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Database Design and  
Development

Topic 6:  
Physical Design (1)

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Physical Design (1) Topic 6 - 6.2

Scope and Coverage

*This topic will cover:*

- The purpose of physical design
- Mapping the logical database design to a physical database design
- Designing tables for the target DBMS
- Creating tables using SQL



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Physical Design (1) Topic 6 - 6.3

Learning Outcomes

*By the end of this topic students will be able to:*

- Understand the purpose of physical design
- Map a logical database design to a physical database design
- Design tables for the chosen database product



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Physical Design (1) Topic 6 - 6.4

# Recap of Phases of Database Design - 1

- **Conceptual** database design
- **Logical** database design
- **Physical** database design



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Physical Design (1) Topic 6 - 6.5

# Recap of Phases of Database Design - 2

- **Conceptual** database design
- **Logical** database design
- **Physical** database design

Activity: give a brief definition of the purposes of each of these phases and the difference between them.



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Physical Design (1) Topic 6 - 6.6

# Conceptual Database Design

- Conceptual database design involves understanding the data in an enterprise and modeling it without regard for any physical considerations or particular data models.



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Physical Design (1) Topic 6 - 6.7

Logical Database Design

- Logical database design involves designing a model of the data in an enterprise that is independent of a particular DBMS but does take account of the chosen data model.

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Physical Design (1) Topic 6 - 6.8

Physical Database Design

- Physical database design involves producing a design that describes the base relations and takes into account file organization, indexes, integrity constraints and security measures.

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Physical Design (1) Topic 6 - 6.9

The Purpose of Physical Design

- Translates logical database structures (entities, attributes, relationships, and constraints) into a physical design.
- The physical design should be suitable for implementation by the chosen DBMS

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Physical Design (1) Topic 6 - 6.10

Knowledge needed of Chosen DBMS

- How to create base tables
- Does the system support the definition of primary, foreign keys and alternate keys
- Does the system support definition of required data (i.e. Definition of columns as NOT NULL)
- Does the system support domains
- Does the system support relational integrity rules
- Does the system support the definition of business rules


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Physical Design (1) Topic 6 - 6.11

Choosing a Database Product

- Requirements – what suits the business
- Budget
- Compatibility with existing technology within organisation
- Support available
- Strength of vendor


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Physical Design (1) Topic 6 - 6.12

Step 3

3.1 Design Base Tables (covered in this lecture)

3.2 Design representations of derived data (covered in Unit 7)

3.3 Design remaining business rules (covered in Unit 8).


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Physical Design (1) Topic 6 - 6.13

Step 4

4.1 Analyse transactions (covered in Unit 9)

4.2 Choose file organisations (covered in Unit 9)

4.3 Choose indexes (covered in Unit 8)

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Physical Design (1) Topic 6 - 6.14

Steps 5 to 8

• Step 5 Design User Views (Covered in Unit 8 and 9)

• Step 6 Design security mechanisms (Covered in Unit 8)

• Step 7 Consider the introduction of controlled redundancy (de-normalisation)(Covered in Unit 9)

• Step 8 Monitor and tune the operational system (Not covered)

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Physical Design (1) Topic 6 - 6.15

Design Base Tables

• Collate the information about tables gathered during the logical design stage.

Table:	For each column:
Name of Table	Domain consisting of data type, length and any constraints
List of Columns	Optional default value
Primary Keys and Foreign Keys	Can the column be null?
Referential Integrity constraints	Is the column derived? (to be discussed later)

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Physical Design (1) Topic 6 - 6.16

Outcome of Logical Design

The Entity Relationship Diagram for the Art Supply Shop

```
graph LR; Customer[Customer] -- "1 to 0..*" --- CustomerItem[CustomerItem]; CustomerItem -- "0..* to 1" --- Item[Item]; Item -- "0..* to 1" --- Supplier[Supplier];
```

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Physical Design (1) Topic 6 - 6.17

```
graph LR; Customer[Customer] -- "1 to 0..*" --- CustomerItem[CustomerItem]; CustomerItem -- "0..* to 1" --- Item[Item]; Item -- "0..* to 1" --- Supplier[Supplier];
```

Initial table structures for 'Art Suppliers' database.  
Customer (CustomerID, CustomerName, Street, Postcode)  
Primary Key CustomerID

CustomerItem or Order  
(CustomerID, ItemID, Date, Time, Quantity)  
Primary Key CustomerID, ItemID, Date

Item  
(ItemID, ItemName, Price, SupplierID)  
Primary Key (ItemID)

