

Introduction

- Design an ERD for the following specification: A relational database is to be designed for a company dealing with industrial applications of computers.
- The Company delivers various products to its customers ranging from a single application program through to complete installation of hardware with customized software.
- The Company employs various experts, consultants and supporting staff.
- All personnel are employed on long-term basis, i.e. there are no short-term or temporary staff.
- Although the Company is somehow structured for administrative purposes (that is, it is divided into departments, each department has many employees and these departments are headed by department managers)
- All projects are carried out in an interdisciplinary way.
- For each project a project team is selected, grouping employees from different departments
- A Project Manager (also an employee of the Company) is appointed who is entirely and exclusively responsible for the control of the project, quite independently of the Company's hierarchy.

1. Read the examples provided on Moodle carefully.
2. Perform the 9-step process of designing ERD for the above specification also on Moodle.
3. To create the final diagram at step 9 use www.draw.io or any online diagramming software of your choosing.
4. Map your ERD to a relation model.

Chen's ERD – Entity Representation Diagram Process

Industrial Applications Company System

Step 1 - Identify Entities (List all potential entity types)

1. Company
2. Products
3. Customer
4. Single Application Program
5. Computer experts
6. Supporting Staff
7. Consultants
8. Long-term Staff
9. Departments
10. Department Mangers
11. Projects
12. Project team
13. Managers
14. Employees

Step 2 - Remove duplicate entities and don't include the system as an entity type.

1. Products
2. Customer
3. Department
4. Projects
5. Manager
6. Employee

Step 3 - List the attributes of each entity

1. **Products**
 - Product ID
 - Name
 - Price
2. **Customer**
 - Customers ID
 - First name
 - Second name
 - Address
3. **Department**
 - Department ID
 - Name
 - Location
4. **Manager**
 - Manager ID
 - Job title
 - Gender
 - First name
 - Second name
 - Address
 - Salary

5. **Employee**

- Employee ID
- Job title
- Gender
- First name
- Second name
- Address
- Salary

6. **Projects**

- Project ID
- Name
- Start/End date

Step 4 - Mark the primary keys

1. **Products**

- Product ID (**Primary Key**)
- Name
- Price

2. **Customer**

- Customers ID (**Primary Key**)
- First name
- Second name
- Address

3. **Department**

- Department ID (**Primary Key**)
- Name
- Location

4. **Manager**

- Manager ID (**Primary Key**)
- Job title
- First name
- Second name
- Address
- Salary

5. **Employee**

- Employee ID (**Primary Key**)
- Job title
- First name
- Second name
- Address
- Salary

6. **Projects**

- Project ID (**Primary Key**)
- Name
- Start/End date

Step 5 • Define relationships of Entities (Strong and Weak entities)

Define relationships of Industrial Applications Company System Entities.

A **strong entity** always has the primary key.

A **weak entity** is an entity that cannot be uniquely identified by its attributes alone.

1. Products(**Strong entity**)
2. Customer(**Strong entity**)
3. Department(**Strong entity**)
4. Projects(**Strong entity**)
5. Manager(**Strong entity**)
6. Employee(**Strong entity**)

Assumptions relationships of Industrial Applications Company System

- Products are created by Department.
- Products are sold to many Customer.
- Customer buy many Products.
- Departments contains many Employees.
- Departments have one Manager.
- Employee are divided into their Department.
- Employees work on many Projects.
- An Employee has one Manager.
- Manager supervises many Employees.
- Each Manager directs many Projects.
- Many Projects are worked by many Employees.
- Projects are directed by one Manager.

