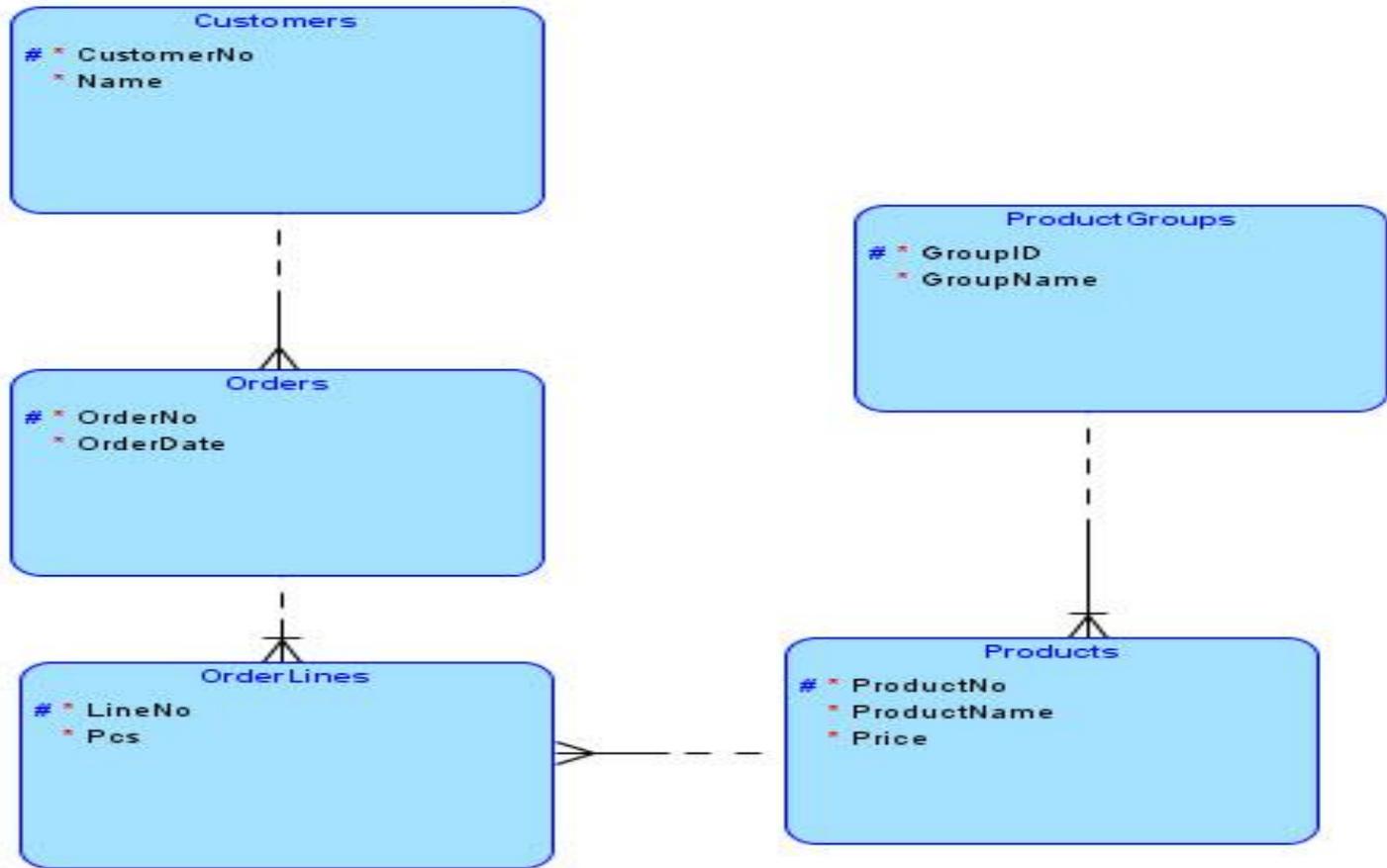
- * Use right **terminology** and clear names, much easier to communicate with the end users (one of the reasons to model!)
- * Try to find and understand the **main** concepts and their relationships (these are the most difficult to change during the iterations)

Conceptual design

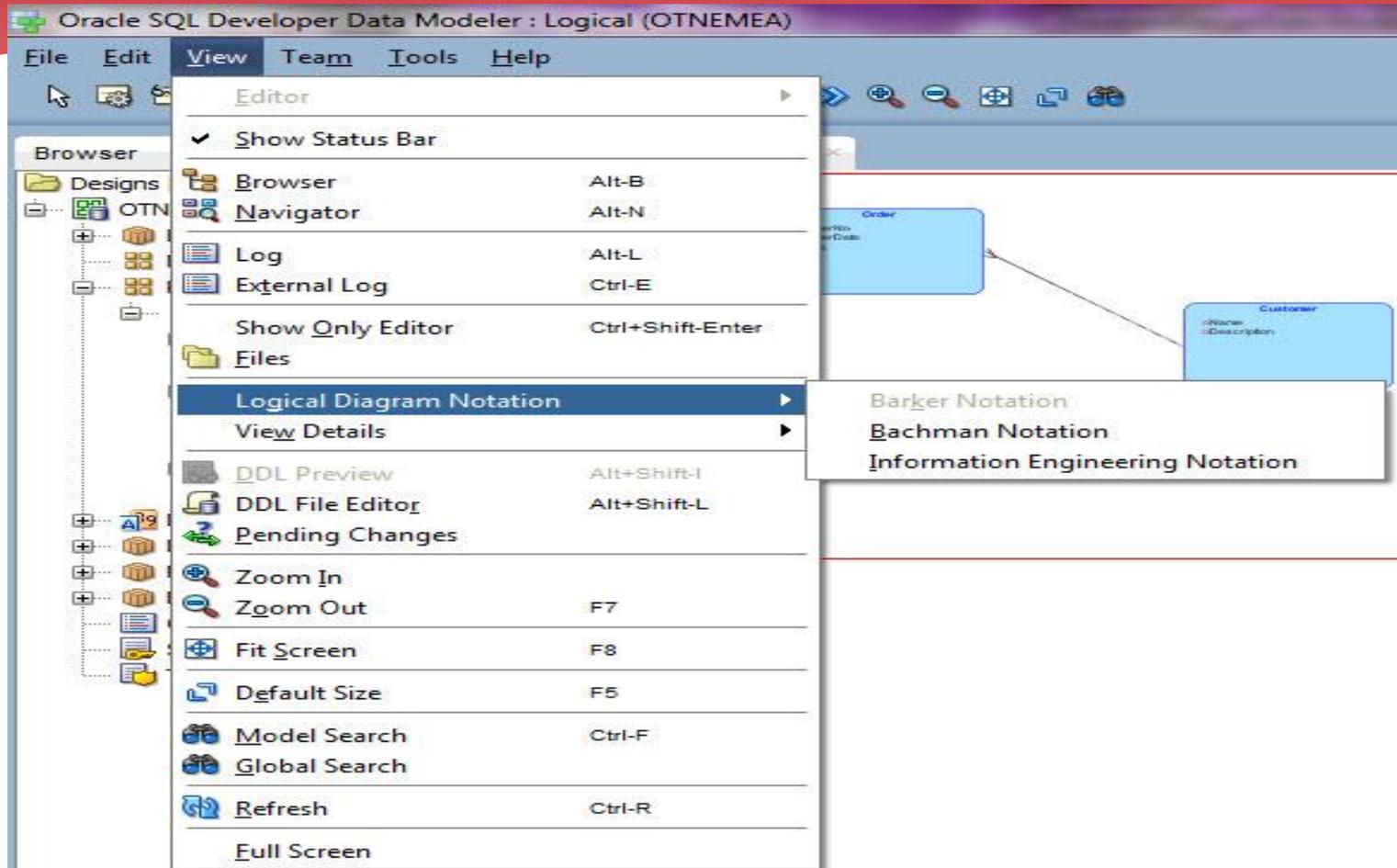
- * Modeling is **difficult** because
 - * Spoken/written language is not exact
 - * Usually all the "important" things are those that "everybody knows" so they are not told.
 - * At this stage we do not know one important thing: how the data will be **retrieved**? That will be on iteration 9...
- * Modeling is **mandatory** because when modeling the database designer realizes **what must be asked!**

Logical model

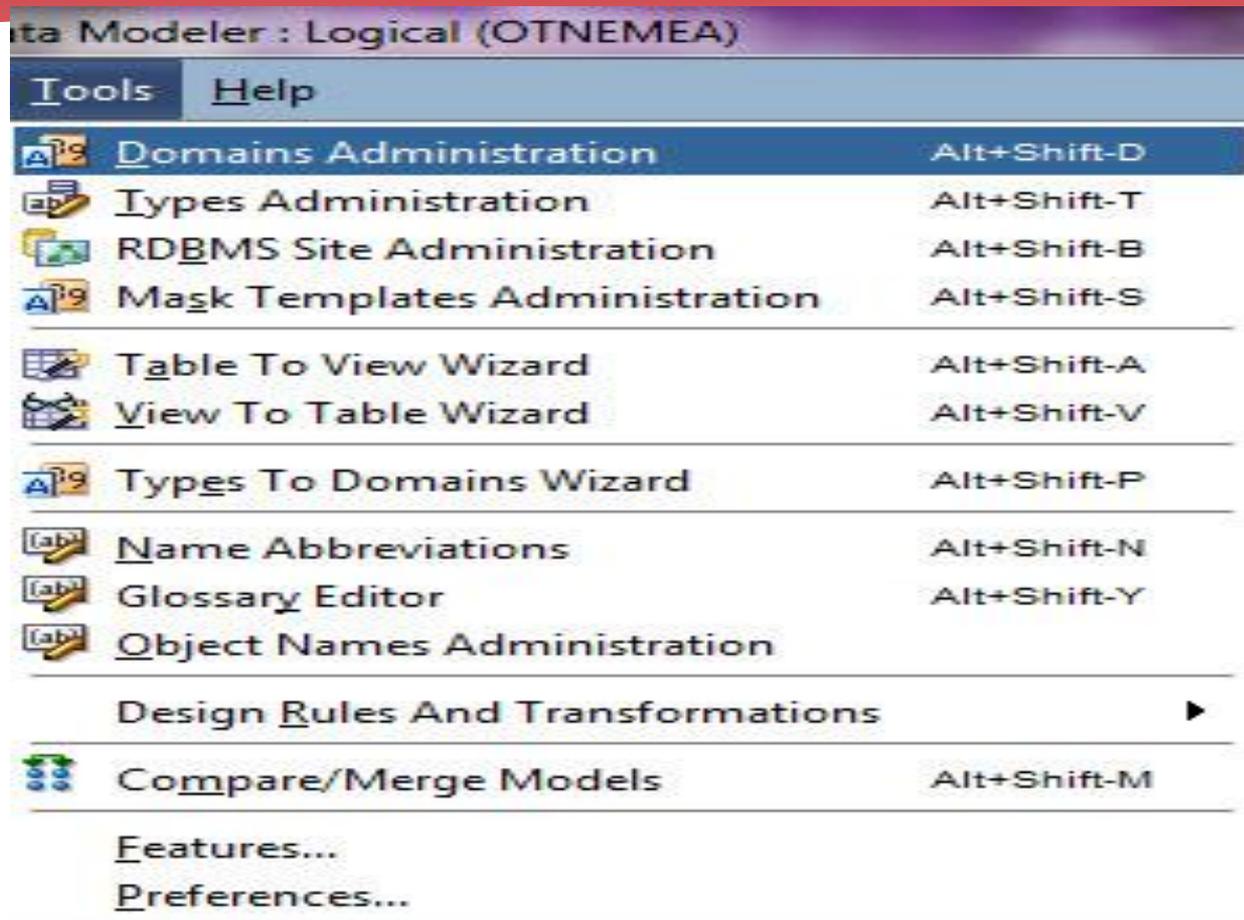
Demo (Logical)



Notation



Domains administration



Domains Administration [X]

Choose domain

Domains File

Available Domains

 Unknown

Domain Properties

Name	<input type="text"/>	Synonym	<input type="text"/>
Logical type	<input type="text" value="unknown"/>	Comments	<input type="text"/>
Size	<input type="text"/>	Unit of Measure	<input type="text"/>
Units	<input type="text"/>	Default Value	<input type="text"/>
Precision	<input type="text"/>	<input type="button" value="Check Constraint"/>	
Scale	<input type="text"/>	<input type="button" value="Ranges"/>	
Domains File	<input type="text"/>	<input type="button" value="Value List"/>	

