**Sample Project Chapter 7 - Creating an Object-Relational Database for The Art Gallery Using an EE-R Diagram.**

An object-relational database can be created from either a UML diagram or an EE-R diagram. For practice, we will use the EE-R diagram for this step. In chapter 3, we modified our E-R diagram by adding hierarchies and a union. We have a Person entity with overlapping specializations Collector, Artist, Customer, and Salesperson. Customer has Buyer as a subentity. We also created an attribute-defined specialization of Artwork into ReturnedWork, WorkforSale, and SoldWork. One difference between the EER diagram and the UML diagram is that the EE-R diagram includes a union called owner for Collector and Artist. 

**Person** Attributes: pid, name(firstName, lastName), address(street, city, state, zip), phone(areaCode, telephoneNumber)

**Artist** Subset of Person, additional attributes: interviewDate, interviewerName, salesLastYear, salesYearToDate, socialSecurityNumber, usualMedium, usualStyle, usualType

**Collector** Subset of Person, additional attributes: socialSecurityNumber, interviewDate, interviewerName, salesLastYear, salesYearToDate

**Salesperson** Subset of Person, additional attributes: socialSecurityNumber

**Customer** Subset of Person, additional Attributes: dateFilledIn, preferredArtistId, preferredMedium, preferredStyle, preferredType

**Buyer** Subset of Customer. Additional Attributes: purchasesLastYear, purchasesYearToDate

**Owner**: union of Artist and Collector. Attributes ownerid, ownertype

**Artwork** Attributes: artworkId*,* workTitle, askingPrice, dateListed, dateShown, status, workMedium, workSize, workStyle, workType, workYearCompleted

**SoldWork** Subset of Artwork. Additional attribute: dateSold

**ReturnedWork** Subset of Artwork: Additional attribute: dateReturned

**WorkForSale S**ubset of Artwork: Additional attribute: location

**Show** Attributes: showTitle, showClosingDate, showTheme, showOpeningDate

**Sale** Attributes: InvoiceNumber, amountRemittedToOwner, saleDate, salePrice, saleTax

Figure S.3.2 EE-R - Diagram for The Art Gallery

* Step 7.6 - Map the EE-R diagram to an Object-Relational Model

We will define structured types for addresses, names, and telephone numbers. We will use UDTs, defining types and then creating object tables of those types. To help us distinguish between the type and the table, we will use the plural form for the name of the table. We will use REF types to represent relationships. We have two hierarchies and a union to map from the EE-R diagram.

For the Person hierarchy, we begin by creating a PersonType type, with subtypes CollectorType, ArtistType, CustomerType, and SalespersonType. Instead of a single table containing all types of persons, we will create separate tables for these subtypes, called Collectors, Artists, Customers, and Salespersons. We will make BuyerType a subtype of CustomerType, but we will store buyers in the substitutable Customers table.

For the second hierarchy, we will create an ArtworkType with subtypes SoldWork, ReturnedWork, and WorkforSale. All subtypes will be stored in the substitutable Artworks table, in which we will replace the foreign key for Artist that we had in the strictly relational model by a reference to Artists, and add a Collectors reference in place of the foreign key for Collector for works owned by collectors. The Sold Works records in that table will have a reference to Buyers.

To translate the union, it would appear that we could create an OwnerType having OwnerID and ownertype as attributes, and an Owners table. Since both Artists and Collectors are PersonType types, we might think we could use a reference in Artworks to a PersonType, which could turn out to be either subtype. However, we decided earlier that in our Oracle implementation, we would not create a substitutable table for Person, but create tables only for the subtypes, so although the reference would be a single type, the scope could be either the Artists table or the Collectors table, and Oracle requires that we specify a single table for the scope. Therefore, we decide that we will include a reference type only to the Collectors table and that if the owner is the artist, the reference will be null. We will not create the OwnerType or the Owners table.