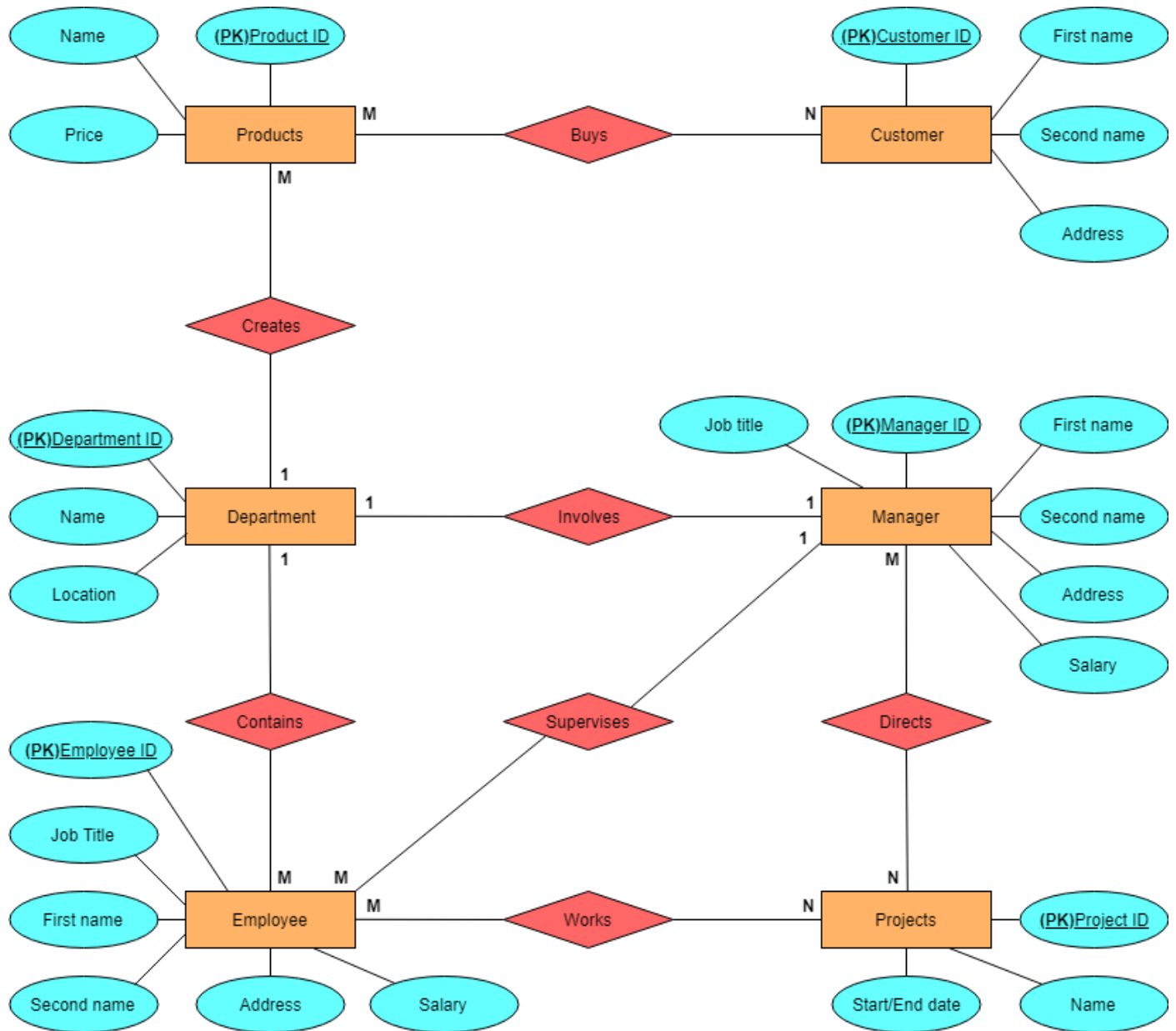
Step 6 Describe the cardinality of the relationships.

- Products are created by Department (**M:1**)
- Products are sold to many Customer. (**M:N**)
- Customer buy many Products. (**M:N**)
- Department contains many Employees. (**1:M**)
- Department have one Manager. (**1:1**)
- Employees are divided into their Department. (**M:1**)
- Employee works on many Projects. (**M:N**)
- Employee are supervised by one Manager. (**M:1**)
- Manager supervises many Employees. (**1:M**)
- Managers directs many Projects. (**M:M**)
- Many Projects are worked by many Employees. (**M:N**)
- Projects are directed by one Manager. (**M:1**)