Domains Administration

Choose domain

Domains File

Available Domains

- Money
- Unknown

Domain Properties

Name	Synonym
<input type="text" value="Money"/>	<input type="text"/>
Logical type	Comments
<input type="text" value="NUMERIC"/>	<input type="text"/>
Size	Unit of Measure
<input type="text" value="15"/>	<input type="text"/>
Units	Default Value
<input type="text" value="CHAR"/>	<input type="text"/>
Precision	<input type="button" value="Check Constraint"/>
<input type="text" value="15"/>	
Scale	<input type="button" value="Ranges"/>
<input type="text" value="2"/>	
Domains File	<input type="button" value="Value List"/>
<input type="text" value="defaultdomains"/>	

Entity Properties - OrderLine

Attributes

General
Attributes
 Unique Identifiers
 Relationships
 Volume Properties
 Engineer To
 Comments
 Comments in RDBMS
 Overlapping Attributes
 Notes
 Impact Analysis
 Measurements
 Change Requests
 Responsible Parties
 Documents
 Dynamic Properties
 Summary

Details Overview

Attributes:

Name	Data type
1 OrderlineNo	NUMERIC (10)
2 Pcs	NUMERIC
3 Price	Money
4 OrderNo	NUMERIC
5 ProductNo	NUMERIC (10)

Attribute Properties

Name: Price

Datatype: Domain Logical Distinct
 Structured Collection

Type: Money Preferred

Primary UID Relation UID Mandatory

Comments Comments in RDBMS Notes

OK Apply Naming Rules Cancel Help

Column Properties - Price [X]

General

- Default and Constraint
- Auto Increment
- Security
- UI Defaults
- Permitted Subtypes
- Comments
- Comments in RDBMS
- Notes
- Impact Analysis
- Measurements
- Change Requests
- Responsible Parties
- Documents
- Dynamic Properties
- Summary

General

Name:

Table:

Abbreviation:

Engineer:

Allow Nulls:

Datatype: ...

Type:

Computed:

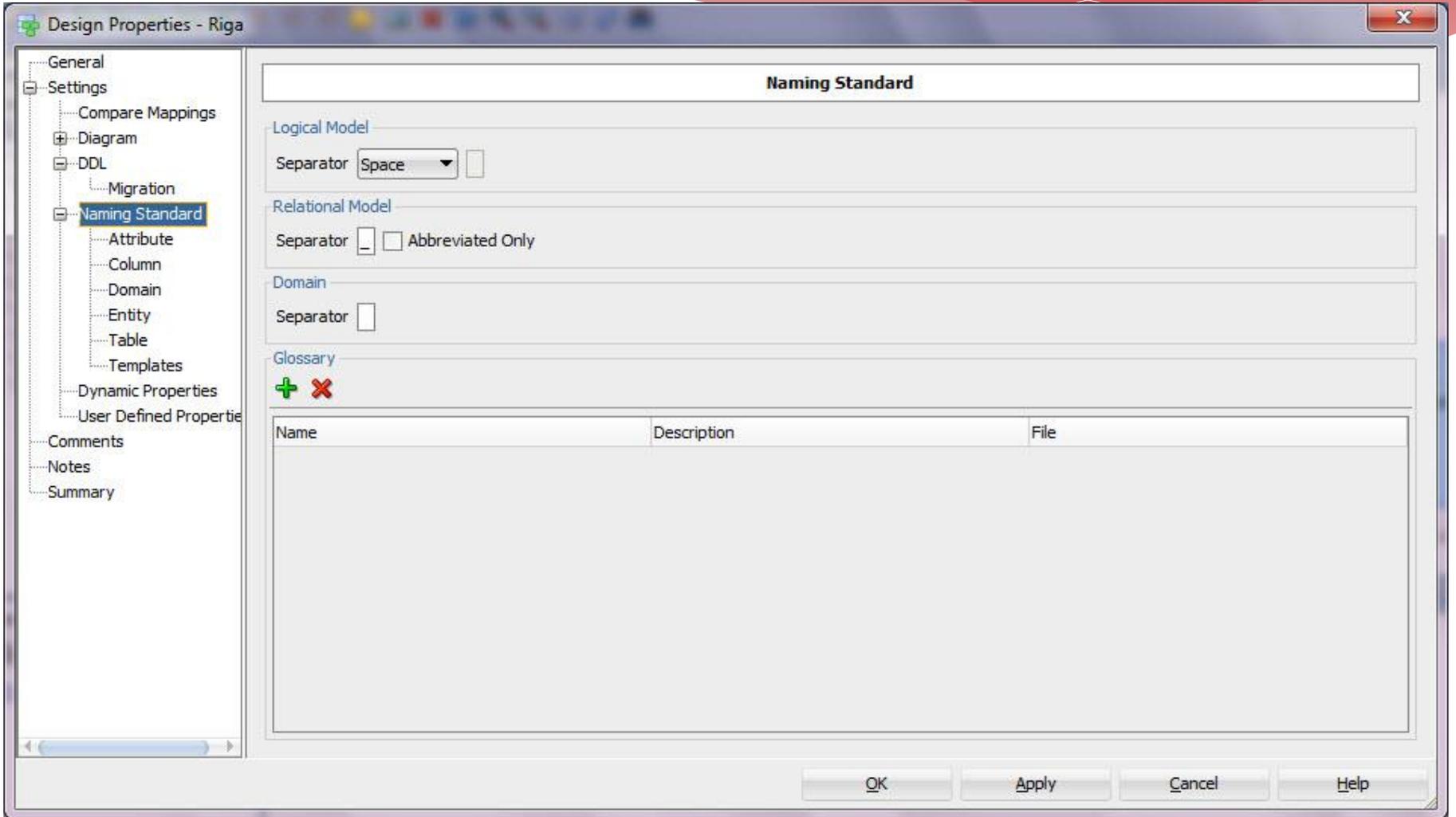
Column Expression:

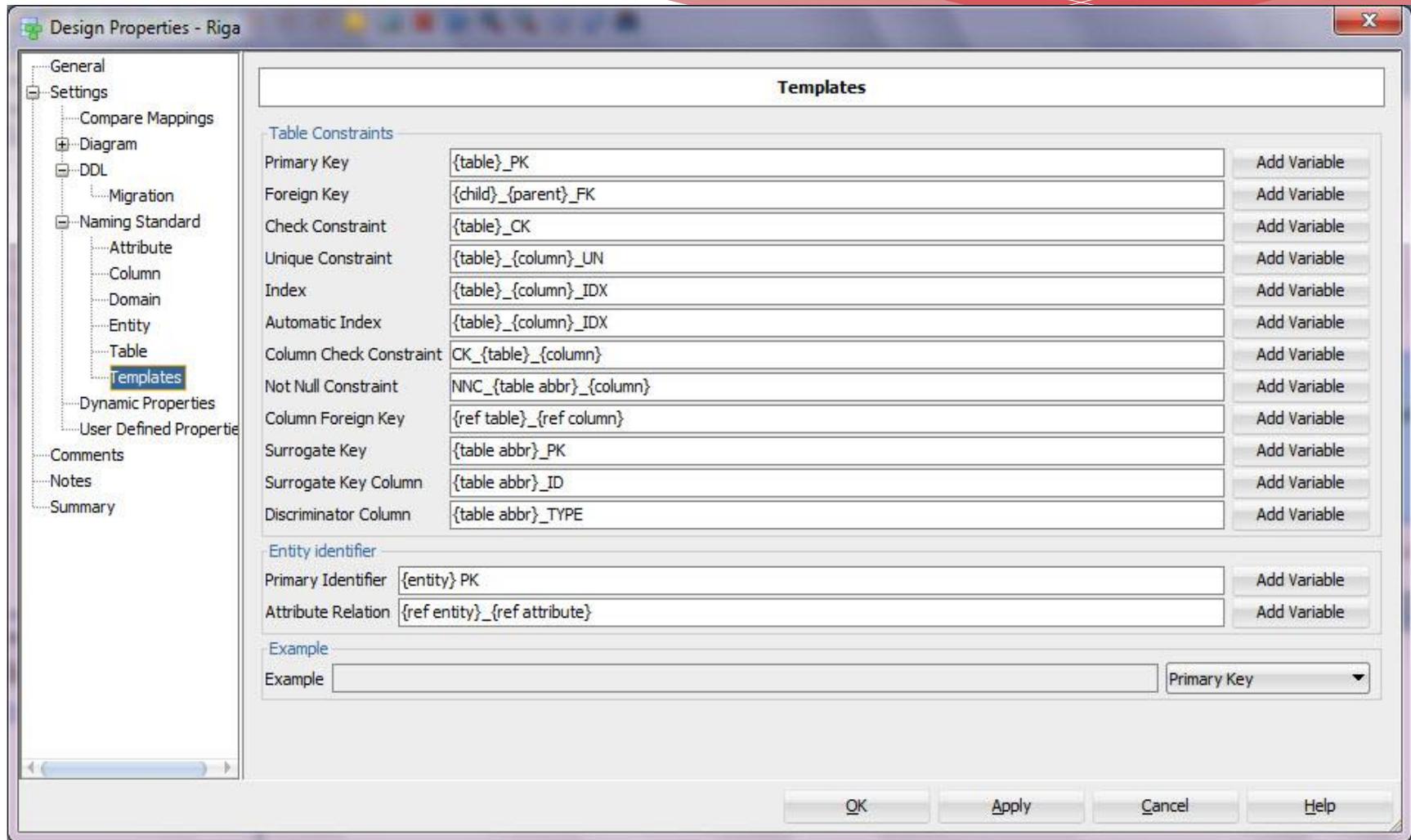
Auto Increment Identity Column

Scope:

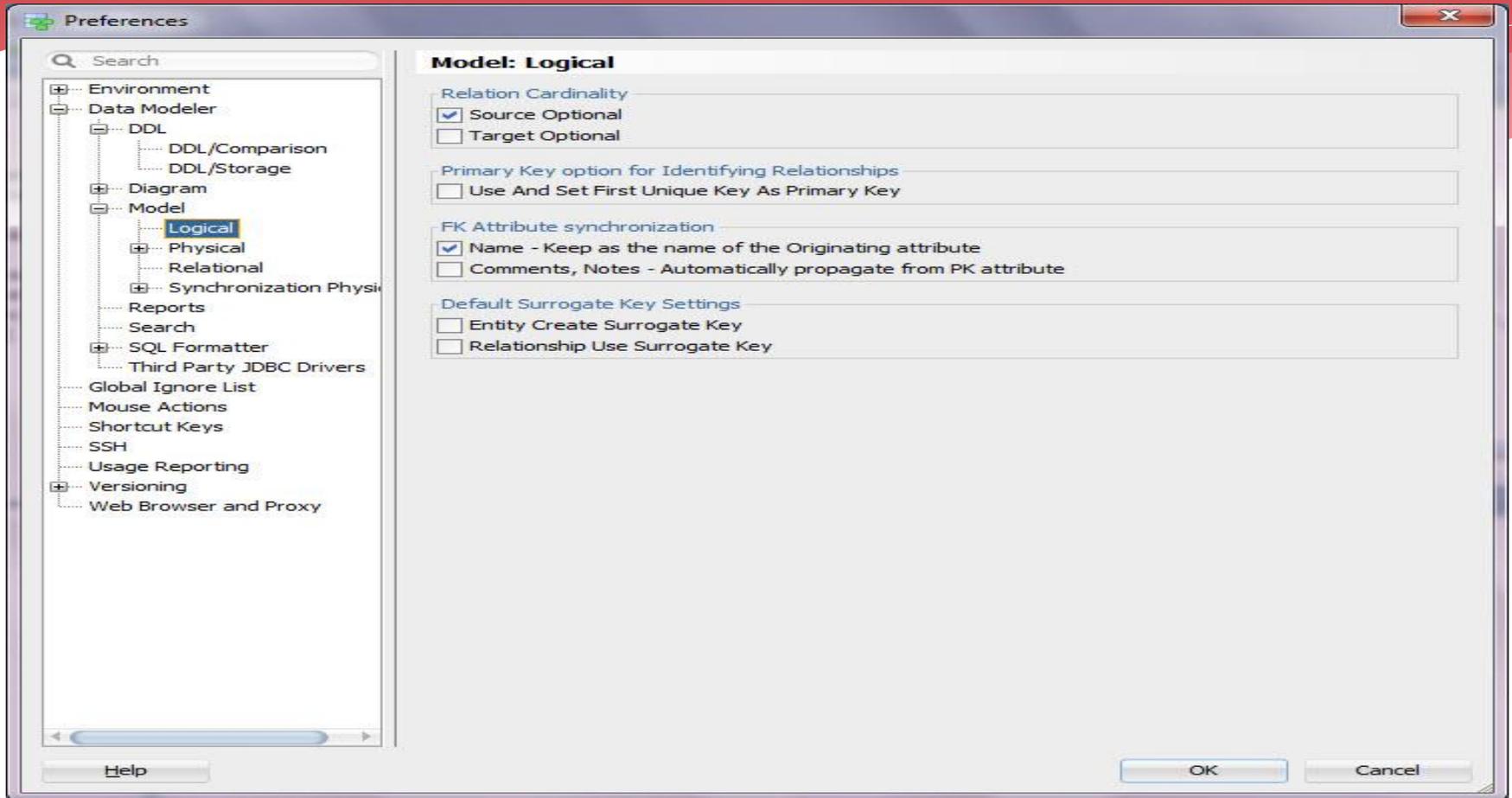
Type Substitution:

