Unit 21: Data Analysis and Design

Unit code: H/601/7323

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to ensure that learners know modelling methodologies and understand logical data modelling in order to implement functional and accurate database systems using logical data modelling techniques.

Unit introduction

Databases are the prime technique used to develop any information system used in modern business. They are also used in e-commerce and internet-based marketing systems. Therefore it is very important that developers of information systems have a detailed understanding of the data analysis and data structures involved in order to be able to develop functional and accurate systems which satisfy the needs of all users.

This unit focuses on the design of data models, although the developed model will also be implemented.

Learners will gain an understanding of the analysis and design principles of database systems. They will learn about different types of database to ensure that the most appropriate is used in any given situation. These could include relational, flat file, hierarchical and network structures.

Learners will become familiar with different design methodologies and the associated terminology involved in the analysis and design of a database. Learners will develop skills and understanding in logical data modelling (LDM), as this is the chosen methodology for the design and implementation of data models in this unit.

Learners will implement their designs and carry out full testing. All work will be fully documented.

On completion of the unit learners will be in a position to analyse and design simple models for databases in a small business environment.

Learning outcomes

On completion of this unit a learner should:

1 Know modelling methodologies

2 Understand logical data modelling

3 Be able to produce logical data models

4 Be able to implement and test logical data models.

Unit content

1 Know modelling methodologies

Database type: flat file; relational; other eg network, hierarchical; features ie advantages, disadvantages

Modelling methodologies: types eg logical data modelling (LDM); normalisation eg functional dependency, determinacy diagrams, first, second and third normal forms; object oriented analysis and design (OOAD) (classes, attributes, associations); features (advantages, disadvantages)

2 Understand logical data modelling

Logical data modelling concepts: entities; attributes; relationships ie one-to-one, one-to-many, many-to-many; entity relationship (ER) diagram; data dictionary; participation conditions of relationships ie mandatory, optional

Benefits: general eg structured model, standard methods, standard notation, no data redundancy

Constraints: domain; entity; referential; user requirements; operational eg platform, organisational conventions

3 Be able to produce logical data models

LDM: contents eg user requirements, data dictionary, entity relationship diagram, entity types, relationship descriptions, constraint list, purpose eg ease of maintenance, ease of alteration/change; other eg programming standard notation (Hungarian, Polish), organisational

User requirements: data to be stored; outputs required; data validation rules

4 Be able to implement and test logical data models

Types of testing: integrity eg domain of field, entity, relationship, constraint; error eg normal, erroneous, extreme

Test strategy: order and priority; test data for population of database

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 describe the advantages and disadvantages of different database types		
P2 describe different modelling methodologies		
P3 explain logical data modelling concepts	**M1** discuss the benefits of logical data modelling	
P4 produce a logical data model for a given requirement [CT1]	**M2** examine potential constraints on a logical data model [IE1]	**D1** demonstrate the relevance of third normal form [EP6]
P5 implement a logical data model		
P6 test a logical data model. [IE4]	**M3** justify the requirements for all types of test to ensure a logical data model is efficient and effective.	**D2** evaluate a logical data model. [IE4]

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Delivery can be based on the order of the learning outcomes.

It is important to note that, at this level, learners are expected to work with relational databases and have systems that integrate several tables through relationships. This is consistent with the National Occupational Standards (NOS). However, it is important that learners are provided with knowledge of other database analysis and modelling techniques, methodologies and implementation structures.

Other modelling methodologies should be investigated. A visiting speaker may be useful to aid understanding of why and when these models are applied.

Learners should investigate database structures other than the flat file and relational databases they are probably already familiar with, and case studies demonstrating the use of these structures can be used to set them in context.

Learners will probably have studied *Unit 18: Database Design*, which concentrates on the software skills needed to implement a database structure. They will have used terms such as 'entity' and 'attribute' and been introduced to normalisation but this will not have been labelled logical data modelling'. All the logical data modelling concepts will need to be revisited or learnt anew and using the work learners have completed for Unit 18 will help set the theory in context. Constraints on modelling also need to be considered in this unit and case studies can provide examples of the effects of a variety of constraints.

Learners should understand the need for clear technical documentation. A useful exercise is to provide a poor example and ask learners to try updating the database in some way. The purpose of good documentation then becomes very clear.

Finally, learners will need to practise designing and implementing data models normalised to third normal form. Normalisation is a difficult skill to learn but active learning materials are available to help build learner confidence.

