

Database Management Systems

Dr. Alshaimaa abo-alian

a_alian@cis.asu.edu.eg



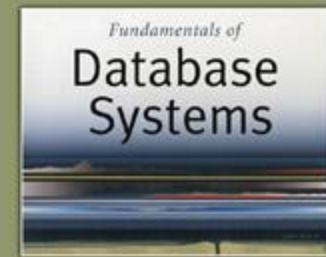
5th Edition

Elmasri / Navathe

Lecture 4

Chapter 9

Relational Database Design by ER-to-Relational Mapping



5th Edition

Elmasri / Navathe



Chapter Outline

■ ER-to-Relational Mapping Algorithm

- Step 1: Mapping of Regular Entity Types
- Step 2: Mapping of Weak Entity Types
- Step 3: Mapping of Binary 1:1 Relation Types
- Step 4: Mapping of Binary 1:N Relationship Types.
- Step 5: Mapping of Binary M:N Relationship Types.
- Step 6: Mapping of Multivalued attributes.
- Step 7: Mapping of N-ary Relationship Types.

FIGURE 7.1

The ER conceptual schema diagram for the COMPANY database.

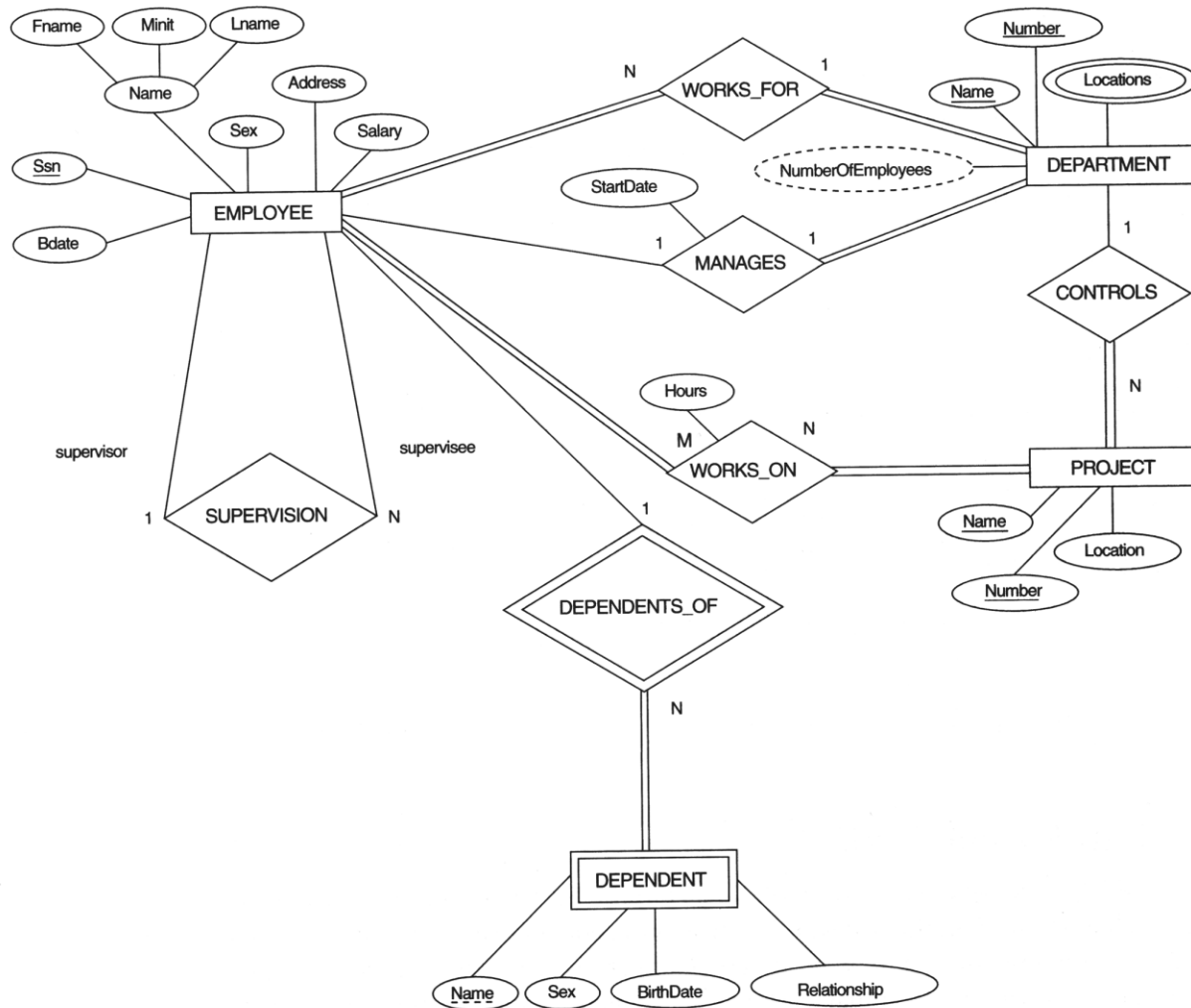


FIGURE 7.2

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

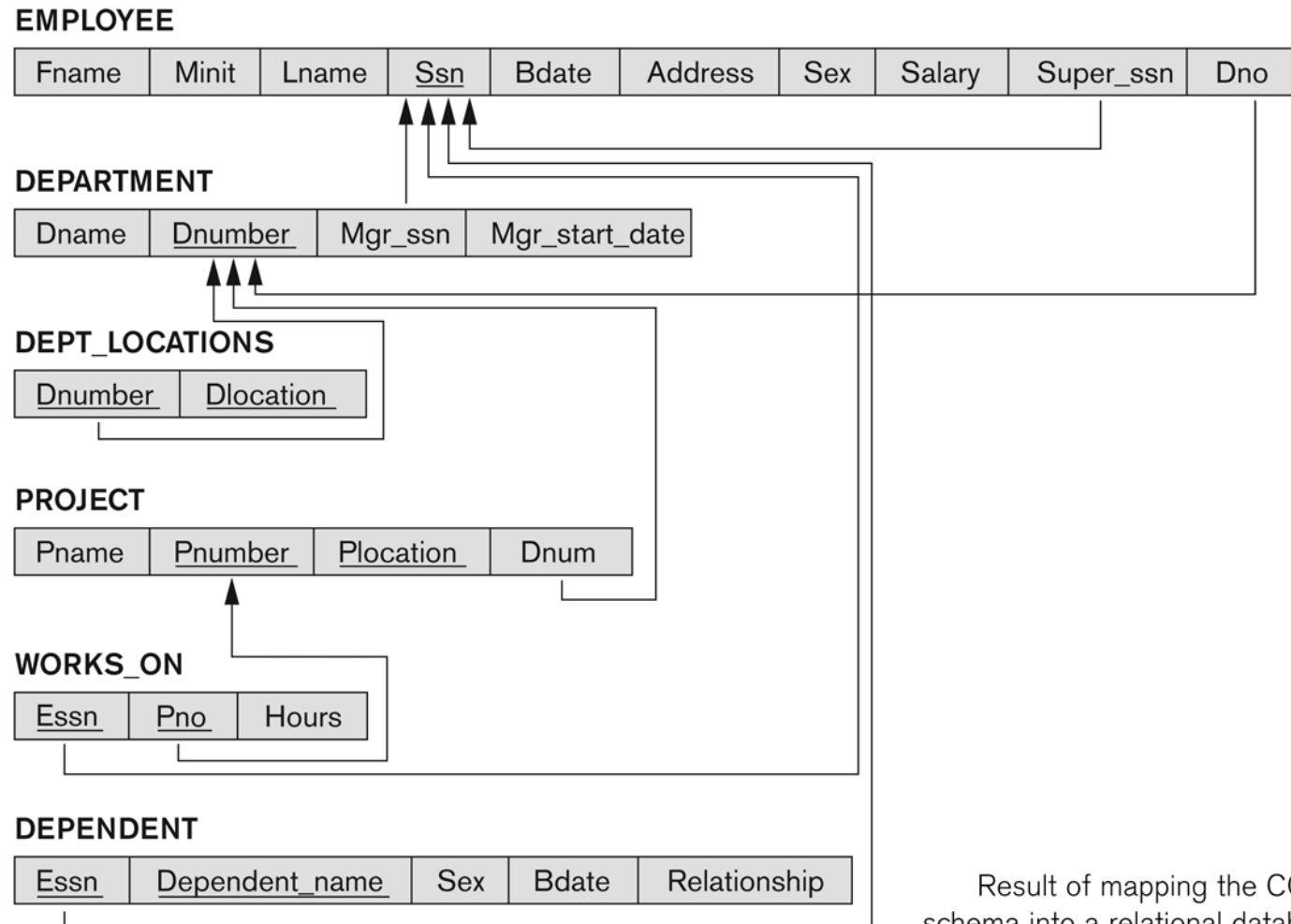


Figure 7.2

Result of mapping the COMPANY ER schema into a relational database schema.



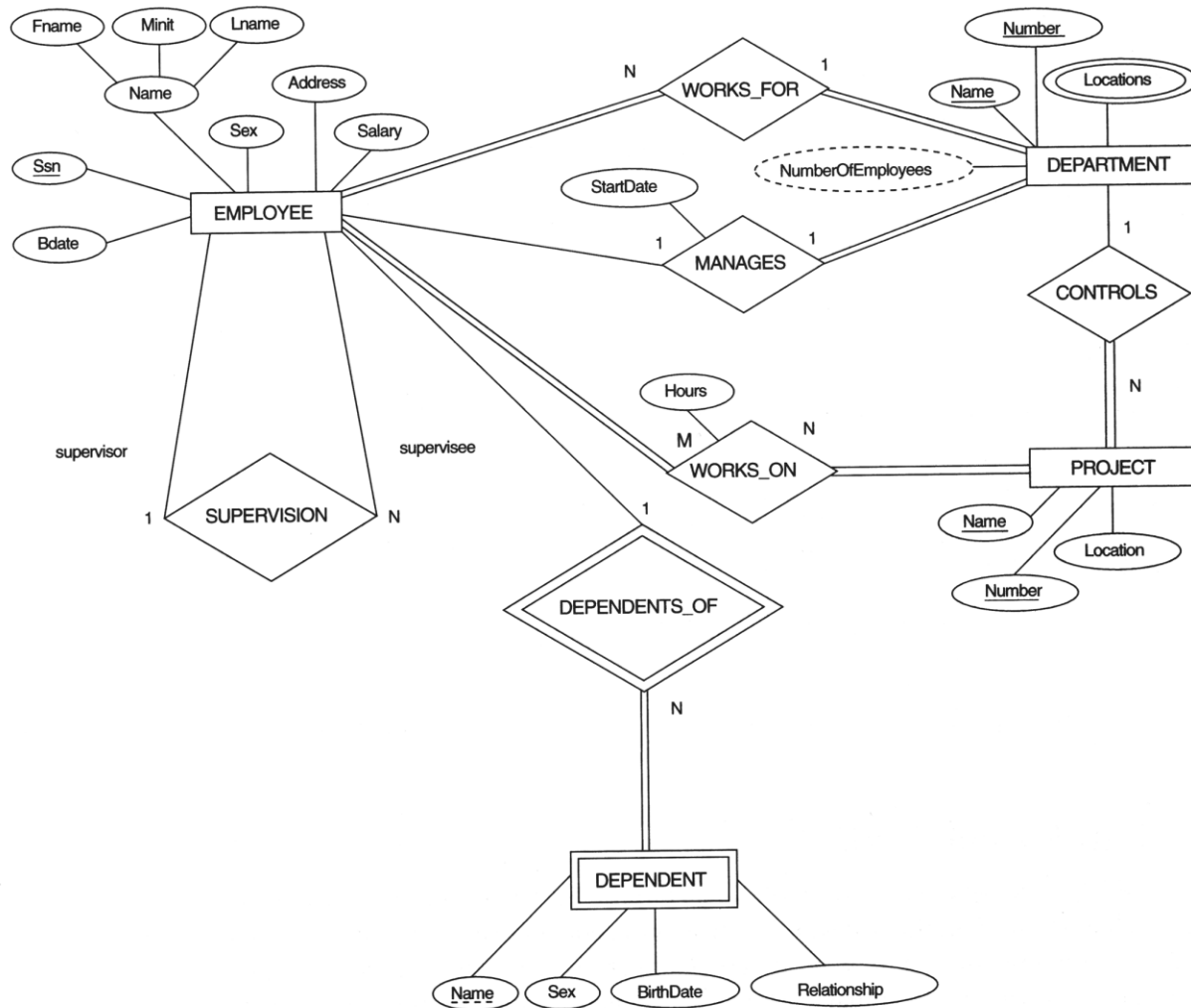
ER-to-Relational Mapping Algorithm

- Step 1: Mapping of Regular Entity Types.
 - For each regular (strong) entity type E in the ER schema, **create a relation R** that includes **all the simple attributes** of E.
 - **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.



FIGURE 7.1

The ER conceptual schema diagram for the COMPANY database.



