

Chapter 7

Relational Database Design by ER- and EER-to-Relational Mapping



FIGURE 7.1
The ER
conceptual
schema
diagram for
the
COMPANY
database.

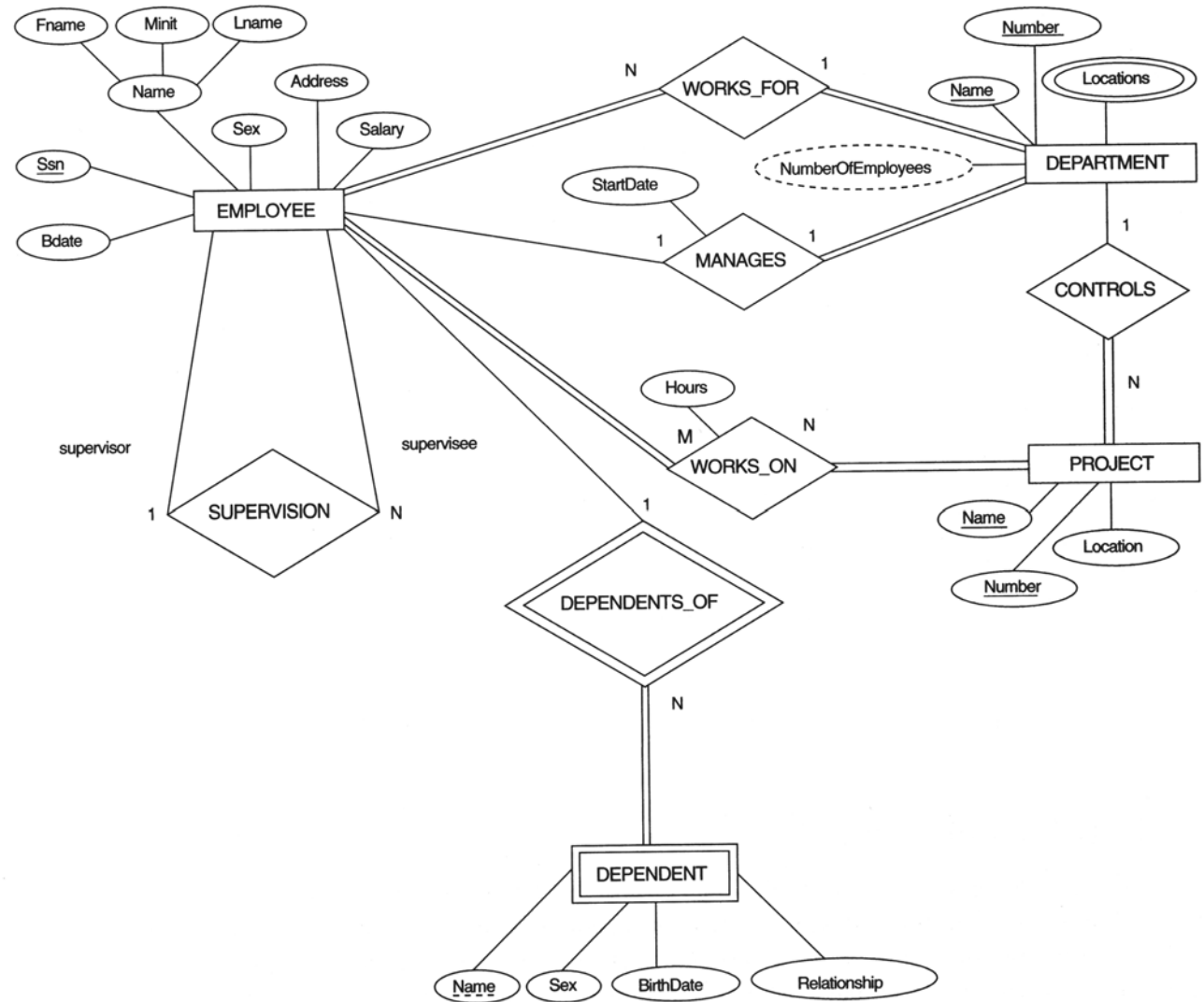
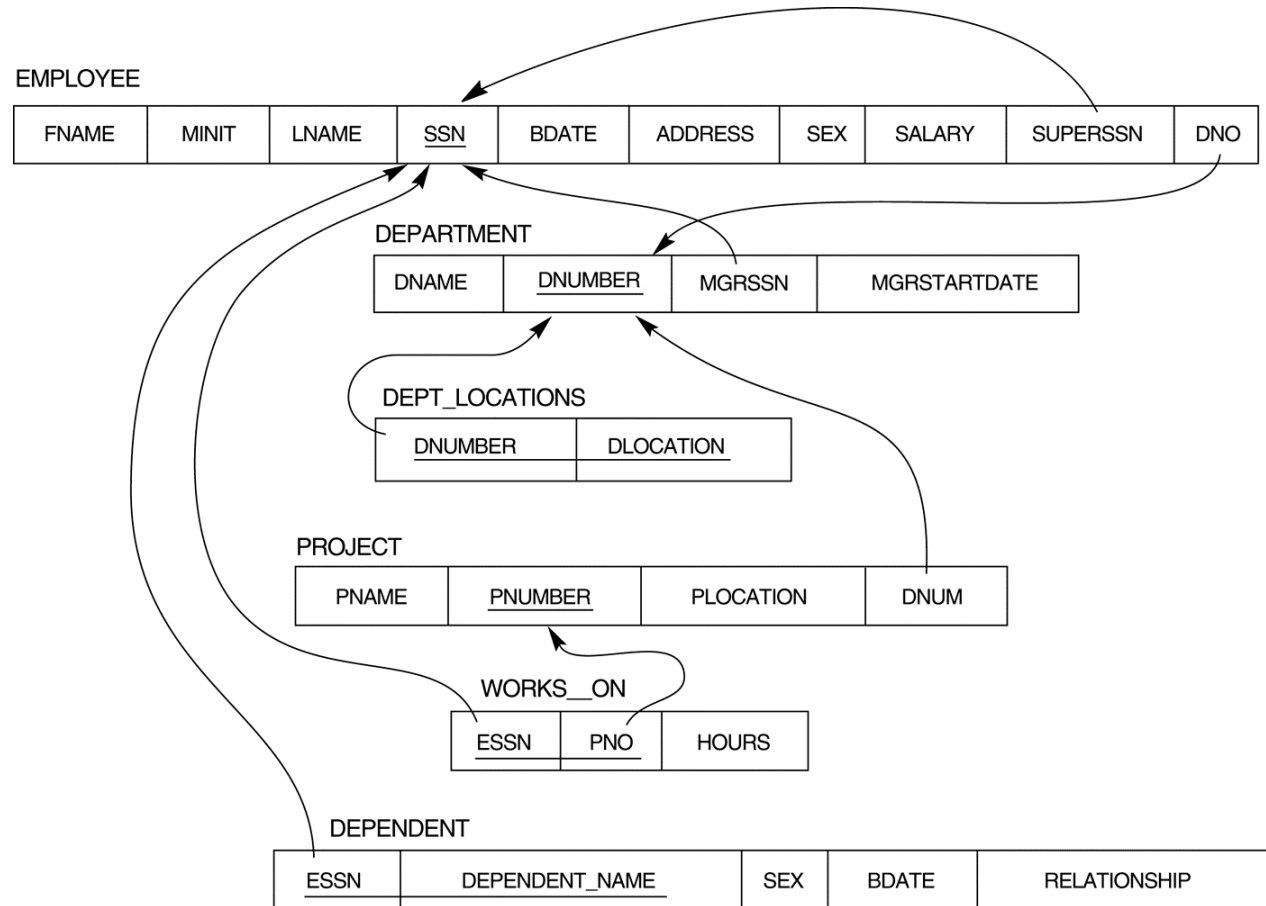