Design Properties





Preferences

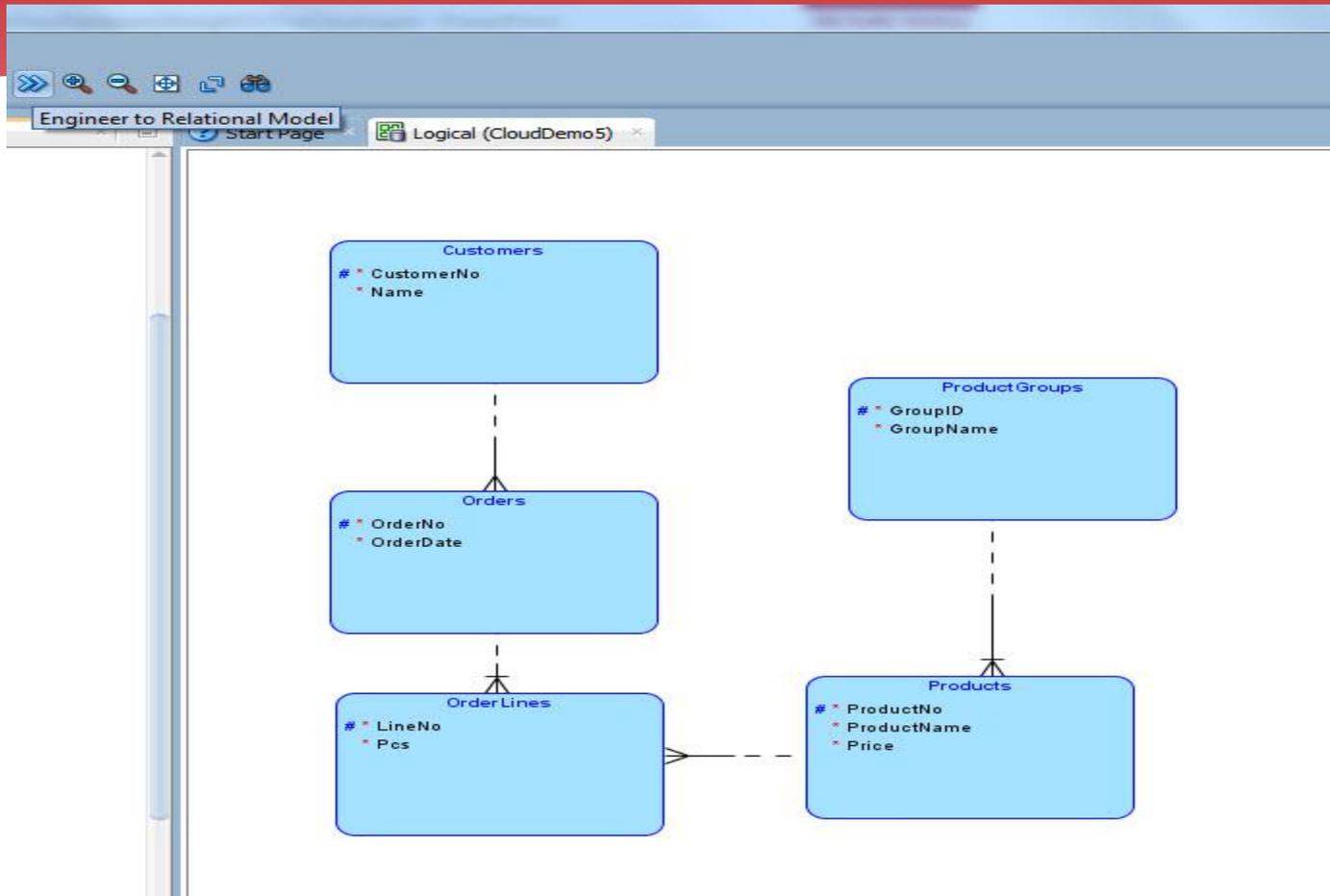


Designing the database

3. **Logical design:** transforming the conceptual model into a logical data model and a logical schema that the RDMS understands

Result: relational-database schema
(relational schemas and constraints)

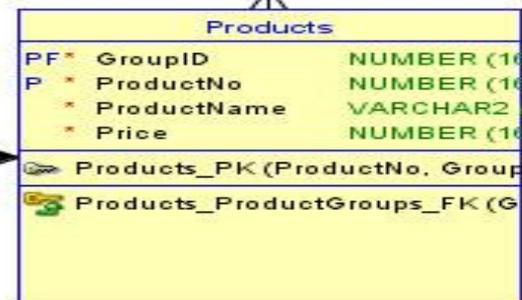
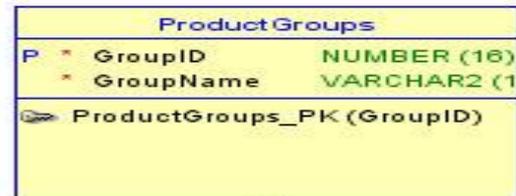
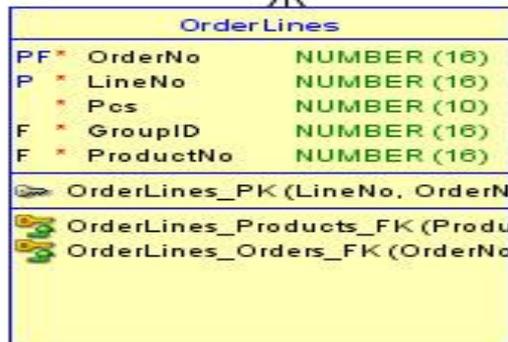
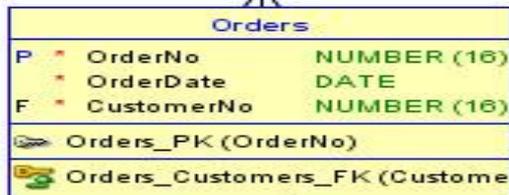
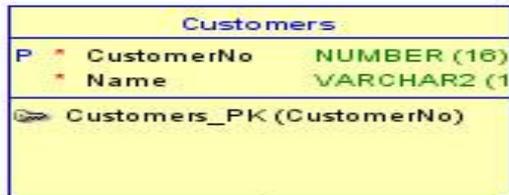
From logical to relational



Demo (Relational)

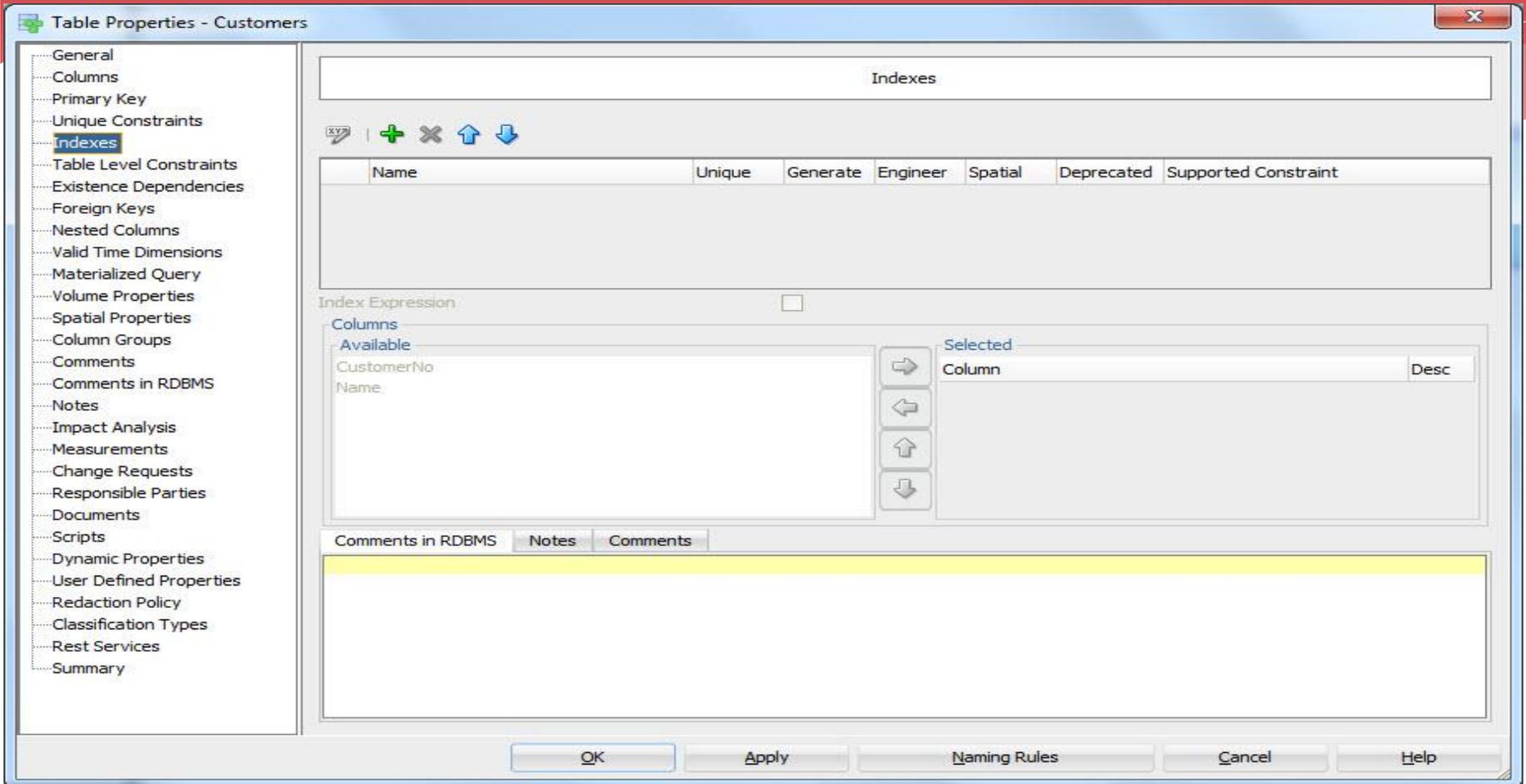
Step 1

- * Check that you got what you wanted...

