AT82.02

DATA MODELING AND MANAGEMENT

UNIT 1-5: RELATIONAL DB DESIGN USING ER TO RELATIONAL MAPPING

CHUTIPORN ANUTARIYA (CHUTI AT AIT DOT AC DOT TH)

Co-funded by the Erasmus+ Programme of the European Union

DS&AI

Relational Database Design by ER-to-Relational Mapping

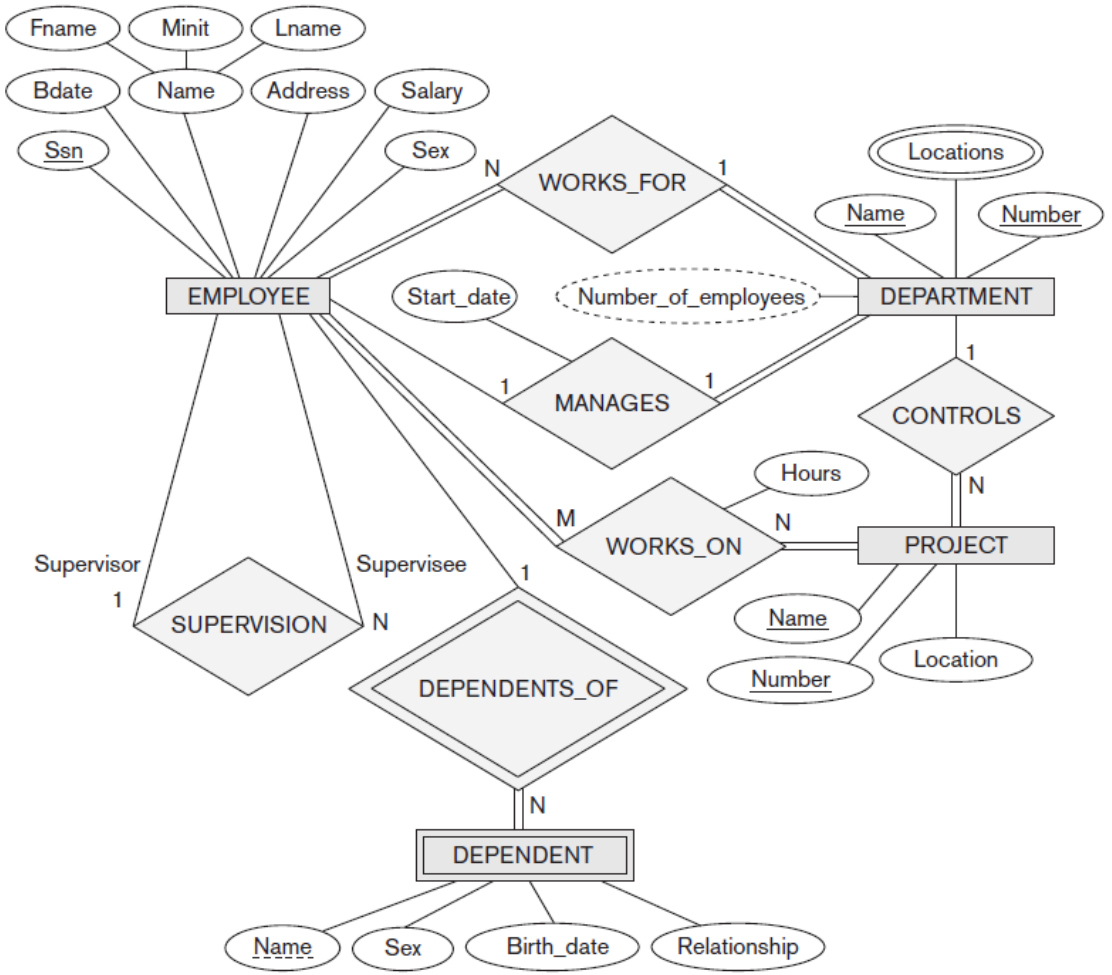
Design a relational database schema

Based on a conceptual schema design

Seven-step algorithm to convert the basic ER model constructs into relations

Relational Database Design Using ER-to-Relational Mapping

Figure 9.1
The ER conceptual schema diagram for the COMPANY database.