(a) **EMPLOYEE**

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary
-------	-------	-------	------------	-------	---------	-----	--------

DEPARTMENT

Dname	<u>Dnumber</u>
-------	----------------

PROJECT

Pname	<u>Pnumber</u>	Plocation
-------	----------------	-----------

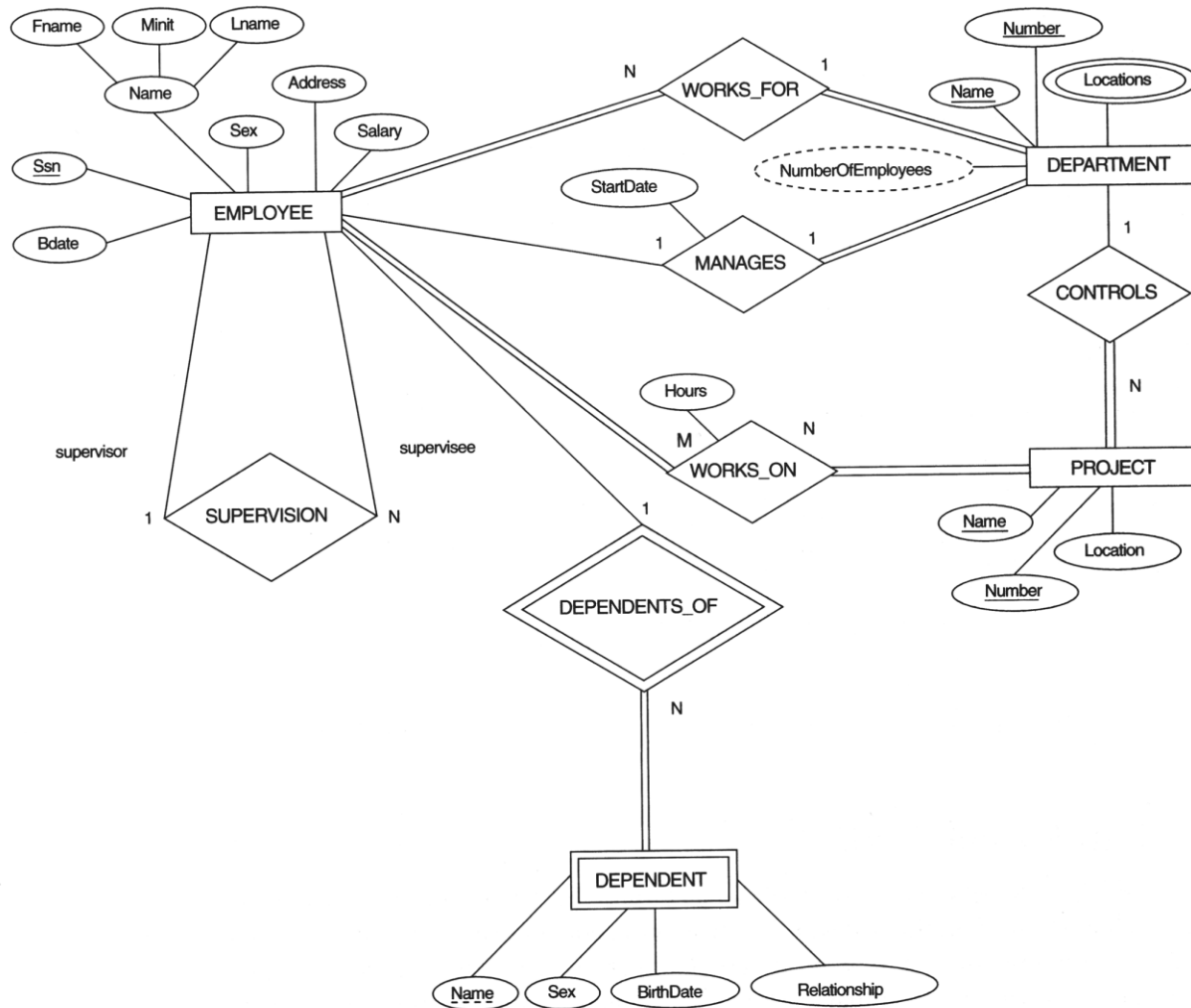
ER-to-Relational Mapping Algorithm (cont.)

- **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*** & include all simple attributes (or simple components of composite attributes) of *W* as attributes of *R*.
 - Also, **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**.



FIGURE 7.1

The ER conceptual schema diagram for the COMPANY database.



(b) **DEPENDENT**

<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
-------------	-----------------------	-----	-------	--------------

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.
- There are three possible approaches:
 1. **Foreign Key approach:** Choose one of the relations-say S-and include a foreign key in S the primary key of T. **It is better to choose an entity type with total participation** in R in the role 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.
 2. **Merged relation option:** An alternate mapping of a 1:1 relationship type is possible by merging the two entity types and the relationship into a single relation. This may be appropriate **when both participations are total**.
 3. **Cross-reference or relationship relation option:** The third alternative is to set up a **third relation R** for the purpose of cross-referencing the primary keys of the two relations S and T representing the entity types.



Option 1: It is better to choose an entity type with total participation

■ EMP

<u>SSN</u>	DNO	StartDate
1234		5	1-1-2000
2345		Null	Null
...	...	Null	Null
9898	1	1-1-2005
...	...	Null	Null

DEPT

<u>DNO</u>	Dname
1	HR
5	Sales

■ OR

<u>SSN</u>
1234	
2345	
...	...
9898	

<u>DNO</u>	Dname	MSSN	StartDate
1	HR	9898	1-1-2005
5	Sales	1234	1-1-2000



Option 2: When both participations are total

■ Accounts

STUD

<u>Username</u>	Password	<u>ID</u>	Name
-----------------	----------	-----------	------

<u>ID</u>	Name	Username	Passwrod
-----------	------	----------	----------

Cross-reference or relationship relation option

■ EMP

<u>SSN</u>
1234	
2345	
...	...
9898
...	...

DEPT

<u>DNO</u>	Dname
1	HR
5	Sales

■ DEPTMANAGER

<u>SSN</u>	<u>DNO</u>	<u>StartDate</u>
1234	1	1-1-2000
9898	5	1-1-2005

FIGURE 7.1

The ER conceptual schema diagram for the COMPANY database.