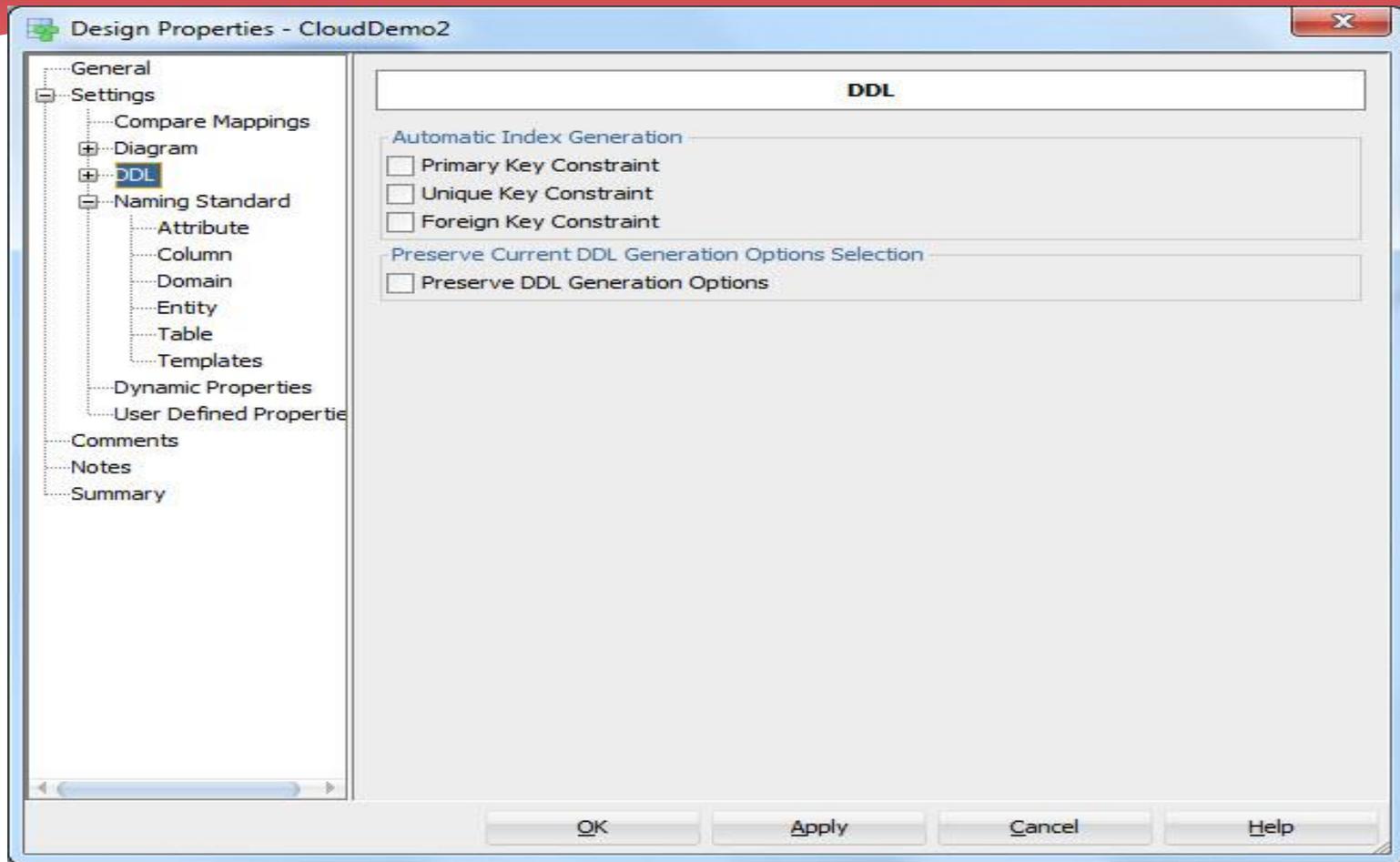


Indexes

Manually



Automatically



Designing the database

4. **Physical design:** instances, tablespaces, indexes, disks ...

And all of these phases over and over again...

(this is different, we have always done that but not so many times and in such a short cycles)

From relational to physical

Demo (Physical)

Oracle SQL Developer Data Modeler

File Edit View Versioning Tools Help

Start Page x Logical (Orderdb) x Relational_1 (Orderdb) x

Browser

- Designs [1]
 - Orderdb
 - Logical Model
 - Entities [4]
 - Customer
 - Order
 - OrderLine
 - Product
 - Relations [3]
 - Relation_2 (Customer - 0..*:1..1 - Order)
 - Relation_4 (Order - 0..*:1..1 - OrderLine)
 - Relation_6 (Product - 0..*:1..1 - OrderLine)
 - Inheritances []
 - Views []
 - SubViews []
 - Displays []
 - Multidimensional Models []
 - Relational Models [1]
 - Relational_1
 - Tables [4]
 - Order
 - OrderLine
 - Product
 - Customer
 - Views []
 - Foreign Keys [3]
 - OrderLine_PK (OrderLineNo, OrderNo)
 - Order_PK (OrderNo)
 - Product_PK (ProductNo)
 - Schemas []
 - SubViews []
 - Physical Models []
 - Displays []
 - Domains [1]
 - Data Types Model
 - Process Model
 - Business Information
 - Change Requests []

Versioning Navigator

Subversion

SVN Console - Log x Pending Changes x

```

propset svn:ignore "*" .localiz " C:/ohjelmat/DataModeler mallit/DesignsDirectory/Orderdb/Orderdb/rel/34ff578a-ee8fbf20/1
propset svn:ignore "*" .localiz *.local " C:/ohjelmat/DataModeler mallit/DesignsDirectory/Orderdb/Orderdb/rel/34ff578a-ee8fbf20/1
2012-09-17 10:28:15 - Design Orderdb saved.
  
```

Messages SVN Console x

Editing

```

erDiagram
    Order ||--o{ Customer : "has"
    Order ||--o{ OrderLine : "has"
    OrderLine ||--o{ Product : "has"
    OrderLine ||--o{ Order : "has"
  
```

Order

P *	OrderNo	NUMBER
	OrderDate	DATE
F *	CustomerNo	NUMBER
PK	Order_PK (OrderNo)	

Customer

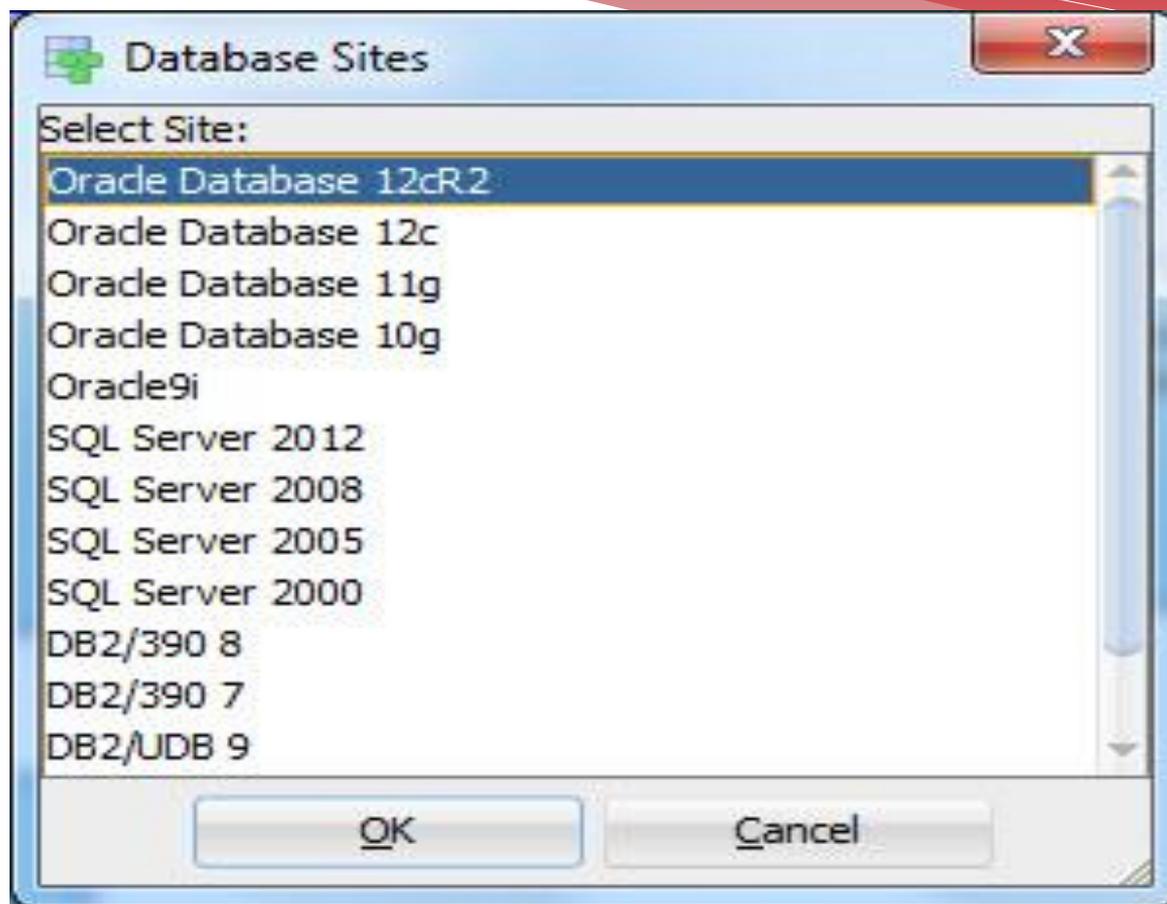
P *	CustomerNo	NUMBER
	Name	VARCHAR
	DeliveryAddress	VARCHAR
	MailAddress	VARCHAR
PK	Customer_PK (CustomerNo)	

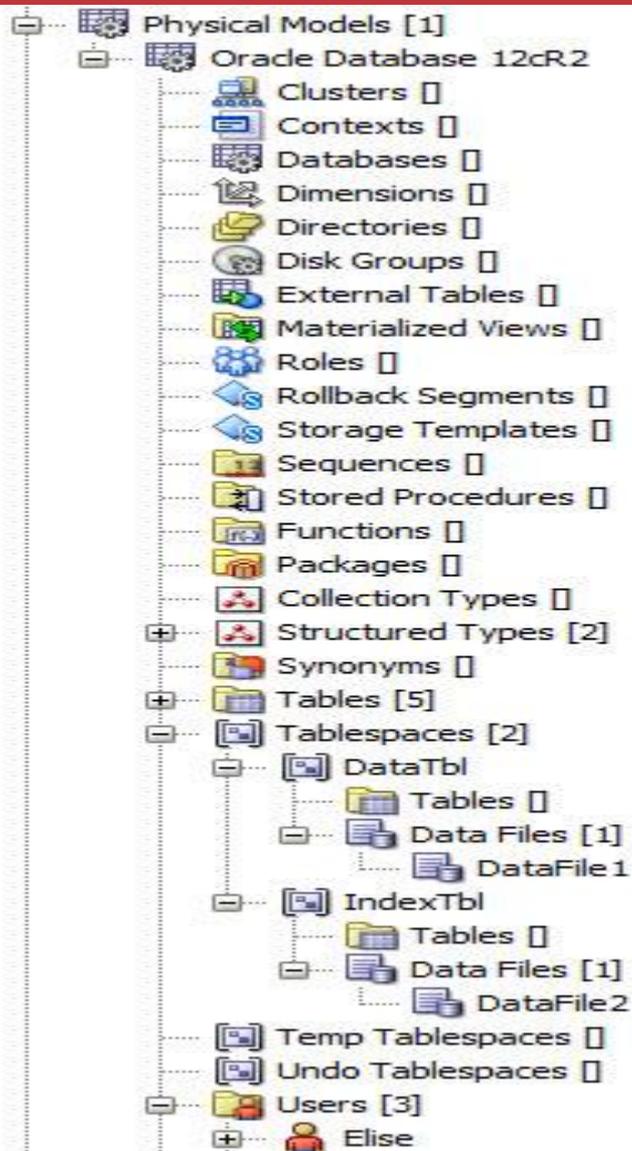
OrderLine

P *	OrderlineNo	NUMBER (10)
	Pcs	NUMBER
	Price	NUMBER (17,2)
PF *	OrderNo	NUMBER
F *	ProductNo	NUMBER (10)
PK	OrderLine_PK (OrderlineNo, OrderNo)	

Product

P *	ProductNo	NUMBER (10)
	ProductName	VARCHAR2
PK	Product_PK (ProductNo)	





Physical Design

- * Creating physical elements (tablespaces, users, ...)
- * Privileges...