FIGURE 7.2
 Result of
 mapping the
COMPANY
 ER schema
 into a
 relational
 schema.



ER-to-Relational Mapping Algorithm

- **Step 1: Mapping of Regular Entity Types.**

- For each regular (strong) entity type E in the ER schema, create a relation R. Include all of the simple attributes of E in R. For composite attributes, include each component as a separate attribute in R.
- Choose one of the key attributes of E as the primary key for R. If the chosen key of E is composite, the set of simple attributes that form it will together form the primary key of R.

Example: We create the relations EMPLOYEE, DEPARTMENT, and PROJECT in the relational schema corresponding to the regular entities in the ER diagram. SSN, DNUMBER, and PNUMBER are the primary keys for the relations EMPLOYEE, DEPARTMENT, and PROJECT as shown.

ER-to-Relational Mapping Algorithm (cont)

● Step 2: Mapping of Weak Entity Types

- For each weak entity type W in the ER schema with owner entity type E , create a relation R and include all simple attributes (or simple components of composite attributes) of W as attributes of R .
- In addition, include as foreign key attributes of R the primary key attribute(s) of the relation(s) that correspond to the owner entity type(s).
- The primary key of R is the *combination* of the primary key(s) of the owner(s) and the partial key of the weak entity type W , if any.

Example: Create the relation `DEPENDENT` in this step to correspond to the weak entity type `DEPENDENT`. Include the primary key `SSN` of the `EMPLOYEE` relation as a foreign key attribute of `DEPENDENT` (renamed to `ESSN`).

The primary key of the `DEPENDENT` relation is the combination `{ESSN, DEPENDENT_NAME}` because `DEPENDENT_NAME` is the partial key of `DEPENDENT`.

ER-to-Relational Mapping Algorithm (cont)

● Step 3: Mapping of Binary 1:1 Relation Types

- For each binary 1:1 relationship type R in the ER schema, identify the relations S and T that correspond to the entity types participating in R.
- Choose one of the relations-S, say-and include a foreign key in S that references the primary key of T. It is better to choose an entity type with *total participation* in R in the role of S.
- Include any simple attributes (or components of composite attributes) of the 1:1 relation type as attributes of S.

Example: 1:1 relation MANAGES is mapped by choosing the participating entity type DEPARTMENT to serve in the role of S, because its participation in the MANAGES relationship type is total.

ER-to-Relational Mapping Algorithm (cont)

- **Step 4: Mapping of Binary 1:N Relationship Types.**
 - For each regular binary 1:N relationship type R, identify the relation S that represent the participating entity type at the N-side of the relationship type.
 - Include as foreign key in S the primary key of the relation T that represents the other entity type participating in R.
 - Include any simple attributes (or components of composite attributes) of the 1:N relation type as attributes of S.

Example: 1:N relationship types WORKS_FOR, CONTROLS, and SUPERVISION in the figure. For WORKS_FOR we include the primary key DNUMBER of the DEPARTMENT relation as foreign key in the EMPLOYEE relation and call it DNO.

ER-to-Relational Mapping Algorithm (cont)

- **Step 5: Mapping of Binary M:N Relationship Types.**
 - For each regular binary M:N relationship type R, *create a new relation S* to represent R.
 - Include as foreign key attributes in S the primary keys of the relations that represent the participating entity types; *their combination will form the primary key* of S.
 - Also include any simple attributes of the M:N relationship type (or simple components of composite attributes) as attributes of S.

Example: The M:N relationship type WORKS_ON from the ER diagram is mapped by creating a relation WORKS_ON in the relational database schema. The primary keys of the PROJECT and EMPLOYEE relations are included as foreign keys in WORKS_ON and renamed PNO and ESSN, respectively.

Attribute HOURS in WORKS_ON represents the HOURS attribute of the relation type. The primary key of the WORKS_ON relation is the combination of the foreign key attributes {ESSN, PNO}.

ER-to-Relational Mapping Algorithm (cont)

- **Step 6: Mapping of Multivalued attributes.**
 - For each multivalued attribute A, create a new relation R. This relation R will include an attribute corresponding to A, plus the primary key attribute K-as a foreign key in R-of the relation that represents the entity type of relationship type that has A as an attribute.
 - The primary key of R is the combination of A and K. If the multivalued attribute is composite, we include its simple components.

Example: The relation DEPT_LOCATIONS is created. The attribute DLOCATION represents the multivalued attribute LOCATIONS of DEPARTMENT, while DNUMBER-as foreign key-represents the primary key of the DEPARTMENT relation. The primary key of R is the combination of {DNUMBER, DLOCATION}.