The Customers table will have a reference to the preferred artist. The Shows table will have a reference to Artists, to represent the featured artist, if any. ShownIn is still needed for the many-to-many relationship, but both foreign keys will be replaced by references. The Sales table will have references to SoldWork type, BuyersType, and SalespersonType, with scopes of the corresponding tables.

* Step 7.7 - Write the DDL to create the object-relational database, using Oracle syntax, and execute the commands. The code shown below is stored in the text file called *DDLforORModelArtGallery* in this directory. You should execute the code to create your own database.

CREATE OR REPLACE TYPE AddressType AS OBJECT(

street VARCHAR2(50),

city VARCHAR2(15),

state CHAR(2),

zip CHAR(10));

CREATE OR REPLACE TYPE PhoneType AS OBJECT(

areaCode CHAR(3),

telephoneNumber CHAR(7));

CREATE OR REPLACE TYPE NameType AS OBJECT(

firstName VARCHAR2 (15),

lastName VARCHAR2 (20));

CREATE OR REPLACE TYPE PersonType AS OBJECT(

pId NUMBER(6),

name NameType,

address AddressType,

phone PhoneType)

NOT FINAL;

CREATE OR REPLACE TYPE ArtistType UNDER PersonType (

interviewDate DATE,

interviewerName NameType,

salesLastYear NUMBER(8,2),

salesYearToDate NUMBER(8,2),

socialSecurityNumber CHAR(9),

usualMedium VARCHAR2(15),

usualStyle VARCHAR2(15),

usualType VARCHAR2(20));

CREATE TABLE Artists OF ArtistType(

CONSTRAINT Artists\_pId\_pk PRIMARY KEY (pid),

CONSTRAINT Artists\_SSN\_uk UNIQUE (socialSecurityNumber));

CREATE OR REPLACE TYPE CollectorType UNDER PersonType(

socialSecurityNumber CHAR(9),

interviewDate DATE,

interviewerName NameType,

salesLastYear NUMBER (8,2),

salesYearToDate NUMBER(8,2));

CREATE TABLE Collectors OF CollectorType(

CONSTRAINT Collectors\_pid\_pk PRIMARY KEY (pid),

CONSTRAINT Collectors\_SSN\_uk UNIQUE (socialSecurityNumber));

CREATE OR REPLACE TYPE CustomerType UNDER PersonType (

dateFilledIn DATE,

preferredartist REF ArtistType,

preferredMedium VARCHAR2(15),

preferredStyle VARCHAR2(15),

preferredType VARCHAR2(20))

NOT FINAL;

CREATE TABLE Customers OF CustomerType(

CONSTRAINT Customers\_pId\_pk PRIMARY KEY (pId));

CREATE OR REPLACE TYPE BuyerType UNDER CustomerType(

purchasesLastYear NUMBER(8,2),

purchasesYearToDate NUMBER(8,2));

CREATE OR REPLACE TYPE ArtworkType AS OBJECT (

artworkId NUMBER(6),

artistId REF ArtistType,

workTitle VARCHAR2(50),

askingPrice NUMBER(8,2),

dateListed DATE,

dateShown DATE,

status VARCHAR2(15),

workMedium VARCHAR2(15),

workSize VARCHAR2(15),

workStyle VARCHAR2(15),

workType VARCHAR2(20),

workYearCompleted CHAR(4),

ownerId REF PersonType)

NOT FINAL;

CREATE TABLE Artworks OF ArtworkType(

CONSTRAINT Artwork\_artworkId\_pk PRIMARY KEY (artworkId));

CREATE OR REPLACE TYPE ReturnedWorkType UNDER ArtworkType (

dateReturned DATE);

CREATE OR REPLACE TYPE WorkForSaleType UNDER ArtworkType (

Location VARCHAR2(50));

CREATE OR REPLACE TYPE SoldWorkType UNDER ArtworkType (

dateSold DATE);

CREATE OR REPLACE TYPE ShowType AS OBJECT (

ShowTitle VARCHAR2(50),

artistid REF artistType,

showClosingDate DATE,

showTheme VARCHAR2(50),

showOpeningDate DATE);