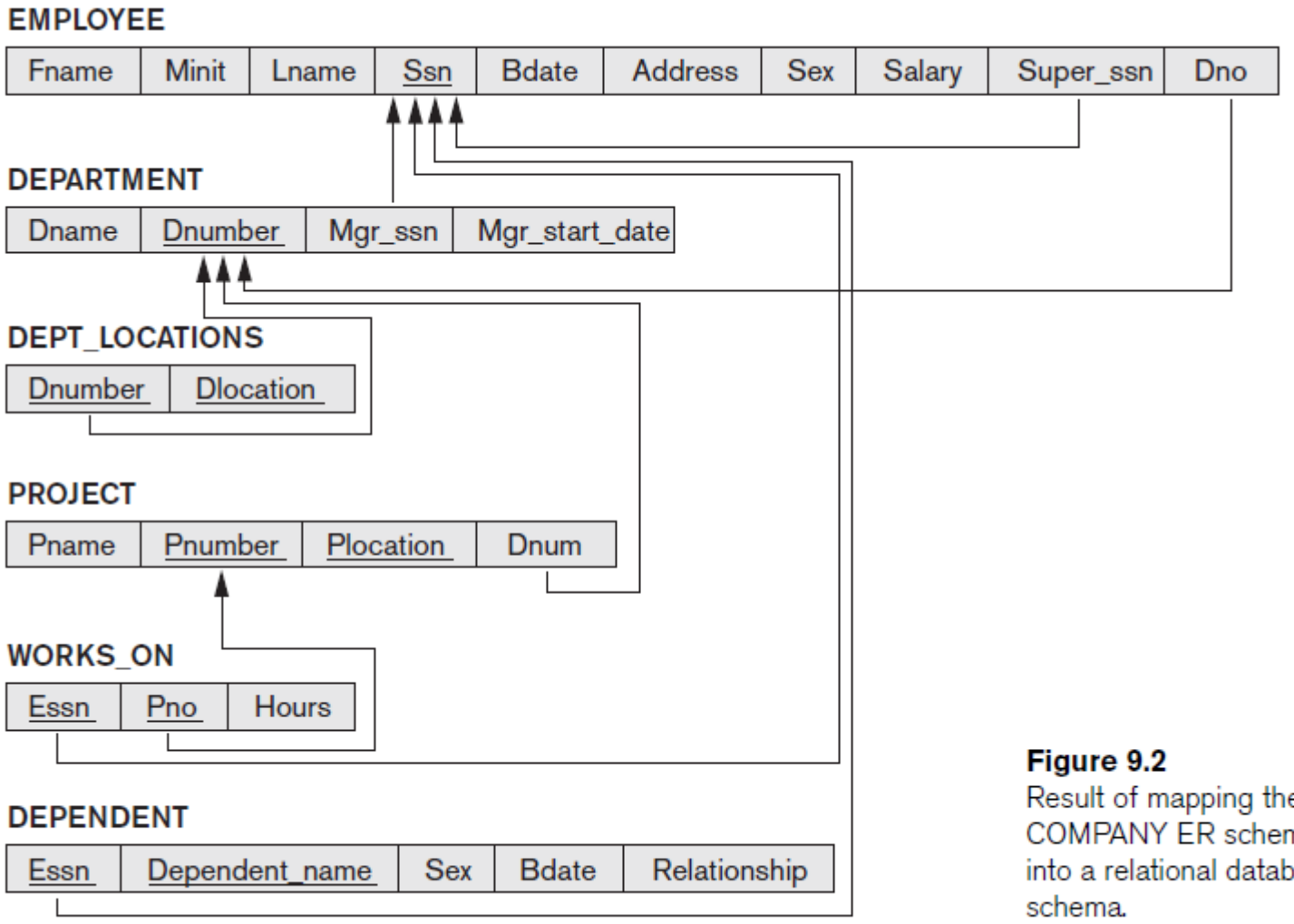
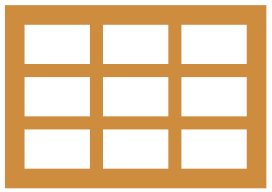


Figure 9.2
Result of mapping the COMPANY ER schema into a relational database schema.

Mapping Algorithm: Step 1



Step 1: Mapping of Regular Entity Types

For each regular entity type, create a relation *R* that includes all the simple attributes of *E*

Called **entity relations**

- Each tuple represents an entity instance

COMPANY database example

Assume that the mapping will create tables with simple single-valued attributes

COMPANY DB after Step 1

Figure 9.3
Illustration of some mapping steps.
a. *Entity* relations after step 1.