Setting up the Properties

TableSpace Properties - TableSpace1

Indexes | Storage | Materialized Views | Comments

General | Default Storage | Clusters | Tables

Name:

Datafiles:

File Type:

Min. Ext Len:

Block size:

Logging:

Force Logging:

Status:

Contents:

Default Compression:

Ext. Management:

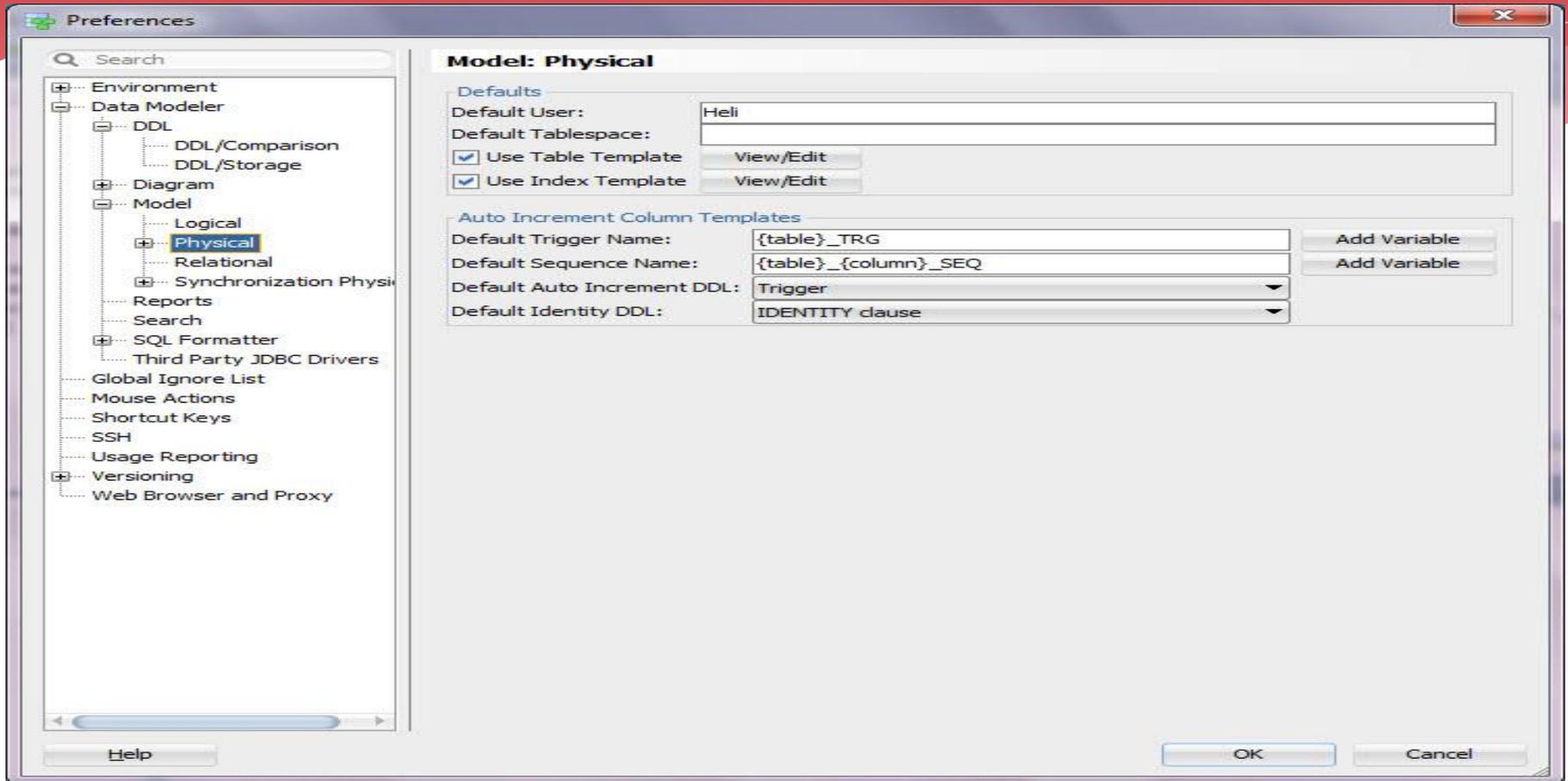
EM Local SubType:

EM Uniform Size:

Seg. Management:

Flashback Mode:

Setting the Defaults



Physical to DDLs

Demo (DDL)

Oracle SQL Developer Data Modeler

File Edit View Versigning Tools Help

Start Page x Logical (Orderdb) x Relational_1 (Orderdb) x

Export To Data Modeler Design

DDL File

Cube Views Metadata

To Microsoft XMLA

To Oracle AW

To CSV

To Reporting Schema

Contexts []

Databases []

Dimensions []

Directories []

Disk Groups []

External Tables []

Materialized Views []

Roles []

Rollback Segments []

Storage Templates []

Sequences []

Stored Procedures []

Functions []

Packages []

Collection Types []

Structured Types [2]

Synonyms []

Tables [4]

Customer

Order

OrderLine

Product

Tablespaces []

Temp Tablespaces []

Undo Tablespaces []

Users [2]

Views []

Displays []

Domains [1]

Versioning Navigator x

Subversion

Relational_1

Messages - Log x Pending Changes x

Orderdb (C:\ohjelmat\DataModeler mallit\DesignsDirectory)\...

Incoming Changes: 0 Outgoing Changes: 0 Unversioned Files: 0

Editing

```

    erDiagram
        Order ||--o{ Customer : "has"
        Order ||--o{ OrderLine : "has"
        OrderLine ||--o{ Product : "has"
    
```

Order

- P * OrderNo NUMBER
- OrderDate DATE
- F * CustomerNo NUMBER
- Order_PK (OrderNo)

Customer

- P * CustomerNo NUMBER
- Name VARCHAR
- DeliveryAddress VARCHAR
- MailAddress VARCHAR
- Customer_PK (CustomerNo)

OrderLine

- P * OrderlineNo NUMBER (10)
- Pos NUMBER
- Price NUMBER (17,2)
- PF * OrderNo NUMBER
- F * ProductNo NUMBER (10)
- OrderLine_PK (OrderlineNo, OrderNo)

Product

- P * ProductNo NUMBER (10)
- ProductName VARCHAR2
- Product_PK (ProductNo)

DDL File Editor - Oracle Database 12cR2

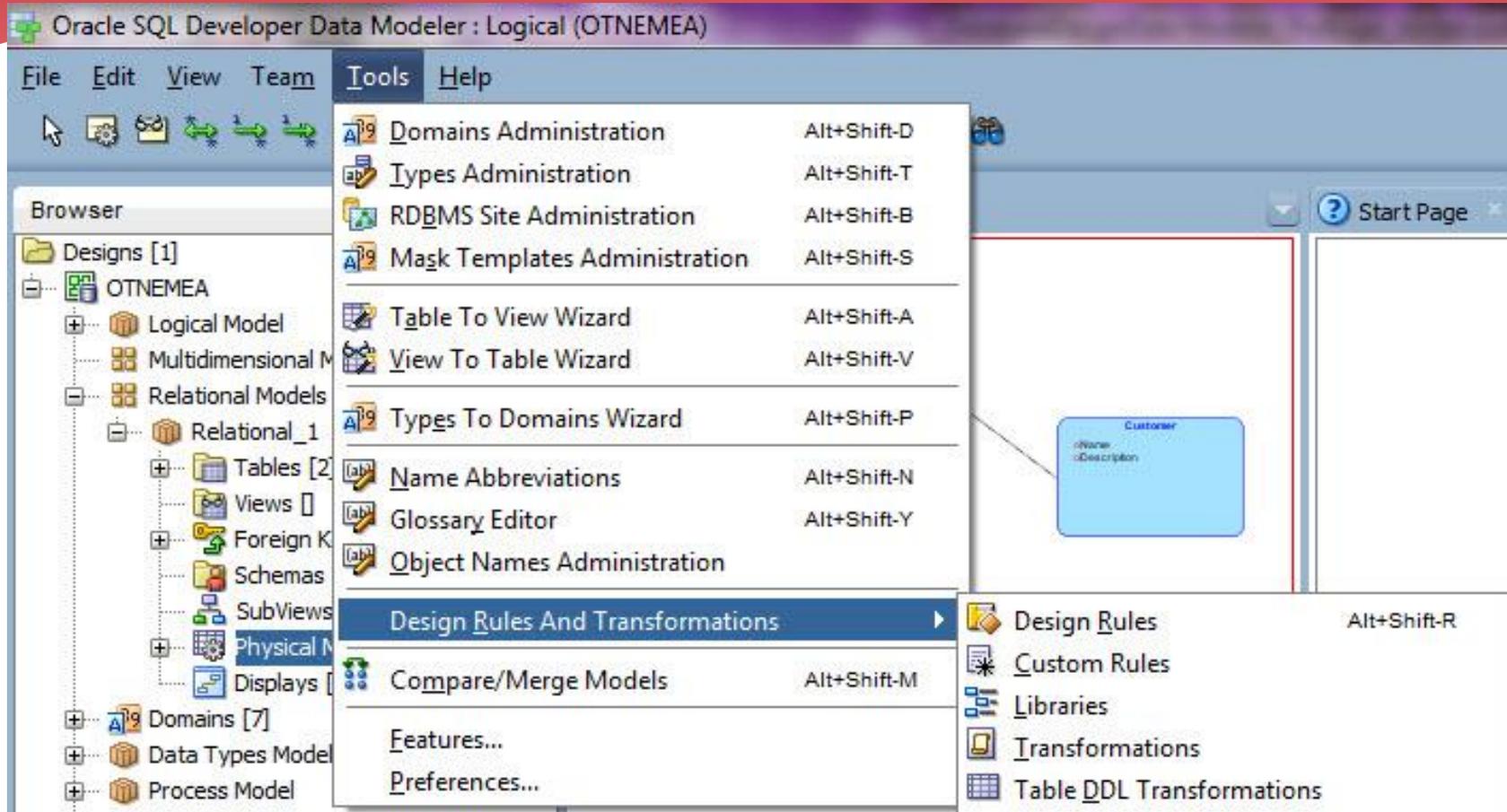
Oracle Database 12cR2 Relational_1 Generate Clear

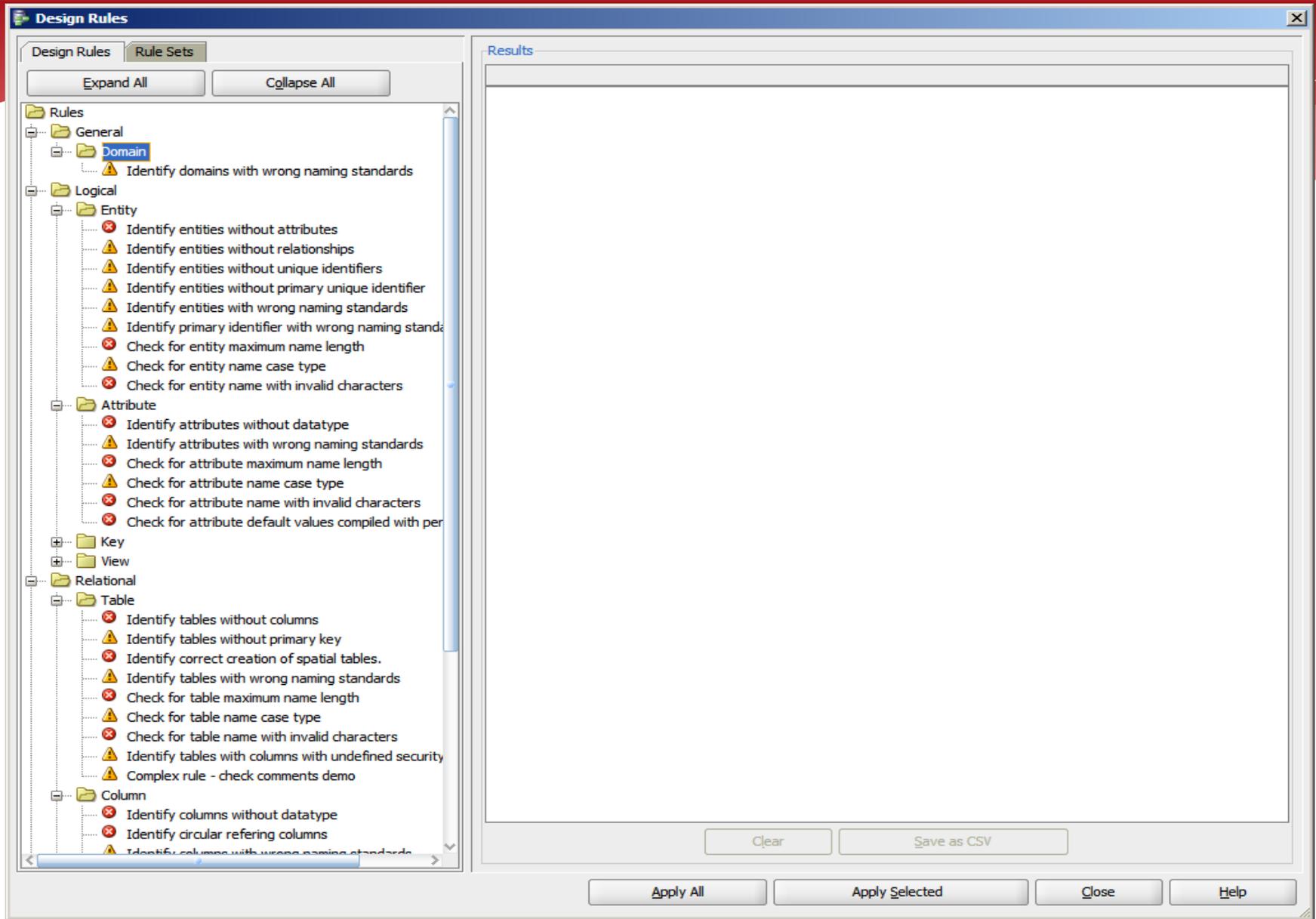
```
21 CREATE TABLE Customers
22 (
23     CustomerNo NUMBER (16) NOT NULL ,
24     Name        VARCHAR2 (100 CHAR) NOT NULL
25 )
26 LOGGING
27 ;
28 CREATE UNIQUE INDEX Customers_CustomerNo_IDX ON Customers
29 (
30     CustomerNo ASC
31 )
32 TABLESPACE IndexTbl
33
34 ALTER TABLE customers ADD CONSTRAINT customers_pk PRIMARY KEY ( customerno );
35
36 CREATE TABLE OrderLines
37 (
38     OrderNo  NUMBER (16) NOT NULL ,
39     LineNo   NUMBER (16) NOT NULL ,
40     Pcs      NUMBER (10) NOT NULL ,
41     GroupID  NUMBER (16) NOT NULL ,
42     ProductNo NUMBER (16) NOT NULL
43 )
44 LOGGING
45 ;
46 CREATE UNIQUE INDEX OLines_LineNo_OrderNo_IDX ON OrderLines
47 (
48     LineNo ASC ,
49     OrderNo ASC
```