CREATE TABLE Shows of ShowType (

CONSTRAINT Shows\_ShowTitle\_pk PRIMARY KEY (ShowTitle));

CREATE TABLE ShownIn(

workId REF ArtworkType,

showId REF ShowType);

CREATE OR REPLACE TYPE SalespersonType UNDER PersonType (

socialSecurityNumber CHAR(9));

CREATE TABLE Salespeople OF SalespersonType(

CONSTRAINT Salespeople\_pid\_pk PRIMARY KEY(pid),

CONSTRAINT Salespeople\_SSN\_uk UNIQUE (socialSecurityNumber));

CREATE OR REPLACE TYPE SaleType AS OBJECT (

invoiceNumber NUMBER(6),

workId REF ArtworkType,

amountRemittedToOwner NUMBER (8,2),

saleDate DATE,

salePrice NUMBER (8,2),

saleTax NUMBER (6,2),

salesperson REF SalespersonType);

CREATE TABLE Sales OF SaleType(

CONSTRAINT Sales\_invNum\_pk PRIMARY KEY (invoiceNumber));

CREATE OR REPLACE TYPE CollectionType AS OBJECT (

cid REF CollectorType,

aid REF ArtistType,

collectionMedium VARCHAR2(15),

collectionStyle VARCHAR2(15),

collectionType VARCHAR2(20));

CREATE TABLE Collections OF CollectionType;

* Step 7.8 - Insert several records in each table. The following code is stored in a text file in this directory called *DataForORModelArtGallery.* Use that file to populate your database. Add some new records of your own, modeling your entries on those shown.

INSERT INTO Artists VALUES(ArtistType(101, NameType('Leonardo','Vincenti'),AddressType('10 Main Street','New York', 'NY','10101'),PhoneType('212', '5559999'),'10-OCT-2010',NameType('Alan','Hughes'), 9000, 4500,'099999876', 'oil', 'realism', 'painting'));

INSERT INTO Artists VALUES(ArtistType(102, NameType('Vincent','Gogh'),AddressType('55 West 18 Street','New Rochelle', 'NY', '10801'),PhoneType('914', '5551234'), '15-Jun-2009',NameType('Alan','Hughes'), 9500, 5500,'099999877', 'oil', 'impressionism', 'painting'));

INSERT INTO Artists VALUES(ArtistType(103, NameType('Winslow','Homes'),AddressType('100 Water Street', 'San Diego', 'CA' ,'92101'),PhoneType('619', '1234567'), '05-Jan-2011',NameType('Alan','Hughes'), 14000, 4000,'083999876', 'watercolor', 'realism', 'painting'));

INSERT INTO Artists VALUES(ArtistType(104, NameType('Alexander','Calderone'),AddressType('10 Main Street', 'New York','NY','10101'),PhoneType('212', '5559999'), '15-Jun-2009',NameType('Alan','Hughes'), 20000, 20000,'123999876', 'steel', 'cubism', 'sculpture'));

INSERT INTO Artists VALUES(ArtistType(105, NameType('Georgia','Keefe'),AddressType('5 Chestnut Street', 'Miami', 'FL','33010'),PhoneType('305', '1239999'), '15-Jun-2009',NameType('Alan','Hughes'), 19000, 14500,'987999876', 'oil', 'realism', 'painting'));

INSERT INTO Customers VALUES(CustomerType(201,NameType('Adam','Burns'),AddressType('1 Spruce Street','New York', 'NY','10101'),PhoneType('917','3456789'), '12-Dec-2009', (SELECT REF(a) FROM Artists a WHERE a.name.firstName='Leonardo' and a.name.lastName='Vincenti'), 'watercolor', 'impressionism', 'painting'));

INSERT INTO Customers VALUES(CustomerType(201,NameType('Carole','Burns'),AddressType('1 Spruce Street','New York', 'NY','10101'),PhoneType('917','3456789'), '12-Dec-2010', (SELECT REF(a) FROM Artists a WHERE a.name.firstName='Vincent' and a.name.lastName='Gogh'), 'watercolor', 'realism', 'sculpture'));