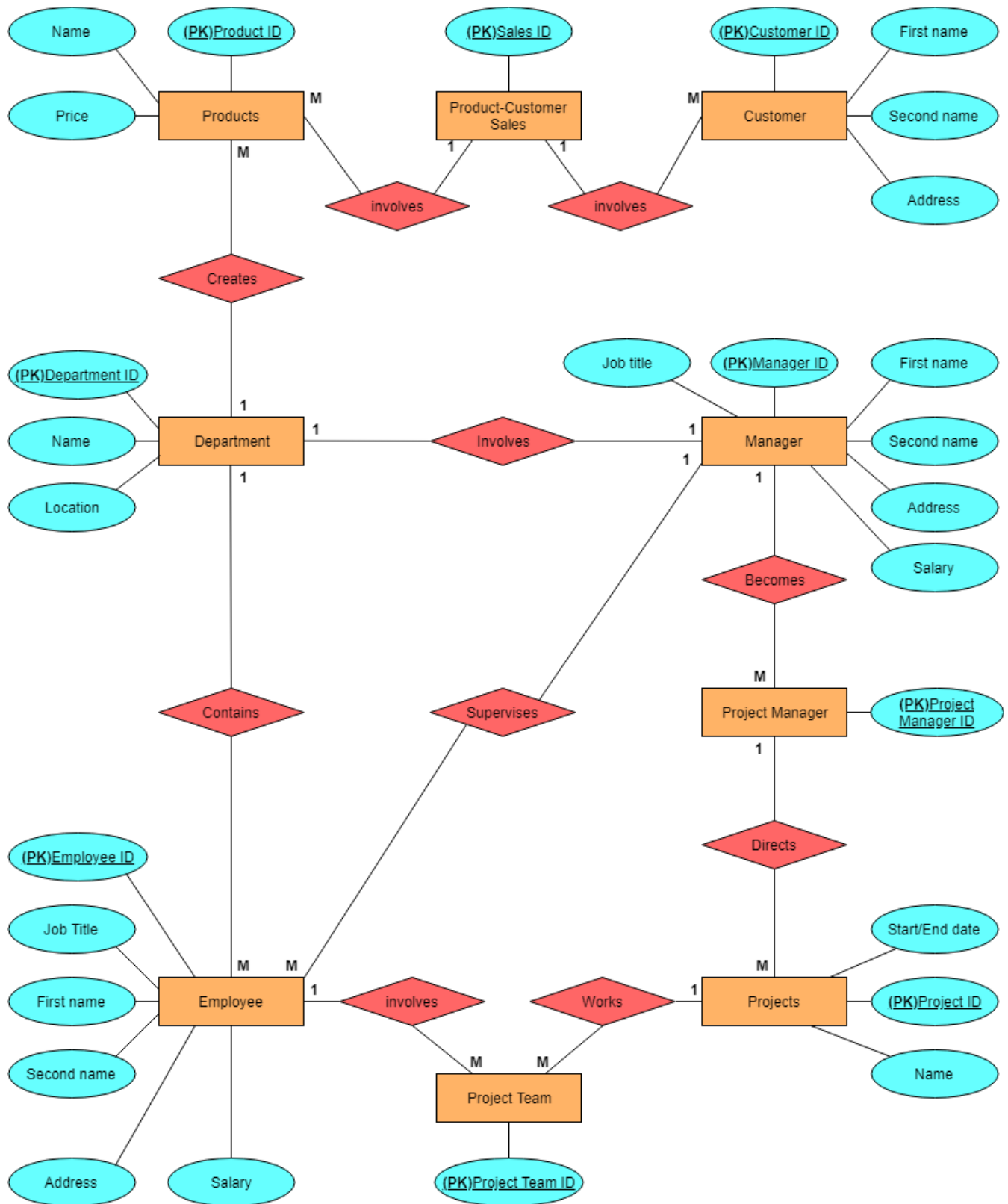
Step 7 Remove redundant relationships if necessary

- [Products]-----[Created]-----[Department] (**M:1**)
- [Customer]-----[Buys]-----[Products] (**M:N**)
- [Department]-----[Contains]-----[Employees] (**1:N**)
- [Department]-----[Involves]-----[Manager] (**1:1**)
- [Employee]-----[Supervised]-----[Manager]. (**M:1**)
- [Employee]-----[Works]-----[Projects] (**M:N**)
- [Manager]-----[directs]-----[Projects] (**M:N**)

Step 8 Combine into single diagram. (All entities and the relationships between them should be combined.)



Step 9 Turn many to many relationships into 1-M and M-1.



Mapping Industrial Applications Company System ERD Into relation model

Products

Product ID	Name	Price
10000	Apptacker 2.0	250
10001	Appswitch 2.0	320
.....

Product-Customer Sales

Sales ID	Product ID	Customer ID
30000	10000	20001
30001	10000	20002
.....

Customer

Customer ID	First Name	Second Name	Address
20000	Alex	Murphy	Dublin 8
20001	Bob	Smith	Dublin 22
20002	Clare	Connor	Dublin 1
.....