Save Find Close Help

Demo (executing the DDLs to the Cloud)

Design Rules





Design Rules [X]

Design Rules | Rule Sets

Expand All | Collapse All

- Rules
 - General
 - Logical
 - Relational
 - Process Model
 - Physical

Results

ERRORS:4WARNINGS:13

- Warning: Customer: Table has columns with undefined security properties
- Error: Customer: no comments in RDBMS defined , no comments defined
- Warning: Order: Table has columns with undefined security properties
- Error: Order: no comments in RDBMS defined , no comments defined
- Warning: OrderLine: Table has columns with undefined security properties
- Error: OrderLine: no comments in RDBMS defined , no comments defined
- Warning: Product: Table has columns with undefined security properties
- Error: Product: no comments in RDBMS defined , no comments defined
- Warning: Customer.Customer_PK: Primary key with wrong naming standards is not recommended.
- Warning: Order.Order_PK: Primary key with wrong naming standards is not recommended.
- Warning: Order.Relation_2: Foreign keys with wrong naming standards are not recommended.
- Warning: OrderLine.OrderLine_PK: Primary key with wrong naming standards is not recommended.
- Warning: OrderLine.Relation_4: Foreign keys with wrong naming standards are not recommended.
- Warning: OrderLine.Relation_6: Foreign keys with wrong naming standards are not recommended.
- Warning: Product.Product_PK: Primary key with wrong naming standards is not recommended.
- Warning: Order: The name is a reserved word: Order
- Warning: Order: The name is a reserved word: Order

Clear | Save as CSV

Apply All | Apply Selected | Close | Help

Different Compares

- * Design vs Design
- * Design vs Database
- * Database vs Design

Different Compares, Designs

- * File | Import | Data Modeler Design
 - * Compares "everything"
- * Tools | Compare/Merge Models
 - * Compares only relational and physical models
 - * ALTER DDLs can be generated
- * These can be used for instance to compare different versions of the design from version control

Different Compares, Database

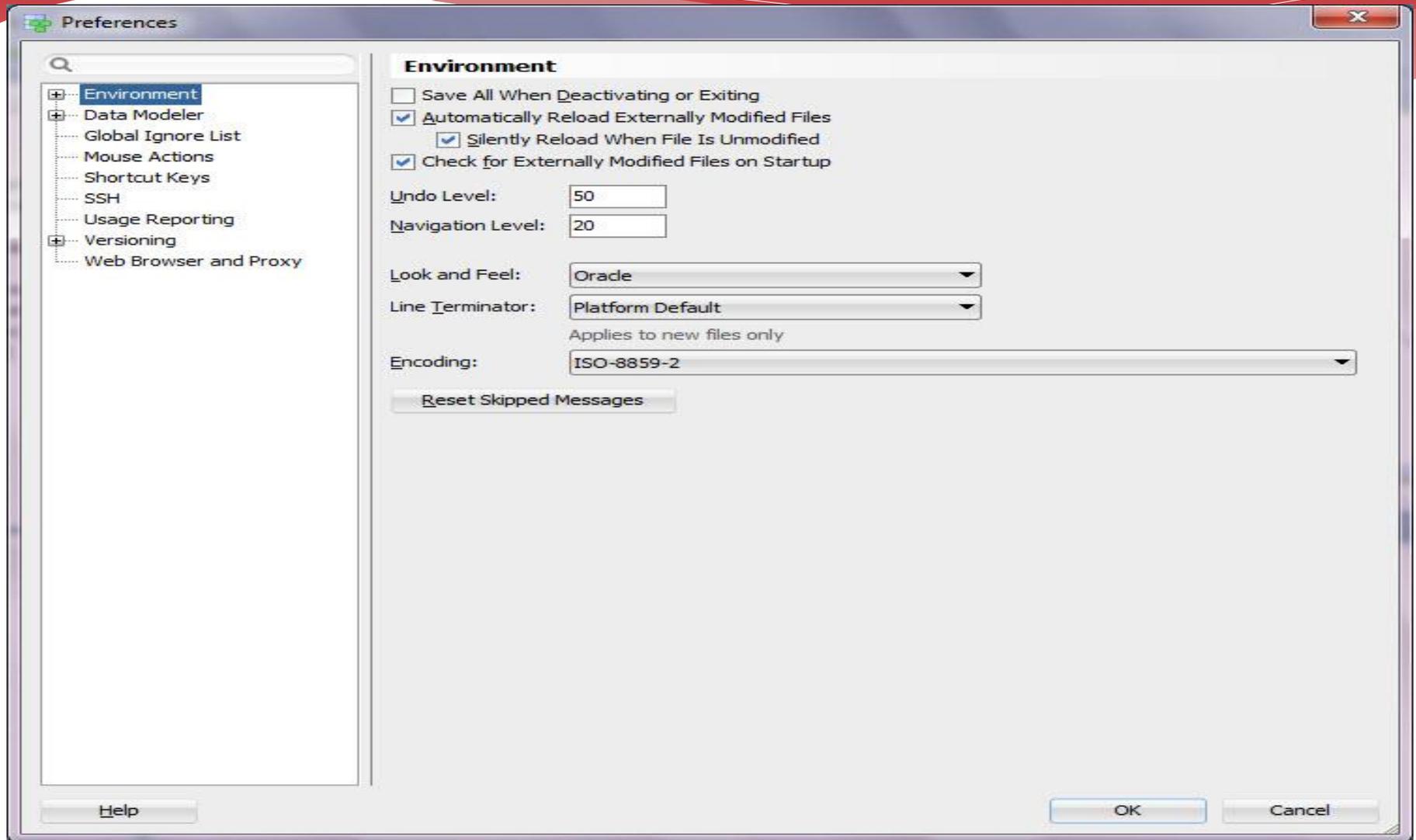
- * Synchronize Model With Data Dictionary
 - * Target: model
- * Synchronize Data Dictionary With Model
 - * Target: database
- * File | Import | DDL File
- * File | Import | Data Dictionary