INSERT INTO Customers VALUES(CustomerType(201,NameType('David','Engel'),AddressType( '715 North Avenue', 'New Rochelle', 'NY', '10801'),PhoneType('914','7777777'), '08-Aug-2010', (SELECT REF(a) FROM Artists a WHERE a.name.firstName='Winslow' and a.name.lastName='Homes'), 'watercolor', 'realism', 'painting'));

INSERT INTO Customers VALUES(CustomerType(201,NameType('Frances','Hughes'),AddressType('10 Pacific Avenue','San Diego', 'CA' , '92101'),PhoneType('619','3216789'), '05-Jan-2011', (SELECT REF(a) FROM Artists a WHERE a.name.firstName='Vincent' and a.name.lastName='Gogh'), 'oil', 'impressionism', 'painting'));

INSERT INTO Customers VALUES(CustomerType(201,NameType('Irene','Jacobs'),AddressType('1 Windswept Place','Chicago','IL', '60601'),PhoneType('312','1239876'), '21-Sep-2010', (SELECT REF(a) FROM Artists a WHERE a.name.firstName='Georgia' and a.name.lastName='Keefe'), 'watercolor', 'abs expression', 'painting'));

INSERT INTO Customers VALUES(BuyerType(501,NameType('Valerie','Smiley'),AddressType('15 Hudson Street','New York', 'NY', '10101'),PhoneType('718','5551234'), '10-Dec-2010', (SELECT REF(a) FROM Artists a WHERE a.name.firstName='Vincent' and a.name.lastName='Gogh'), 'watercolor', 'realism', 'painting' , 5000, 7500));

INSERT INTO Customers VALUES(BuyerType(502,NameType('Winston'','Lee'),AddressType('20 Liffey Avenue', 'Chicago', 'IL', '60601'),PhoneType('312','7654321'), '12-Dec-2010', (SELECT REF(a) FROM Artists a WHERE a.name.firstName='Winslow' and a.name.lastName='Homes'), 'watercolor', 'realism', 'painting' , 3000, 0));

INSERT INTO Customers VALUES(BuyerType(503,NameType('Samantha','Babson'),AddressType('25 Thames Lane', 'San Diego', 'CA' ,'92101'),PhoneType('619','4329876'), '12-Oct-2010', (SELECT REF(a) FROM Artists a WHERE a.name.firstName='Georgia' and a.name.lastName='Keefe'), 'watercolor', 'realism', 'painting' , 15000, 0));

INSERT INTO Customers VALUES(BuyerType(504,NameType('John','Flagg'),AddressType('22 Amazon Street', 'New York', 'NY','10101'),PhoneType('212','7659876'), '12-Jan-2011', (SELECT REF(a) FROM Artists a WHERE a.name.firstName='Vincent' and a.name.lastName='Gogh'), 'watercolor', 'realism', 'painting' , 3000,0));

INSERT INTO Customers VALUES(BuyerType(505,NameType('Terrence','Smallshaw'),AddressType('5 Nile Street', 'Miami', 'FL','33010'),PhoneType('305','2323456'), '15-Mar-2011', (SELECT REF(a) FROM Artists a WHERE a.name.firstName='Alexander' and a.name.lastName='Calderone'), 'watercolor', 'realism', 'painting' , 15000, 17000));

INSERT INTO Salespeople VALUES(SalespersonType(301, NameType('John','Smith'),AddressType('10 Sapphire Row', 'New Rochelle', 'NY','10801'),PhoneType('914', '1112222'),'102445566'));

INSERT INTO Salespeople VALUES(SalespersonType(302, NameType('Alan','Hughes'),AddressType('10 Diamond Street', 'New York', 'NY','10101'),PhoneType('212', '1232222'),'121344321'));