Supplier  
(SupplierID, SupplierName)  
Primary Key SupplierID

Tables at the outcome of Logical design

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Physical Design (1) Topic 6 - 6.18

The physical design of the Customer Table using DBDL

Domain CustomerIDS fixed length character string length 5	
Domain Street_names variable length character string maximum length 20	
Domain Post_codes fixed length character string lenght 8	
Customer ( CustomerID CustomerIDS	NOT NULL
CustomerName Char 30	NOT NULL
Street Street_names	NOT NULL
PostCode Post_codes	NOT NULL)
Primary Key CustomerID	

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Physical Design (1) Topic 6 - 6.19

The physical design of the Customer Table using DBDL

Domain CustomerIDS fixed length character string length 5	
Domain Street_names variable length character string maximum length 20	
Domain Post_codes fixed length character string length 8	
Customer ( CustomerID CustomerIDS	NOT NULL
CustomerName Char 30	NOT NULL
Street Street_names	NOT NULL
PostCode Post_codes	NOT NULL)
Primary Key CustomerID	

Activity: write the SQL to implement this table.

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Physical Design (1) Topic 6 - 6.20

Data Definition - 1

Create table customers  
(CustomerID char not null,  
CustomerName varchar(20) not null,  
Street char(20) not null,  
PostCode char(8) not null,  
primary key CustomerID);

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Physical Design (1) Topic 6 - 6.21

Data Definition - 2

Create table customers ← **The table name**  
(CustomerID char not null,  
CustomerName varchar(20) not null,  
Street char(20) not null,  
PostCode char(8) not null,  
primary key CustomerID);

Here the columns are defined.  
The datatypes are specified along with the length in brackets.  
If a column is specified as NOT NULL then it is mandatory and must be populated when a new row is created.

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Physical Design (1) Topic 6 - 6.22

CASE Tools

- Computer Aided Software Engineering
- Has a repository to store definitions of structures like entities and attributes
- SQL scripts can be generated from definitions
- Developers still need to be able to write their own SQL!

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Physical Design (1) Topic 6 - 6.23

Primary Key

Create table customers  
(CustomerID char not null,  
CustomerName varchar(20)  
not null,  
Street char(20) not null,  
PostCode char(8) not null,  
primary key CustomerID);

Create table customers  
(CustomerID char not null  
primary key,  
CustomerName varchar(20)  
not null,  
Street char(20) not null,  
PostCode char(8) not null);

Primary Key  
defined in  
different  
places

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Physical Design (1) Topic 6 - 6.24

Foreign Key

**Item**  
(ItemID, ItemName, Price,  
SupplierID)  
Primary Key (ItemID)

**Supplier**  
(SupplierID, SupplierName)  
Primary Key SupplierID

Create table Item  
(ItemID char (5) not null,  
ItemName char(30),  
Price float (3),  
SupplierID number(5),  
primary key ItemID,  
foreign key (SupplierID) references  
Supplier(SupplierID));

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Physical Design (1) Topic 6 - 6.25

### Create Domain

- Explicitly create a domain:

Create domain Allowable\_Colours as Char  
Default 'Red'  
Check (Value in ('Red','Blue','Green'));

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Physical Design (1) Topic 6 - 6.26

### Adding a Foreign Key Later

ALTER TABLE ORDERS  
ADD FOREIGN KEY (customer\_id) REFERENCES  
CUSTOMER(customer\_id);

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Physical Design (1) Topic 6 - 6.27

### Example of Adding a Column using Alter Table

ALTER TABLE job\_type  
ADD salary FLOAT;

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Physical Design (1) Topic 6 - 6.28

Modifying Tables using SQL

- Add an extra column
- Drop a column from a table
- Modify the maximum length of the table
- Add a new constraint
- Drop a constraint
- Set a default for a column
- Drop a default for a column

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Physical Design (1) Topic 6 - 6.29

Example of Adding a Column using Alter Table

```
ALTER TABLE job_type
ADD salary FLOAT;
```

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Physical Design (1) Topic 6 - 6.30

Choosing a Database Product

- Requirements – what suits the business
- Budget
- Compatibility with existing technology within organisation
- Support available
- Strength of vendor

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Physical Design (1) Topic 6 - 6.31

## Learning Outcomes

*By the end of this unit students will be able to:*

- Understand the purpose of physical design
- Map a logical database design to a physical database design
- Design tables for the chosen database product

Have we met them?

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Physical Design (1) Topic 6 - 6.32

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Physical Design (1) Topic 6 - 6.33

## Topic 6 – Physical Design (1)

*Any Questions?*

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