**Sample Project Chapter 3 - Drawing an EE-R Diagram for The Art Gallery.**

* Step 3.5 - Modify the E-R diagram and draw an EE-R diagram to represent the enterprise. Use generalization and union as necessary to express entity set relationships, adding appropriate constraint notation. Identify relationship participation and cardinality constraints using (min,max) notation.

We begin with the E-R diagram and we note that this initial diagram is missing some important features and has some confusing entities and relationships. We identify entity set hierarchies and relationships and modify the diagram.

In the E-R diagram, we observe that Artist, Buyer, Potential Customer, Collector, and Salesperson all have similar attributes. Since they are all people, we could create a Person entity set with subsets of Artist, Collector, Salesperson, PotentialCustomer, and Buyer. However, we also notice that Buyer and PotentialCustomer have some common attributes and they have similar meanings. Both are customers. We see that we keep preferences for potential customers but not for buyers. It makes good business sense to add the preference information for Buyer, and this makes their attributes identical, except that we have additional information about sales totals for buyers. We decide that a buyer is a customer who has actually made a purchase, i.e. a Buyer is someone who has a relationship with a Sale entity. Therefore, we can create an entity set that we will call Customer having a subset Buyer that has a relationship with Sale. The other subsets of Person remain - Artist, Collector, Salesperson. For convenience, we will create a pId attribute as the primary key for all Person entities.

The Artwork entity is pictured in the original E-R diagram as having a relationship to Sale but in fact only those works that have been sold participate in this relationship. The status attribute determines which Artwork entities participate in the relationship. From the possible status values, we can identify three disjoint subsets of Artwork, namely, SoldWork, WorkForSale, and ReturnedWork. Of these, only SoldWork relates to Sale. We add an attribute, location, for WorkForSale. It will give the current location of the artwork, and we move the dateReturned attribute to ReturnedWork.

The Artist and Collector entity sets both relate to Artwork. Examining these sets more closely, we see that an artwork is sometimes owned by the artist and sometimes by a collector. We create a union called Owner of both types of owners of artworks. However, Artist still always participates in the Creates relationship with Artwork, whether the artist is the owner or not.

*EERDiagram-FigS.3.2* shows a sketch of an EE-R diagram for the sample project. To keep the diagram simple, entity set attributes are listed below. We have created a Person entity set, with Collector, Artist, Customer, and Salesperson as subsets. Customer has a subset, Buyer. The Artwork entity set has subsets ReturnedWork, WorkForSale, and SoldWork. We have added relationships among the entity sets, but we need to verify them and to decide on the cardinality and participation constraints. We use the *(min,max)* notation. To produce that diagram we examined each relationship as described below.



**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

For the Creates relationship, we decided earlier that Artist has partial participation, since we may keep data on interviewed artists who do not yet have artworks accepted by the gallery, so the min is 0. The max is n, since an artist can have created many accepted artworks, so we use (0,n) for Artist to Creates. The Artwork always participates in the Creates relationship with exactly one artist, so we use (1,1) for Artwork to Creates. For SoldWork to SoldIn, since each sold work of art is sold exactly once, we use (1,1) for SoldWork to SoldIn. For Sale to SoldIn, both min and max are also 1 , so we write (1,1) on this line. For Sale to SoldTo, each sale has exactly one buyer, so we write (1,1). For Buyer to SoldTo, since a Buyer is, by definition, someone who has been involved in a Sale, the min is 1. Since a buyer can buy many artworks, the max is n, so we use (1,n). For Sale to SoldBy, each sale is made by exactly one salesperson, so we use (1,1). For Salesperson to SoldBy, since a salesperson may not have made any sales yet, the min is 0. A salesperson can make many sales, so the max is n, giving us (0,n). For Owner to Owns, we agreed that we might store Collector or Artist information on people who have not yet had an artwork accepted, so we will assume we can store Owner information without an artwork, making the min 0. An Owner can have many works of art, so the max is n, giving us (0,n). For Artwork to Owns, each work of art has exactly one owner, making it (1,1). For Artwork to ShownIn, the min is 0, since not all works are featured in a show. The max is n, since an artwork can appear in many shows. For Show to ShownIn, we will make the min 1, assuming we could have a showing of a single spectacular piece of art. The max will be n, since a show would normally have many works of art. An artist may or may not appear as preferred by a customer, or may be named by many customers, so the Artist to preferredBy relationship is (0,n). A Customer may or may not name a preferred artist, so that relationship is (0,1).

Now we must decide whether the Owner union is partial or total. To be total, it would mean that every Collector and every Artist must be an Owner. Since we now may have information about artists whose works are owned by collectors, and who are therefore not the owners of those works, this union is partial.

We note that we need to add the new attributes pId and location to the data dictionary for the EE-R model.