INSERT INTO Salespeople VALUES(SalespersonType(303, NameType('Mary','Brady'),AddressType( '10 Pearl Avenue', 'New Rochelle', 'NY','10801'),PhoneType('914', '3332222'),'101889988'));

INSERT INTO Salespeople VALUES(SalespersonType(304, NameType('Jill','Fleming'),AddressType('10 Ruby Row','New York', 'NY', '10101'),PhoneType('212', '4443333'),'111223344'));

INSERT INTO Salespeople VALUES(SalespersonType(305, NameType('Terrence','DeSimone'),AddressType('10 Emerald Lane', 'New York', 'NY','10101'),PhoneType('212', '8889999'),'123123123'));

INSERT INTO Collectors VALUES(CollectorType(401, NameType('John','Jackson'),AddressType('24 Pine Avenue','New York', 'NY','10101'),PhoneType('917', '7771234'),'102345678', '01-Feb-2010', nameType('Alan','Hughes'), 4000,3000));

INSERT INTO Collectors VALUES(CollectorType(402, NameType('Mary','Lee'),AddressType('10 Ash Street','Miami', 'FL','33010'),PhoneType('305', '5551234'),'987654321', '01-Mar-2009', nameType('Alan','Hughes'), 2000,3000));

INSERT INTO Collectors VALUES(CollectorType(403, NameType('Ramon','Perez'),AddressType('15 Poplar Avenue','San Diego', 'CA' ,'92101'),PhoneType('619', '8881234'),'034345678', '15-Apr-2011', nameType('Alan','Hughes'), 4500,3500));

INSERT INTO Collectors VALUES(CollectorType(404, NameType('Rick','Lee'),AddressType('24 Pine Avenue','New York', 'NY','10101'),PhoneType('212', '9991234'),'888881234', '20-Jun-2011', nameType('Alan','Hughes'), 4000,3000));

INSERT INTO Collectors VALUES(CollectorType(405, NameType('Samantha','Torno'),AddressType('10 Ash Street','Miami', 'FL','33010'),PhoneType('305', '5551234'),'777345678', '05-May-2010', nameType('Alan','Hughes'), 40000,30000));

INSERT INTO Artworks VALUES(WorkForSaleType(1,(SELECT REF(A) FROM Artists a WHERE a.name.firstName='Leonardo' and a.name.lastName='Vincenti'),'Flight', 15000.00, '08-Sep-2010',null, 'oil', '36 in X 48 in', 'realism', 'painting','2009',(SELECT REF(A) FROM Artists a WHERE a.name.firstName='Leonardo' and a.name.lastName='Vincenti'), 'showroom A'));

INSERT INTO Artworks VALUES(WorkForSaleType(2,(SELECT REF(A) FROM Artists a WHERE a.name.firstName='Winslow' and a.name.lastName='Homes'),'Mediterranean Coast', 4000.00, '18-Oct-2010',null, 'watercolor', '22 in X 28 in', 'realism', 'painting','2000',(SELECT REF(C) FROM Collectors c WHERE c.name.firstName='Samantha' and c.name.lastName='Torno'), 'showroom B'));

INSERT INTO Artworks VALUES(ReturnedWorkeType(3,(SELECT REF(A) FROM Artists a WHERE a.name.firstName='Alexander' and a.name.lastName='Calderone'),'Five Planes', 15000.00, '10-Jan-2011','10-Mar-2011', 'steel', '36 X 30 X 60 in', 'cubism', 'sculpture','2003',(SELECT REF(C) FROM Collectors c WHERE c.name.firstName='Samantha' and c.name.lastName='Torno'), '1-Sep-2011'));

INSERT INTO Artworks VALUES(SoldType(4,(SELECT REF(A) FROM Artists a WHERE a.name.firstName='Winslow' and a.name.lastName='Homes'),'Bermuda Sunset', 8000.00,

'15-Mar-2011',null, watercolor', '22 in X 28 in', 'realism', 'painting','2003',(SELECT REF(A) FROM Artists a WHERE a.name.firstName='Winslow' and a.name.lastName='Homes'), '25-Mar-2011'));