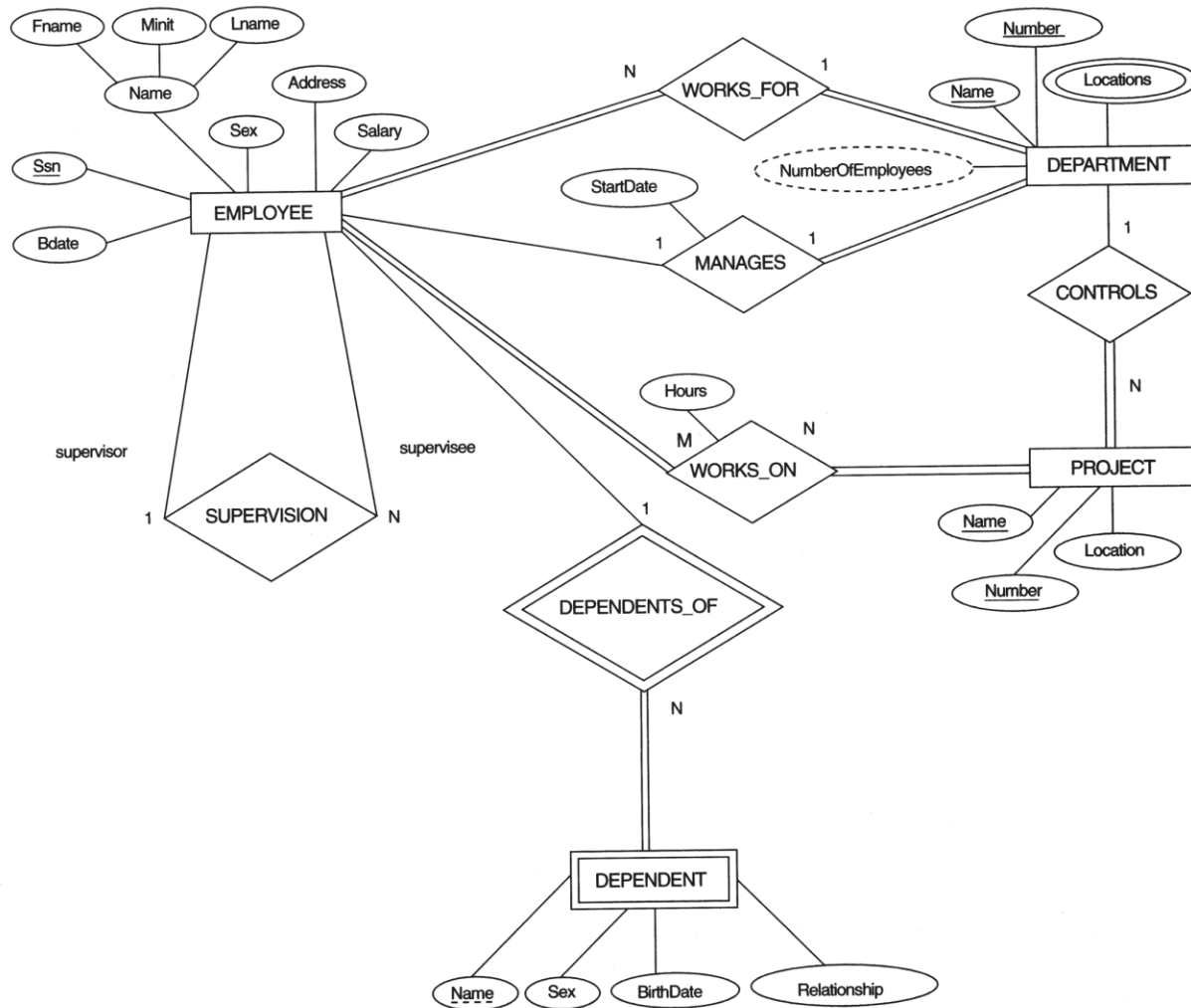


FIGURE 7.2

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

DEPARTMENT

Dname	<u>Dnumber</u>	Mgr_ssn	Mgr_start_date
-------	----------------	---------	----------------

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** 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.

FIGURE 7.1

The ER conceptual schema diagram for the COMPANY database.