Understanding the need for testing and what should be tested can be an extension of the practice designs. Realising what may go wrong if testing is incomplete is a good way to learn and there have been a number of reported cases of large database systems failing due to poor testing.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to the unit
Modelling methodologies: • whole-class exercise – tutor presentation on database types, followed by practical exercise • whole-class exercise – visiting speaker and/or tutor presentation on methodologies, followed by practical exercise • a mixture of tutor-led sessions, research, directed learning and talks.
Assignment 1 – Sort out this Mess
Logical data modelling: • whole-class exercise – tutor presentation on concepts • group exercise – using previous work highlight concepts, discuss terminology • whole-class exercise – tutor presentation on normalisation, followed by practical exercise • whole-class exercise – tutor presentation on constraints. • group exercise – investigate case studies and discuss constraints • whole-class exercise – tutor presentation on documentation, followed by practical exercise • a mixture of tutor-led sessions, directed learning, exercises.
Developing LDMs: • individual exercise – learners produce LDMs • whole-class exercise – tutor presentation on testing, followed by practical exercise.
Assignment 2 – The Ideal Solution
Assignment 3 – The Working Solution

Assessment

Learners could be given a case study from which they can undertake analysis and produce a logical data model. If this approach is used, the case study should cover the development of between four and six discrete entities in order to be able to demonstrate fully the relationships and multi-table queries. Alternatively, learners could develop a user requirement brief in consultation with their tutor, which may arise from a real life situation or as part of work-related activities.

Suggested Assignment 1 – Sort out this Mess

This could be based on a business need to redevelop an overloaded and now inefficient database system. In the first assignment, the scenario could be the need for a presentation to determine the methodology that will be used for redevelopment.

For P1, learners need to describe the advantages and disadvantages of different database types as suggested in the unit content, including the uses and appropriateness of each in given situations. Examples of each database type in use should be provided as supporting evidence.

For P2, learners need to describe at least two methodologies, including the detail of how they are structured and show the advantages and disadvantages of each type, together with appropriate examples.

P3 requires an explanation of LDM concepts as outlined in the unit content. Examples can be used to illustrate each concept.

For M1, learners should demonstrate understanding of the benefits of the structured approach of logical data modelling before implementation of any database system.

Suggested Assignment 2 – The Ideal Solution

Having chosen to use logical data modelling, the next stage is to develop the model after analysing the user's requirements and defining the data to be included. This is probably best evidenced via the paperwork produced in developing the model but could be presented through a presentation or report.

For P4, learners must develop a model comprising at least four entities, by following all the stages listed in the unit content.

For M2, learners should have considered the potential constraints on their model and indicated how these have affected the final design.

To demonstrate the relevance of third normal form for D1, learners should show how they arrived at 3rd NF for their data model and discuss why normalisation is necessary in the context of their model.

Suggested Assignment 3 – The Working Solution

After the model has been agreed, it is now to be implemented and tested.

For P5, learners should translate a data model that they have designed into a real data structure for a database or programmed solution. Evidence could include printouts of the data model supported by notes or records of discussions between learners and the tutor. It is not expected that learners will learn structured query language (SQL) in order to be able to implement and test their model.

For P6, learners should create a test strategy and associated test plan for a model, following a standard industry format. The tests should be those they would expect to carry out to ensure the stability of the model under all circumstances and include integrity tests. The tables should be populated with data that will enable tutors to show these tests to work and be evidenced. It is acceptable that the assessor observes the tests being performed providing evidence is submitted in the form of a witness statement. Hard copy evidence of the testing, however, should be submitted as evidence towards M3.

Full test documentation should be produced on successful implementation for M3 with an appended justification of why each type of test is necessary.

For D2, learners are expected to evaluate the strengths and weaknesses of their developed systems against the requirements of the user. They should also identify, and justify the changes they would make if required.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1-P3, M1	Sort out this Mess	An inefficient database system needs redeveloping. What structures and methods should be used?	Presentation
P4, M2, D1	The Ideal Solution	Produce a logical data model to meet the user's requirements.	Designs (ERDs etc) Normalised tables Report
P5, P6, M3, D2	The Working Solution	Implement, test and evaluate the LDM.	Printouts Notes Witness statements Test plans and results Technical documentation Evaluation

Links to other BTEC units

This unit forms part of the BTEC in IT sector suite. This unit has particular links with the following unit titles in the IT suite:

Level 1	Level 2	Level 3
		Unit 5: Advanced Database Skills
		Unit 7: IT Systems Analysis and Design

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Essential resources

Learners will need access to industry standard database software (for example Microsoft Access) plus hardware capable of running the software (including a printer).

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	testing and evaluating the model, judging its relevance and value examining potential constraints
Creative thinkers	generating ideas and exploring possibilities for producing a logical data model for a given requirement.

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Independent enquirers	identifying questions to answer and problems to resolve in the logical data model
Reflective learners	justifying the testing requirements
Effective participators	acting as an advocate for the relevance of third normal form.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Using ICT	
Plan solutions to complex tasks by analysing the necessary stages	producing a logical data model
Select, interact with and use ICT systems safely and securely for a complex task in non-routine and unfamiliar contexts	implementing a logical data model
Manage information storage to enable efficient retrieval	implementing a logical data model
ICT – Developing, presenting and communicating information	
Combine and present information in ways that are fit for purpose and audience	producing technical documentation.