Department

Depart_ID	Name	Location	MGR_ID	Employ_ID
40000	Network	Ireland(Dublin)	50000	50000 50245
40001	Tech Support	UK(London)	50001	50001 50023
40002	Marketing	France(Paris)	50002	50002 50033
.....

Manager

MGR_ID	Job Title	First Name	Second Name	Address	Salary
50000	Network Manager	Jim	Donnelly	Dublin 7	65000
50001	Tech Support Manager	Thomas	Curtis	Dublin 8	57000
50002	Marketing Manager	Jack	Connor	Dublin 1	58000
.....

Employee

Employ_ID	Job Title	First Name	Second Name	Address	Salary
60000	Tech Support	Liam	Foran	Dublin 3	35700
60001	Consultant	Chloe	Whelan	Dublin 5	42000
60002	Python Expert	Anna	Kenny	Dublin 10	59500
.....

Projects

Project ID	Name	Start Date	End Date
70000	App Marketing	18/06/2018	18/06/2018
70001	Program App 3.0	12/01/2018	12/01/2019
70002	Network Topology 3.0	17/03/2018	10/10/2018
.....

Project Manager

PM ID	MGR_ID	Project ID
80000	50000	70002
80001	50000	70001
90002	50001	70000
.....

Project Team

PT ID	Employ_ID	Project ID
90000	60003	70000
90001	60001	70001
90002	60002	70000
.....

Mapping Industrial Applications Company System Relation Model **Simplifying and Normalization**

- Manager and Employee has the same details. Combine tables with Primary ID of Manager and Employee. Manager is also an employee of the company.
- Normalisation process must be taken place to all tables in particular to the Department Relational table. There is currently duplicate Employees in the Department table. This must be changed

Combing Manager and Employee table.

Manager

MGR_ID	Employ_ID
50000	60598
50001	60578
50002	60523
.....

Department Table Normalisation process

Department

Depart_ID	Name	Location	MGR_ID	Employ_ID
40000	Network	Ireland(Dublin)	50000	50000 50245
40001	Tech Support	UK(London)	50001	50001 50023
40002	Marketing	France(Paris)	50002	50002 50033
.....

UNF: Department [Depart_ID, Name, Location, MGR_ID,(Employ_ID)]

1NF: Department [Depart_ID, Name, Location,]
Depart_Employ [Depart_ID, MGR_ID, Employ_ID]

2NF: Department [Depart_ID, Name, Location,]
Depart_Employ [Depart_ID,Employ_ID]
Depart_Manag [Depart_ID,MGR_ID]

3NF: same as 2NF

Mapping Industrial Applications Company System ERD Into relation model (Renewal)

Products

Product ID	Name	Price
10000	Apptacker 2.0	250
10001	Appswitch 2.0	320
.....

Product-Customer Sales

Sales ID	Product ID	Customer ID
30000	10000	20001
30001	10000	20002
.....

Customer

Customer ID	First Name	Second Name	Address
20000	Alex	Murphy	Dublin 8
20001	Bob	Smith	Dublin 22
20002	Clare	Connor	Dublin 1
.....

Department

Depart_ID	Name	Location
40000	Network	Ireland(Dublin)
40001	Tech Support	UK(London)
40002	Marketing	France(Paris)
.....

Depart_Employ

Depart_ID	Employ_ID
40000	50000
40000	50245
40001	50001
40002	50002
.....

Depart_Manag

Depart_ID	MGR_ID
40000	50000
40001	50001
40002	50002
.....
.....

Employee

Employ_ID	Job Title	First Name	Second Name	Address	Salary
60000	Tech Support	Liam	Foran	Dublin 3	35700
60001	Consultant	Chloe	Whelan	Dublin 5	42000
60002	Python Expert	Anna	Kenny	Dublin 10	59500
.....

Manager

MGR_ID	Employ_ID
50000	60598
50001	60578
50002	60523
*****	*****

Project Manager

PM ID	MGR_ID	Project ID
80000	50000	70002
80001	50000	70001
90002	50001	70000
*****	*****	*****

Projects

Project ID	Name	Start Date	End Date
70000	App Marketing	18/06/2018	18/06/2018
70001	Program App 3.0	12/01/2018	12/01/2019
70002	Network Topology 3.0	17/03/2018	10/10/2018
*****	*****		*****

Project Team

PT ID	Employ_ID	Project ID
90000	60003	70000
90001	60001	70001
90002	60002	70000
*****	*****	*****