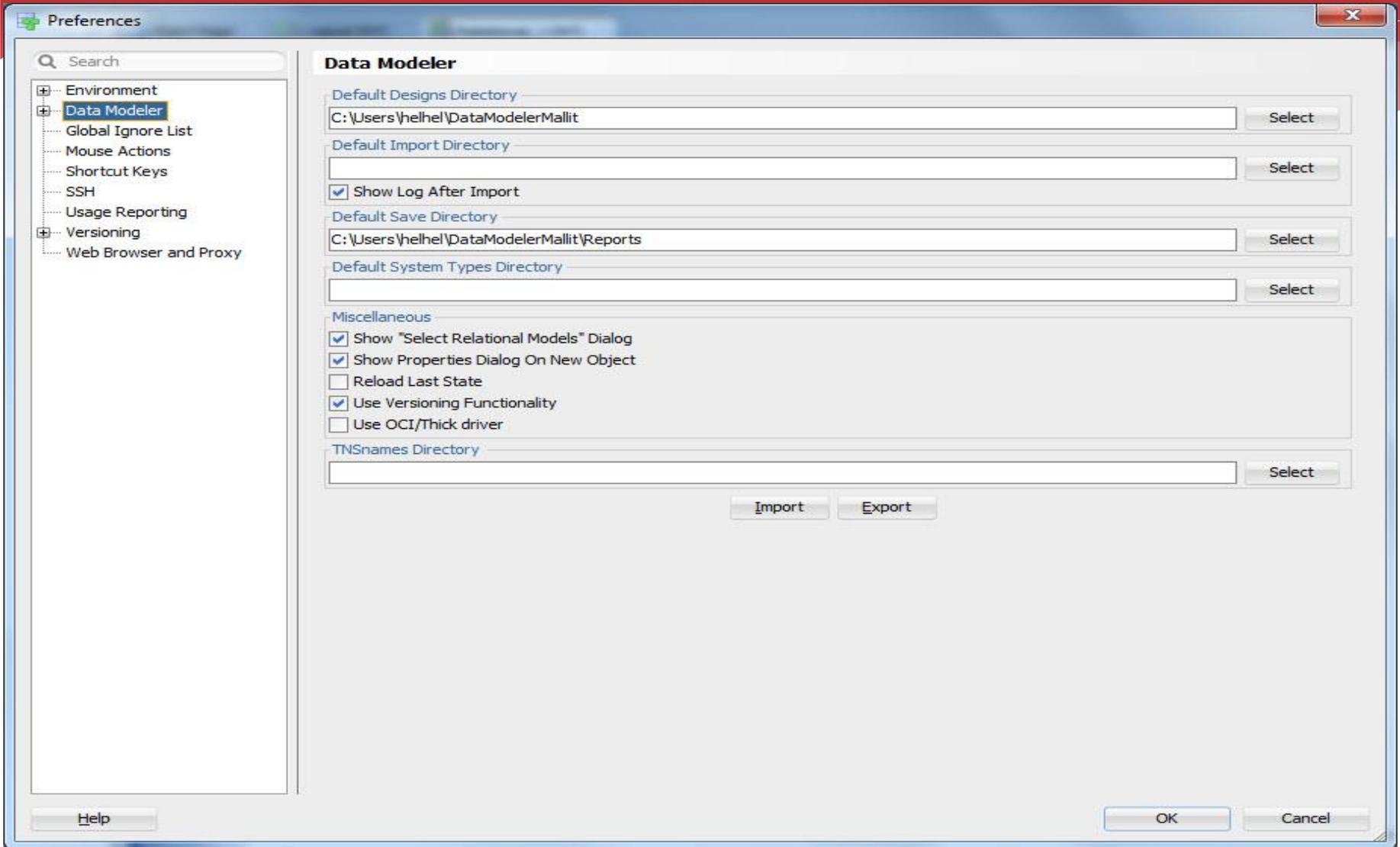
Preferences

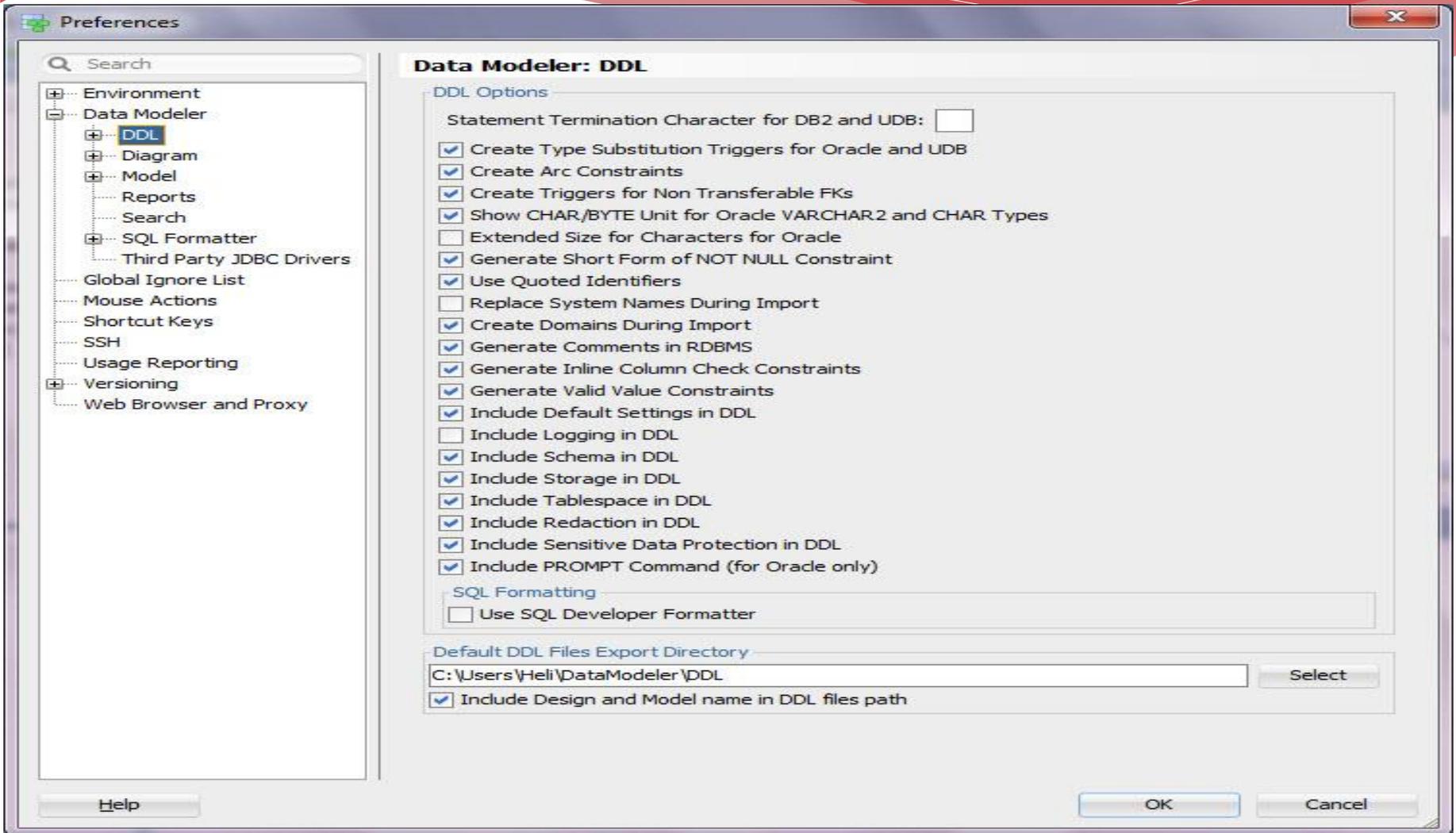
The screenshot displays the Oracle SQL Developer Data Modeler interface. The main workspace shows a logical model with four tables: Order, Customer, OrderLine, and Product. The Order table has columns OrderNo (NUMBER), OrderDate (DATE), and CustomerNo (NUMBER). The Customer table has columns CustomerNo (NUMBER), Name (VARCHAR), DeliveryAddress (VARCHAR), and MailAddress (VARCHAR). The OrderLine table has columns OrderlineNo (NUMBER (10)), Pcs (NUMBER), OrderNo (NUMBER), and ProductNo (NUMBER (10)). The Product table has columns ProductNo (NUMBER (10)) and ProductName (VARCHAR2). Relationships are shown: Order PK to Customer FK (CustomerNo), OrderLine PK to Order FK (OrderNo), and OrderLine PK to Product FK (ProductNo).

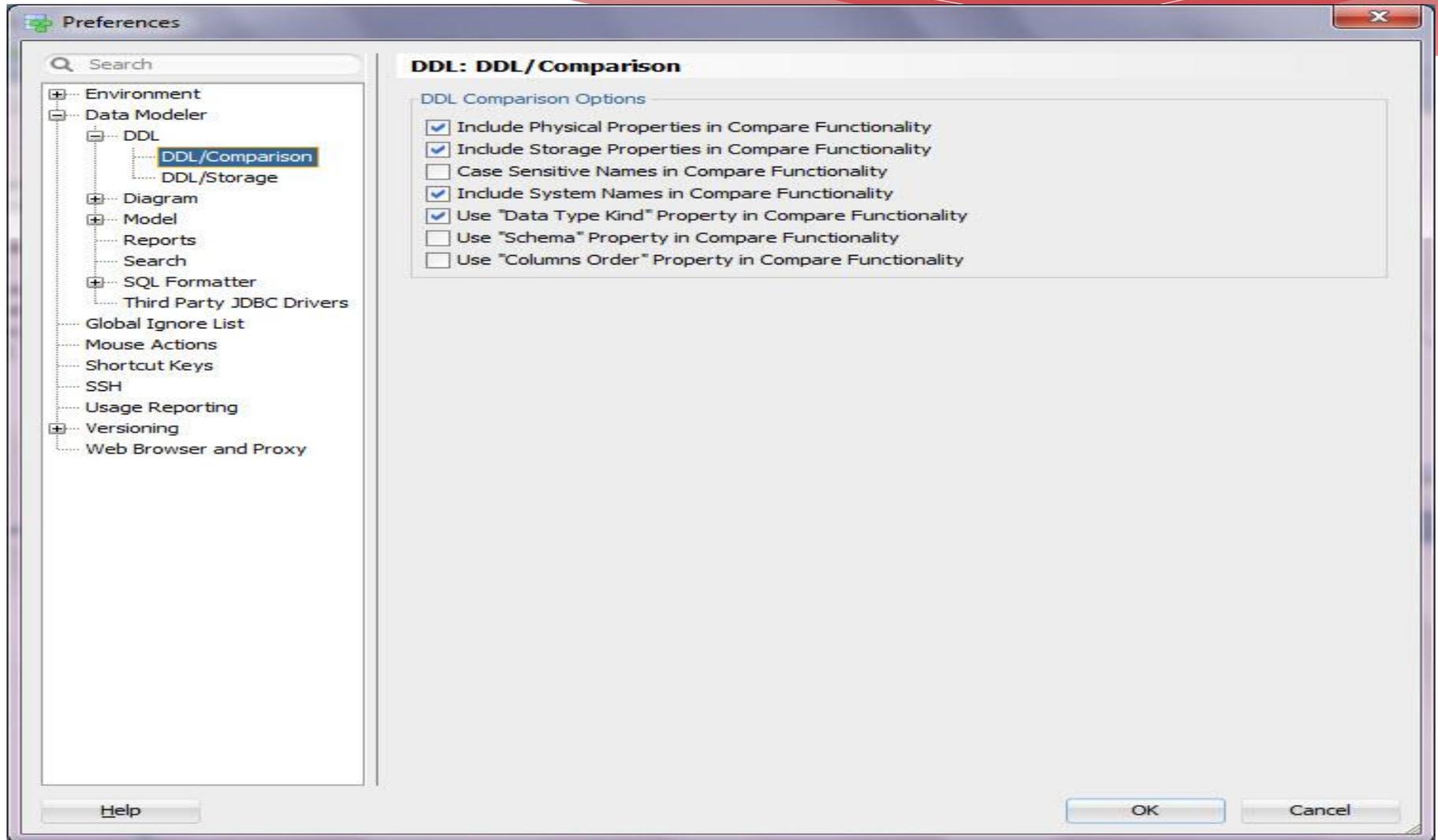
The Tools menu is open, showing options like Domains Administration, Types Administration, RDBMS Site Administration, Table To View Wizard, View To Table Wizard, Types To Domains Wizard, Name Abbreviations, Glossary Editor, Design Rules, and Compare/Merge Models. The Preferences... option is highlighted.

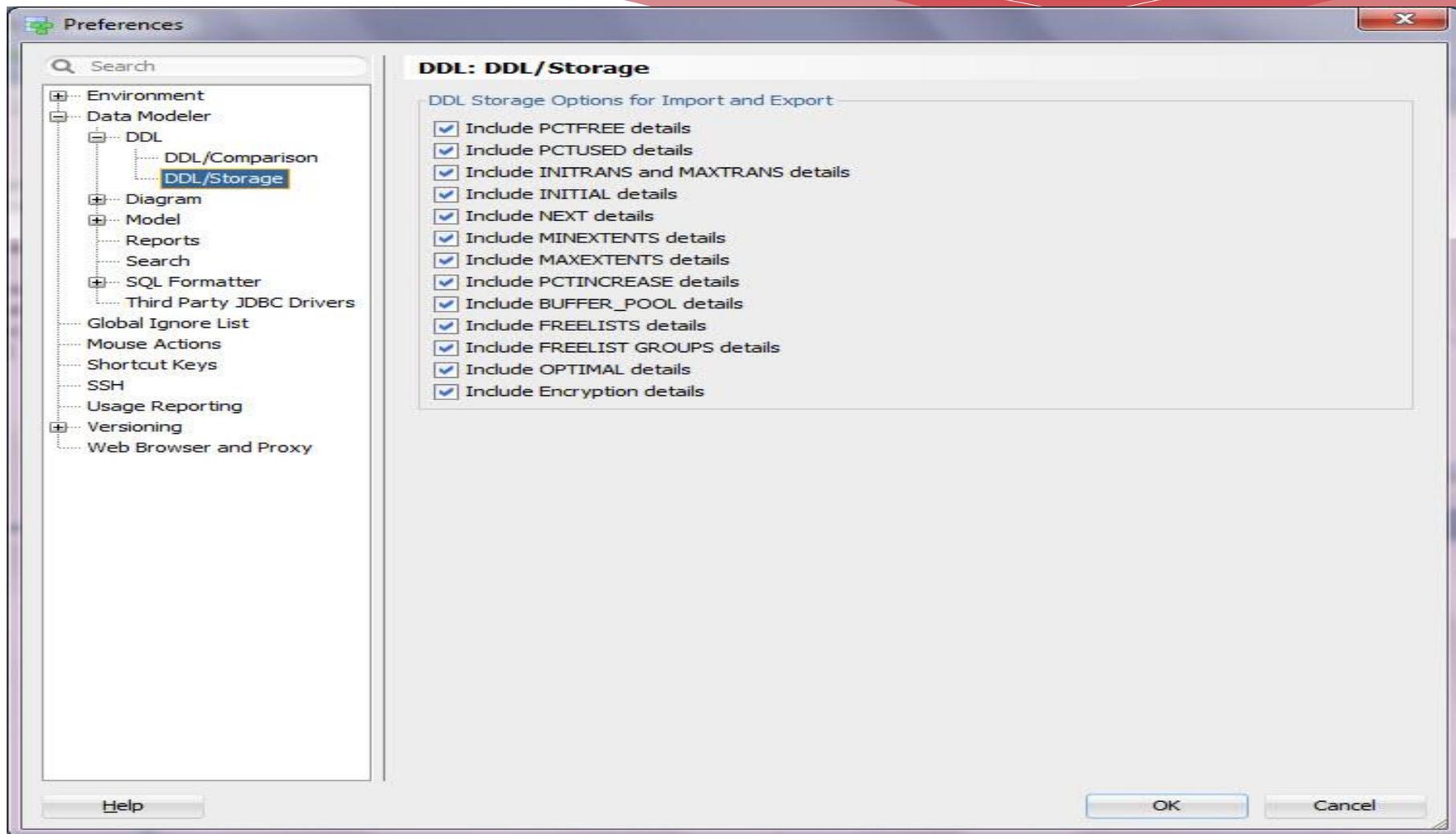
The Versing Navigator shows a Subversion design directory with branches, tags, and trunk. The Messages - Log and Pending Changes panes are empty. The status bar at the bottom indicates 0 Incoming Changes, 0 Outgoing Changes, and 0 Unversioned Files.