INSERT INTO Collections VALUES(CollectionType((SELECT REF(C) FROM Collectors c WHERE pid=401),(SELECT REF(a) FROM Artists A WHERE pid=102), 'watercolor', 'realism', 'painting'));

INSERT INTO Shows VALUES(ShowType('The Sea in Watercolor',(SELECT REF(a) FROM Artists A WHERE pid=102), '30-Apr-2011','seascapes','01-Apr-2011'));

INSERT INTO Shows VALUES(ShowType('Calderone''s Mastery of Space',(SELECT REF(a) FROM Artists A WHERE pid=104), '20-Mar-2011','steel sculpture','01-Mar-2011'));

INSERT INTO ShownIn VALUES((SELECT REF(w) FROM Artworks w WHERE artworkID=2), (SELECT REF(s) FROM Shows s WHERE showTitle = 'The Sea in Watercolor'));

INSERT INTO ShownIn VALUES((SELECT REF(w) FROM Artworks w WHERE artworkID=3), (SELECT REF(s) FROM Shows s WHERE showTitle = 'The Sea in Watercolor'));

INSERT INTO ShownIn VALUES((SELECT REF(w) FROM Artworks w WHERE artworkID=4), (SELECT REF(s) FROM Shows s WHERE showTitle = 'Calderone''s Mastery of Space'));

INSERT INTO Sales VALUES(SaleType(123456,(SELECT REF(w) FROM Artworks w WHERE artworkID=4),0,'15-APR-2011' ,7500,750,(SELECT REF(s) FROM Salespeople s WHERE s.name.firstname='John' and s.name.lastname='Smith')));

* Step 7.9 - Write five DML commands for the new database, illustrating differences from the strictly relational DML. The following code is stored in a textfile in this directory called *QueriesforORModelArtGallery*. You should copy and execute them to test your database. Make up some queries of your own and test them on the database.

--1. Find the names of all artists who were interviewed after January 1, 2009 but who have no works of art listed.

SELECT a.name.firstName, a.name.lastName

FROM Artists a

WHERE a.interviewDate > '01-Jan-2009' AND a.pid NOT IN (SELECT a.aid.pid

FROM Artworks a);

--2. Find the total commission for salesperson John Smith earned between the dates April 1, 2011 and April 15, 2011. --Recall that the gallery charges 10% commission, and the salesperson receives one-half of that, which is 5% of the --selling price.

SELECT .05 \* SUM(s.salePrice) AS Commission\_for\_John\_Smith

FROM Sales s

WHERE s.saleDate >='01-Apr-2011' AND s.saleDate <='15-Apr-2011' AND

s.sid.pid = (SELECT p.pid

FROM Salespeople p

WHERE p.name.firstName= 'John' AND p.name.lastName ='Smith');

--3.Find the collector names and artwork titles of all artworks that are owned by collectors, not by the --artists themselves, in order by the collector’s last name.

SELECT c.name.lastName as Coll, w.workTitle as Title

FROM Collectors c, Artworks w

WHERE w.ownId.pid=c.pid and w.ownId.pid IN (SELECT pid FROM Collectors)

ORDER BY c.name.lastName;

--4.For each Customer, find information about shows that feature his or her preferred artist.

SELECT c.name.lastName As Customer, s.showOpeningDate As Opens, s.showClosingDate AS Closes,s.showTitle as Show

FROM Shows s , Customers c

WHERE s.aid.pid = c.aid.pid

ORDER BY c.name.lastName;

--5.Find the average sale price of works of artist Winslow Homes.

SELECT AVG(s.salePrice) AS AveragePrice\_for\_Homes

FROM Sales s

WHERE s.workId.artworkID IN (SELECT w.artworkid

FROM Artworks w

WHERE w.aid.pid = (SELECT a.pid

FROM Artists a

WHERE a.name.lastName = 'Homes' AND a.name.firstName ='Winslow'));