ER-to-Relational Mapping Algorithm (cont)

- **Step 7: Mapping of N-ary Relationship Types.**
 - For each n-ary relationship type R, where $n > 2$, create a new relation S to represent R.
 - Include as foreign key attributes in S the primary keys of the relations that represent the participating entity types.
 - Also include any simple attributes of the n-ary relationship type (or simple components of composite attributes) as attributes of S.

Example: The relationship type SUPPLY in the following ER diagram. This can be mapped to the relation SUPPLY shown in the relational schema, whose primary key is the combination of the three foreign keys {SNAME, PARTNO, PROJNAME}

FIGURE 4.11

Ternary relationship types. (a) The SUPPLY relationship.

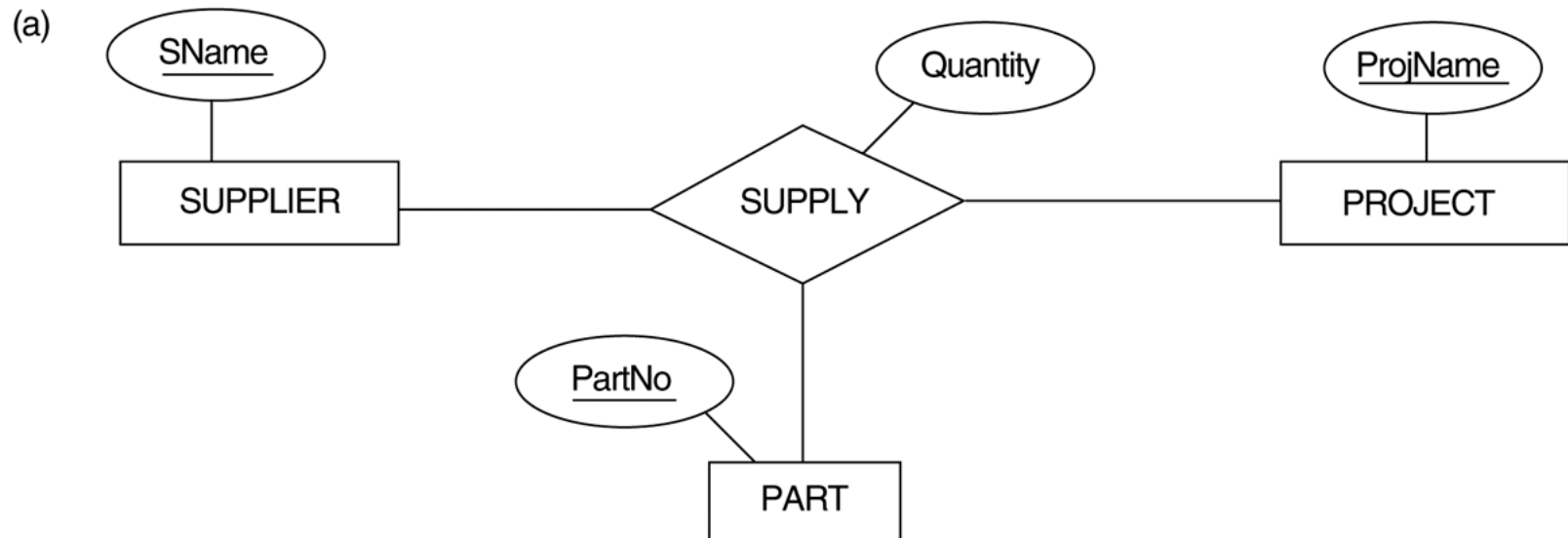


FIGURE 7.3

Mapping the n -ary relationship type SUPPLY from Figure 4.11a.

SUPPLIER

<u>SNAME</u>	...
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PROJECT

<u>PROJNAME</u>	...
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PART

<u>PARTNO</u>	...
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SUPPLY

<u>SNAME</u>	PROJNAME	<u>PARTNO</u>	QUANTITY
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Summary of Mapping constructs and constraints

Table 7.1 Correspondence between ER and Relational Models

ER Model	Relational Model
Entity type	“Entity” relation
1:1 or 1:N relationship type	Foreign key added to a relation
M:N relationship type	“Relationship” relation and two foreign keys
<i>n</i> -ary relationship type	“Relationship” relation and <i>n</i> foreign keys
Simple attribute	Attribute
Composite attribute	Set of simple component attributes
Multivalued attribute	Relation and foreign key
Key attribute	Primary (or secondary) key