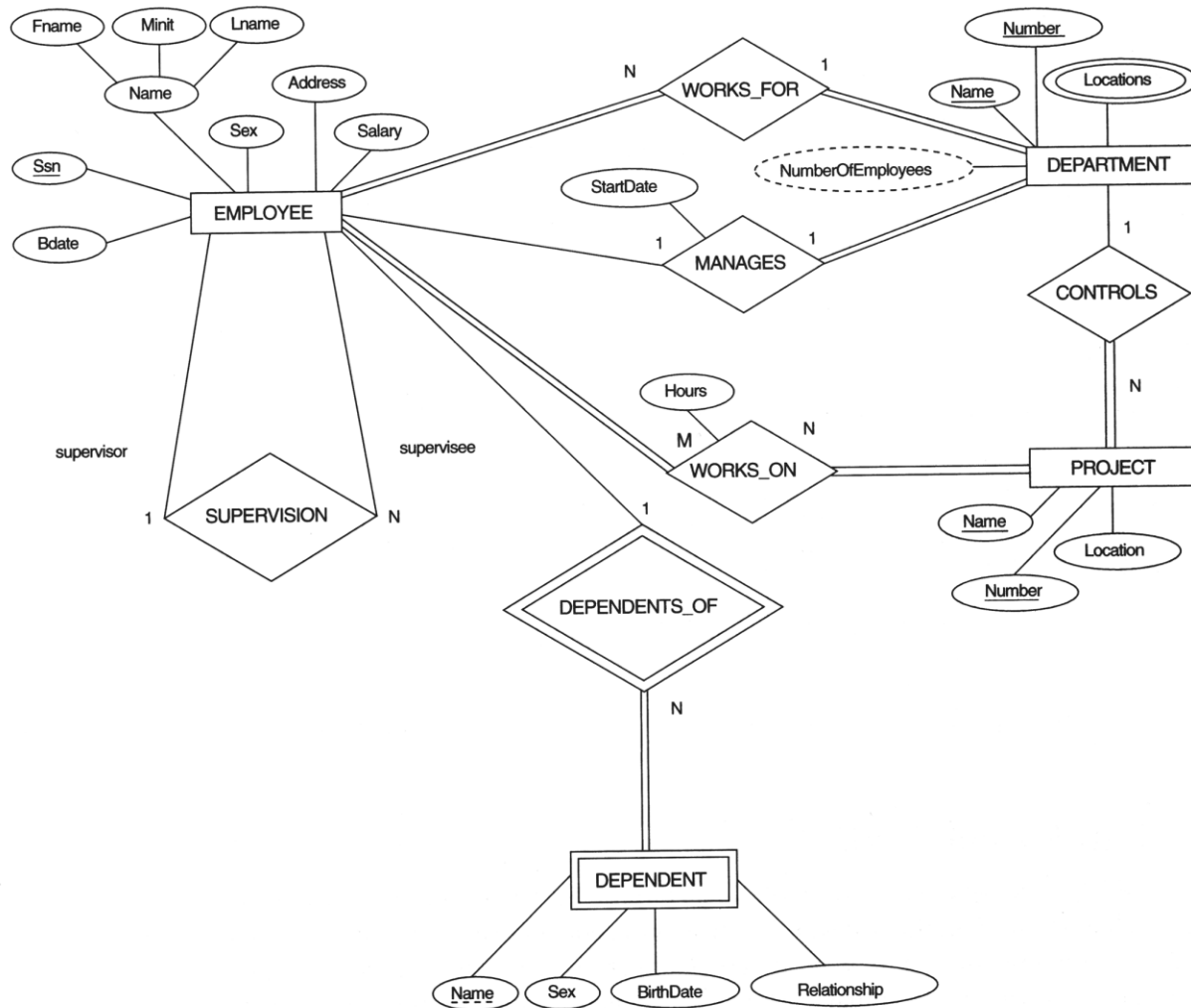


FIGURE 7.2

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

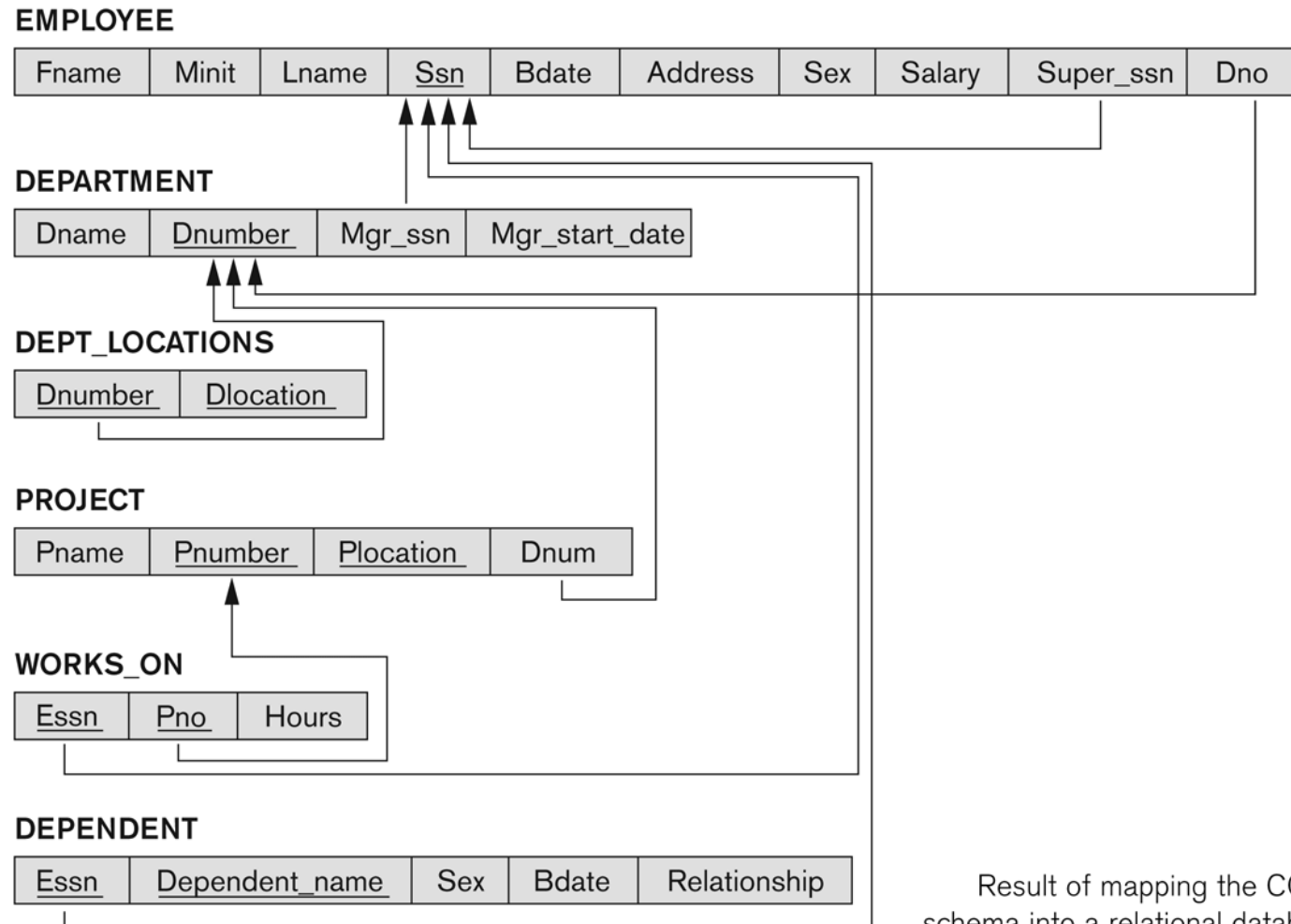


Figure 7.2

Result of mapping the COMPANY ER schema into a relational database schema.



ER-to-Relational Mapping Algorithm (contd.)

- **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}.



FIGURE 7.1

The ER conceptual schema diagram for the COMPANY database.