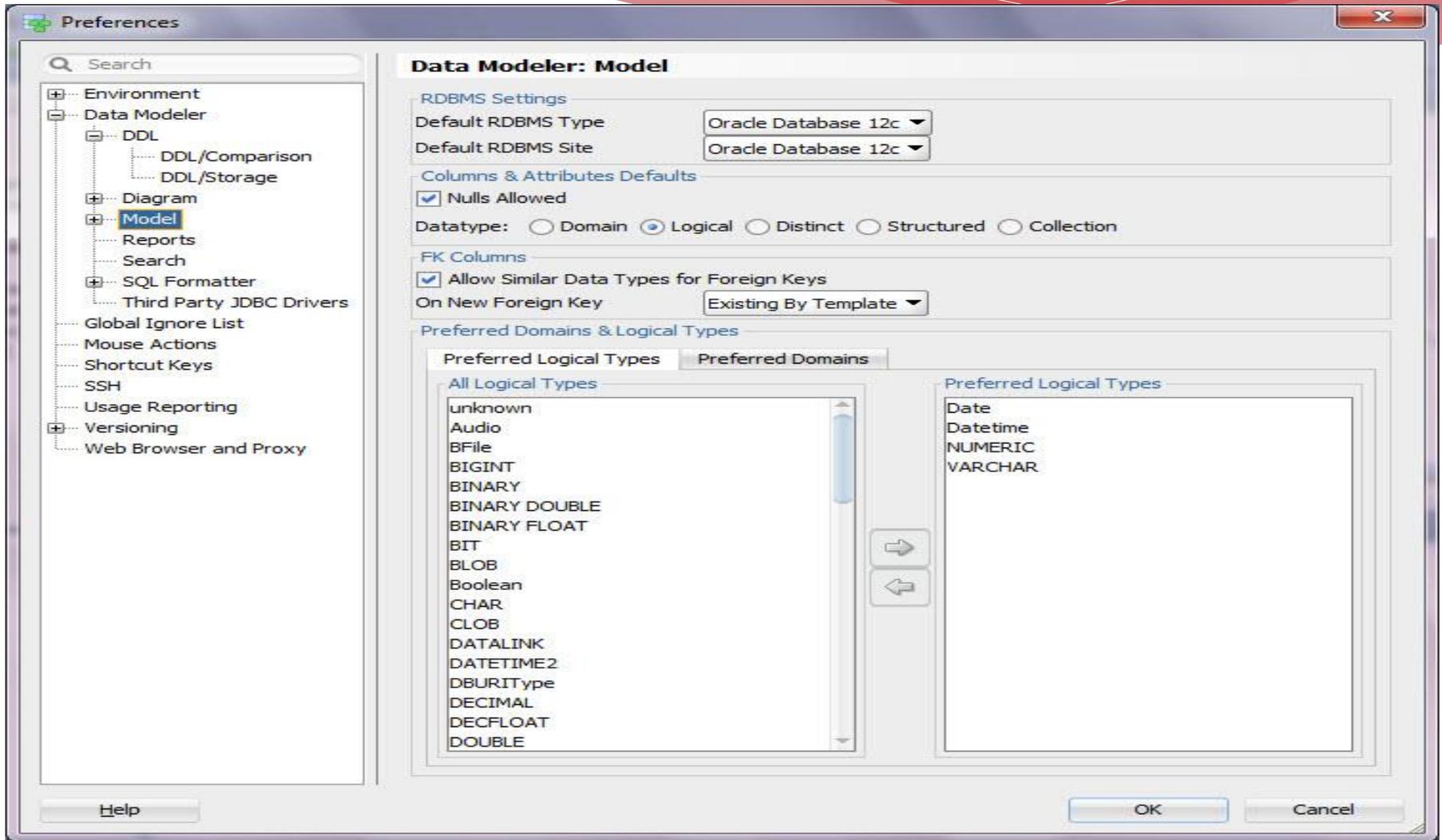




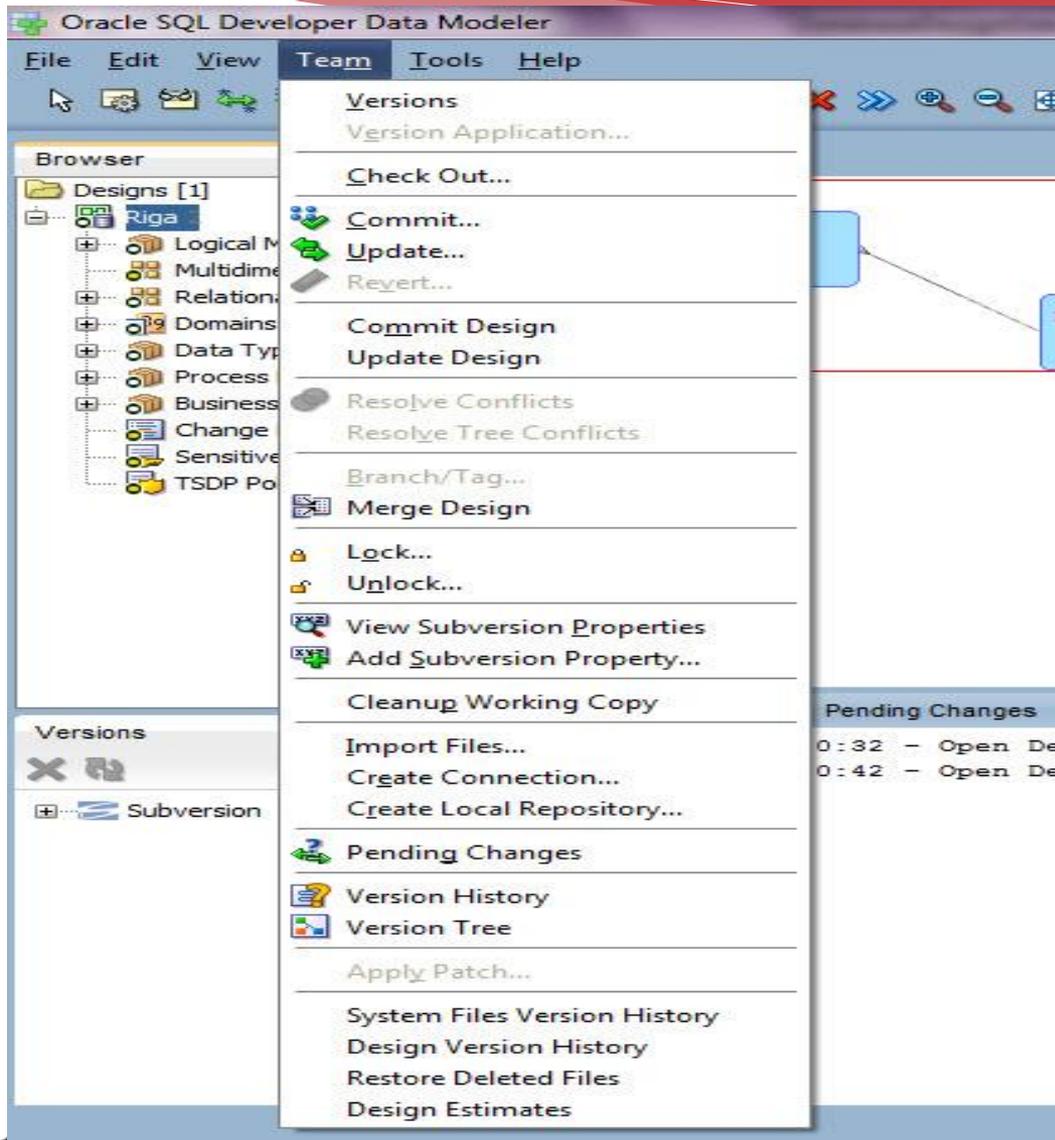








Version control (Subversion)



Oracle SQL Developer Data Modeler

File Edit View Versioning Tools Help

Browser x

Start Page x Logical (Orderdb) x Relational_1 (Orderdb) x

Designs [1]
Orderdb

- Logical Model
 - Entities [4]
 - Customer
 - Order
 - OrderLine
 - Product
 - Primary Keys [1]
 - Alternate Keys []
 - Relations [1]
 - Inheritance From Supertype []
 - Inheritations To Subtypes []
 - Relations [3]
 - Inheritations []
 - Views []
 - SubViews []
 - Displays []
 - Multidimensional Models []
 - Relational Models [1]
 - Domains [3]
 - Data Types Model
 - Process Model
 - Business Information
 - Change Requests []

Relational_1

Order

P *	OrderNo	NUMBER
	OrderDate	DATE
F *	CustomerNo	NUMBER
Order_PK (OrderNo)		

Customer

P *	CustomerNo	NUMBER
	Name	VARCHAR
	DeliveryAddress	VARCHAR
	MailAddress	VARCHAR
	ContactPerson	VARCHAR
Customer_PK (CustomerNo)		

OrderLine

P *	OrderlineNo	NUMBER (10)
	Pos	NUMBER
	Price	NUMBER (15,2)
PF *	OrderNo	NUMBER
F *	ProductNo	NUMBER (10)

Product

P *	ProductNo	NUMBER (10)
	Product Name	VARCHAR2
	Description	VARCHAR2
Product_PK (ProductNo)		

Versioning Navigator x

Subversion

Messages - Log x Pending Changes x

Orderdb (C:\ohjelmat\DataModeler\mallit\DesignsDirectory\...)

Orderdb

- Logical
 - Entities
 - Product [113]
 - Customer [113]
 - Relational Models
 - mapping

Incoming Changes: 0 Outgoing Changes: 5 Unversioned Files: 0

Editing

XML Metadata Comparator

Filter

Product (Last Synchronized (Local))

- Complex Properties
 - attributes
 - (0) ProductNo
 - Complex Properties
 - (1) ProductName
 - TO DELETE**
- identifiers
- fonts

Product (Local Saved)

- Complex Properties
 - attributes
 - (0) ProductNo
 - Complex Properties
 - (1) ProductName
 - Description**
- identifiers
- fonts

Details

Property	Selected		
name	<input checked="" type="checkbox"/>		Description
id	<input checked="" type="checkbox"/>		B23C918F-BAE4-590E-3A31-BB36CAA16...
ownerDesignName	<input checked="" type="checkbox"/>		Orderdb
nullsAllowed	<input checked="" type="checkbox"/>	false	true
useDomainConstraints	<input checked="" type="checkbox"/>	true	false
Data Type Kind	<input checked="" type="checkbox"/>		Logical Type
logicalDatatype	<input checked="" type="checkbox"/>	LOGDT017	VARCHAR / LOGDT024
dataTypeSize	<input checked="" type="checkbox"/>		200
createdBy	<input checked="" type="checkbox"/>		helskyaho_h
createdTime	<input checked="" type="checkbox"/>		2012-09-27 11:14:08 UTC

Merge Close Help

Oracle SQL Developer Data Modeler

File Edit View Versingning Tools Help

Start Page x Logical (Orderdb) x Relational_1 (Orderdb) x

Browser x

- Designs [1]
 - Orderdb
 - Logical Model
 - Entities [4]
 - Customer
 - Order
 - OrderLine
 - Product
 - ProductNo
 - ProductName
 - Description
 - Primary Keys [1]
 - Alternate Keys []
 - Relations [1]
 - Inheritance From Supertype []
 - Inheritances To Subtypes []
 - Relations [3]
 - Inheritances []
 - Views []
 - SubViews []
 - Displays []
 - Multidimensional Models []
 - Relational Models [1]
 - Domains [3]
 - Data Types Model
 - Process Model
 - Business Information
 - Change Requests []

Order

P *	OrderNo	NUMBER
	OrderDate	DATE
F *	CustomerNo	NUMBER
Order_PK (OrderNo)		

Customer

P *	CustomerNo	NUMBER
	Name	VARCHAR
	DeliveryAddress	VARCHAR
	MailAddress	VARCHAR
	ContactPerson	VARCHAR
Customer_PK (CustomerNo)		

OrderLine

P *	OrderlineNo	NUMBER (10)
	Pes	NUMBER
	Price	NUMBER (15)
PF *	OrderNo	NUMBER
F *	ProductNo	NUMBER (10)
OrderLine_PK (OrderlineNo, Or		

Product

P *	ProductNo	NUMBER (10)
	ProductName	VARCHAR2
	Description	VARCHAR2
Product_PK (ProductNo)		

Versioning Navigator x

SVN Console - Log x Pending Changes x

Orderdb (C:\ohjelmat\DataModeler mallit\DesignsDirectory\...)

Orderdb Commit...

Incoming Changes: 0 Outgoing Changes: 1 Unversioned Files: 0

Editing

Commit Resources

Name ▲	Location	Status	Select
 Customer	Logical \ Entities	M	<input checked="" type="checkbox"/>

Keep Locks

Comments:

Template or Previous Comments:

<Select> ▼

This list is configured with [comment templates](#)

Conclusions

- * To be able to connect to the database, to see its content online and to maintain the data: **SQL Developer**
- * To *design* the database and to maintain the data structures: **Data Modeler**
- * To *design* the data architecture: **Data Modeler**

Conclusions

- * Data Modeler is a good tool; good support for iterative processes
- * Enables documenting and versioning (and comparing the versions)
- * Enables multiuser environment
- * Is free to use
- * Support for other databases as well
- * I see no reason not to use it!

THANK YOU!

QUESTIONS?

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