(a)

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary

DEPARTMENT

Dname	Dnumber

PROJECT

Pname	Pnumber	Plocation

Mapping Algorithm: Step 2

Step 2: Mapping of Weak Entity Types

- For each weak entity type, create a relation *R* and include all simple attributes of the entity type as attributes of *R*
- Include primary key attribute of owner as foreign key attributes of *R*

COMPANY DB after Step 2

Figure 9.3
Illustration of some mapping steps.
a. *Entity* relations after step 1.
b. Additional *weak entity* relation after step 2.

(a)

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary

DEPARTMENT

Dname	Dnumber

PROJECT

Pname	Pnumber	Plocation

(b)

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

Mapping Algorithm: Step 3

Step 3: Mapping of Binary 1:1 Relationship Types

- For each binary 1:1 relationship type
  - Identify relations that correspond to entity types participating in *R*
- Possible approaches:
  - **Foreign key approach**
  - **Merged relationship approach**
  - **Crossreference or relationship relation approach**

Mapping Algorithm: Step 4

Step 4: Mapping of Binary 1:*N* Relationship Types

- For each regular binary 1:*N* relationship type
  - Identify relation that represents participating entity type at *N*-side of relationship type
  - Include primary key of other entity type as foreign key in *S*
  - Include simple attributes of 1:*N* relationship type as attributes of *S*
- Alternative approach
  - Use the **relationship relation** (cross-reference) option as in the third option for binary 1:1 relationships

Mapping Algorithm: Step 5

Step 5: Mapping of Binary *M*:*N* Relationship Types

- For each binary *M*:*N* relationship type
  - Create a new relation *S*
  - Include primary key of participating entity types as foreign key attributes in *S*
  - Include any simple attributes of *M*:*N* relationship type

COMPANY DB after Step 5

Figure 9.3
Illustration of some mapping steps.
a. *Entity* relations after step 1.
b. Additional *weak entity* relation after step 2.
c. *Relationship* relation after step 5.

(a) **EMPLOYEE**

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary

DEPARTMENT

Dname	Dnumber

PROJECT

Pname	Pnumber	Plocation

(b) **DEPENDENT**

Essn	Dependent_name	Sex	Bdate	Relationship

(c) **WORKS_ON**

Essn	Pno	Hours

Mapping Algorithm: Step 6

Step 6: Mapping of Multivalued Attributes

- For each multivalued attribute
  - Create a new relation
  - Primary key of *R* is the combination of *A* and *K*
  - If the multivalued attribute is composite, include its simple components

COMPANY DB after Step 6

Figure 9.3
Illustration of some mapping steps.
a. *Entity* relations after step 1.
b. Additional *weak entity* relation after step 2.
c. *Relationship* relation after step 5.
d. Relation representing multivalued attribute after step 6.

(a) **EMPLOYEE**

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary

DEPARTMENT

Dname	Dnumber

PROJECT

Pname	Pnumber	Plocation

(b) **DEPENDENT**

Essn	Dependent_name	Sex	Bdate	Relationship

(c) **WORKS_ON**

Essn	Pno	Hours

(d) **DEPT_LOCATIONS**

Dnumber	Dlocation

ER-to-Relational Mapping Algorithm: Step 7

Step 7: Mapping of *N*-ary Relationship Types

- For each *n*-ary relationship type *R*
  - Create a new relation *S* to represent *R*
  - Include primary keys of participating entity types as foreign keys
  - Include any simple attributes as attributes

Summary of Mapping for ER Model Constructs

Table 9.1 Correspondence between ER and Relational Models

ER MODEL	RELATIONAL MODEL
Entity type	*Entity* relation
1:1 or 1:N relationship type	Foreign key (or *relationship* relation)
M:N relationship type	*Relationship* relation and *two* foreign keys
n-ary relationship type	*Relationship* relation and *n* foreign keys
Simple attribute	Attribute
Composite attribute	Set of simple component attributes
Multivalued attribute	Relation and foreign key
Value set	Domain
Key attribute	Primary (or secondary) key

References

R. Elmasri and S. Navathe: Fundamentals of Database Systems, 7/E, Addison-Wesley, 2015