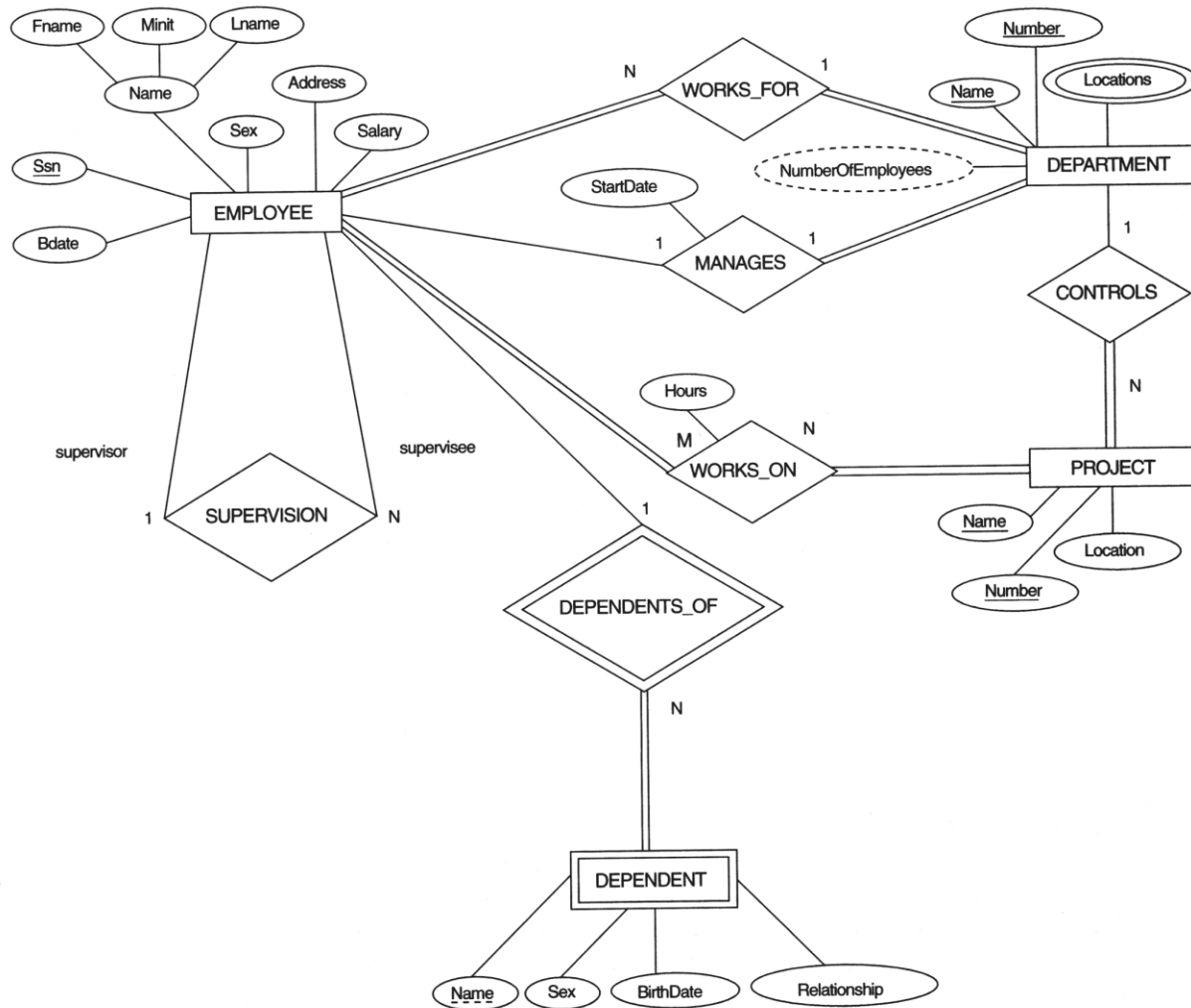


FIGURE 7.2

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

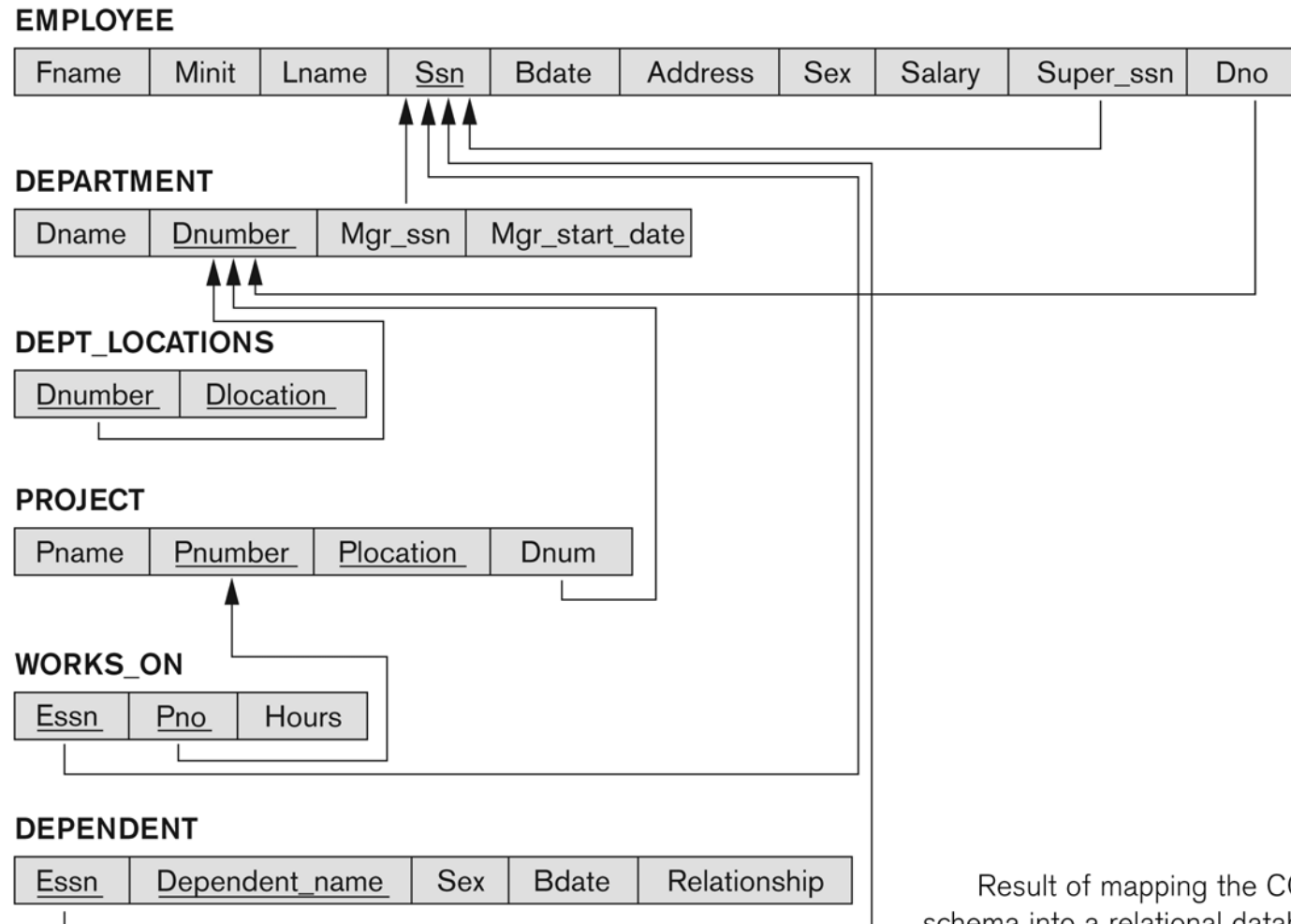


Figure 7.2

Result of mapping the COMPANY ER schema into a relational database schema.



ER-to-Relational Mapping Algorithm (contd.)

- **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}.

FIGURE 7.1

The ER conceptual schema diagram for the COMPANY database.

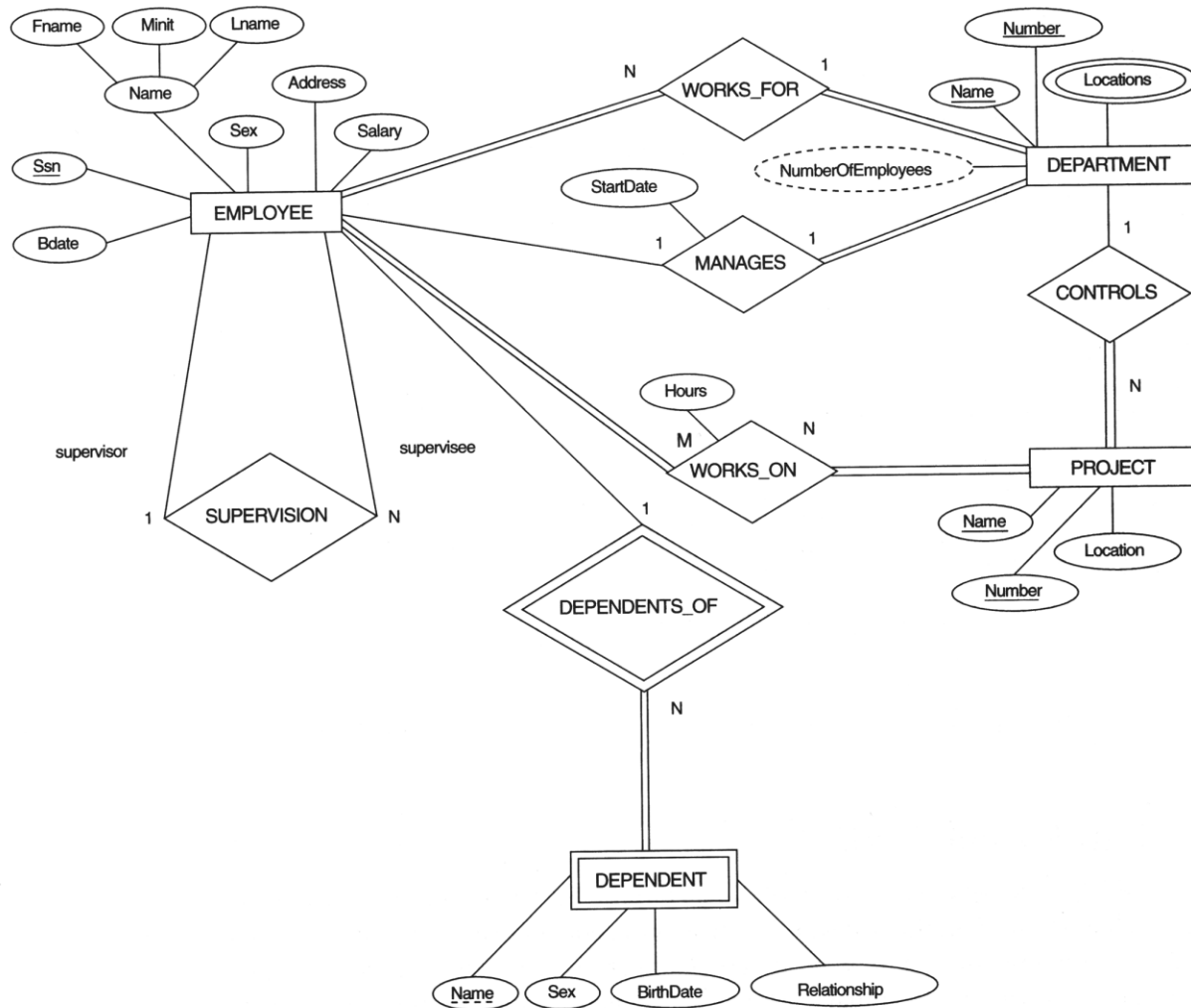


FIGURE 7.2

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

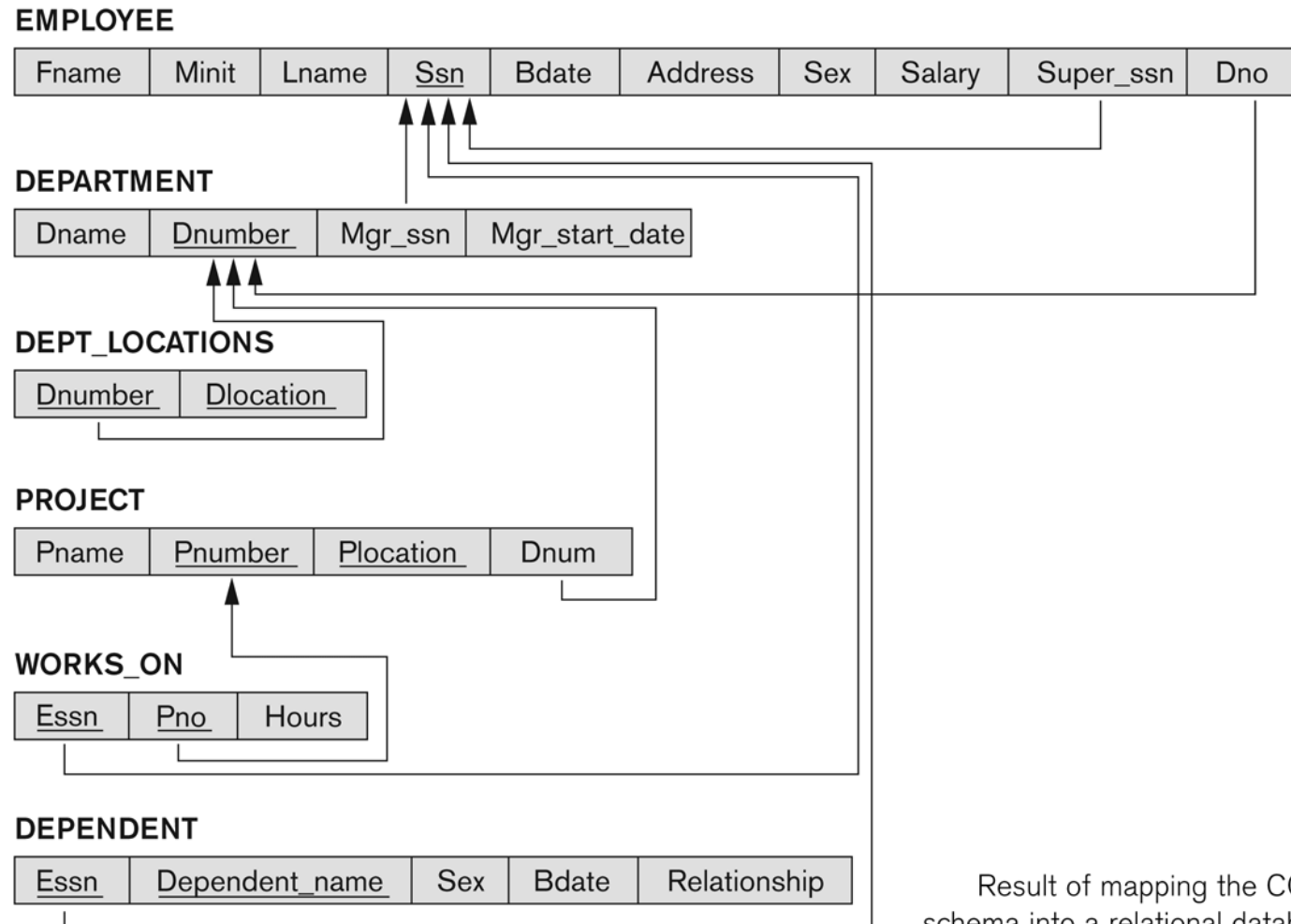


Figure 7.2

Result of mapping the COMPANY ER schema into a relational database schema.



ER-to-Relational Mapping Algorithm (contd.)

- **Step 7: Mapping of N-ary Relationship Types.**
 - For each n-ary relationship type R, where $n > 2$, **create a new relationship 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 ER on the next slide.
 - 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.

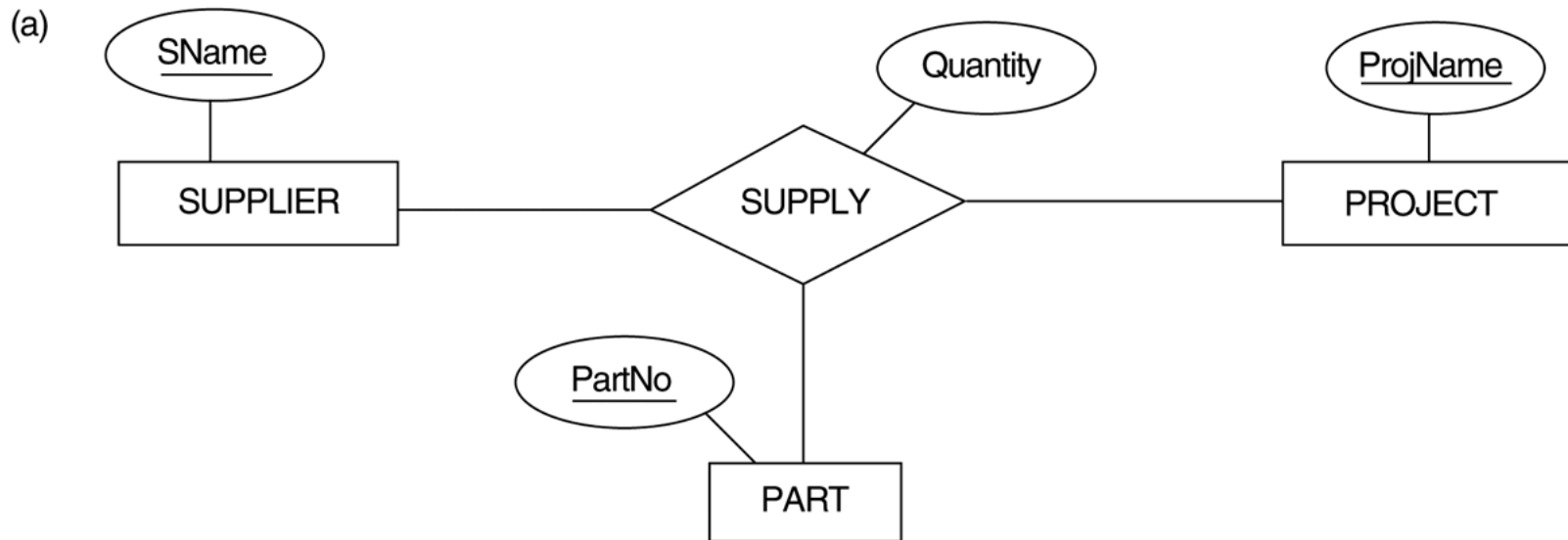
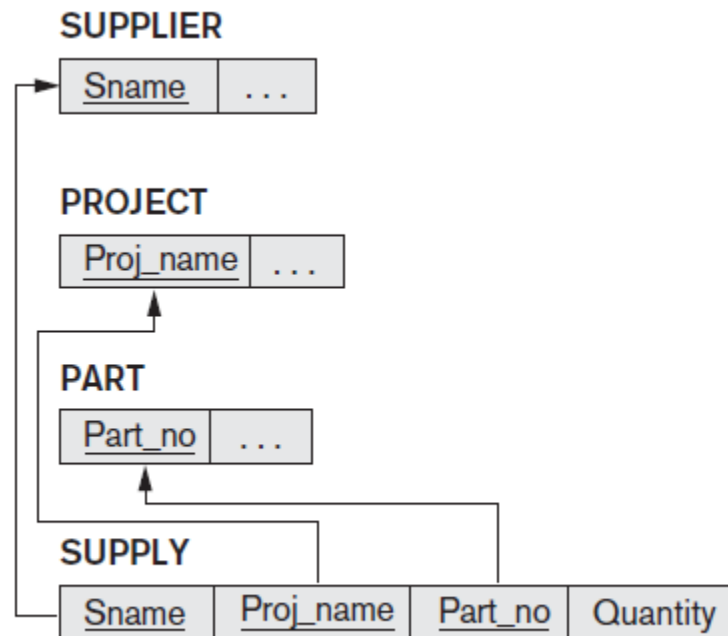


FIGURE 7.3

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



Summary of Mapping constructs and constraints

Table 7.1 Correspondence between ER and Relational Models

ER Model

Entity type

1:1 or 1:N relationship type

M:N relationship type

n -ary relationship type

Simple attribute

Composite attribute

Multivalued attribute

Value set

Key attribute

Relational Model

“Entity” relation

Foreign key (or “relationship” relation)

“Relationship” relation and two foreign keys

“Relationship” relation and n foreign keys

Attribute

Set of simple component attributes

Relation and foreign key

Domain

Primary (or secondary) key

Chapter Summary

■ ER-to-Relational Mapping Algorithm

- Step 1: Mapping of Regular Entity Types
- Step 2: Mapping of Weak Entity Types
- Step 3: Mapping of Binary 1:1 Relation Types
- Step 4: Mapping of Binary 1:N Relationship Types.
- Step 5: Mapping of Binary M:N Relationship Types.
- Step 6: Mapping of Multivalued attributes.
- Step 7: Mapping of N-ary Relationship Types.