THE BCS PROFESSIONAL EXAMINATION
Diploma

October 2017

EXAMINERS' REPORT
Systems Analysis and Design

Case study for both Sections A and B
BCS Builders

BCS Builders is a company offering house building and property improvement services to the public. The proprietor of the company employs a number of skilled workers such as bricklayers, carpenters and plumbers. The proprietor manages the building projects himself and may occasionally help with the construction work.

BCS Builders wants to computerise the management of building work. This includes processing of estimates, job scheduling, and payments as described below in more detail.

When a customer contacts the company to ask for an estimate, the proprietor makes a note of the customer's contact details and an outline of the proposed work. He agrees a date with the customer to view the property in order to give an estimate of the cost for the work. When visiting the property on the agreed date the proprietor adds more detail to the outline of the proposed work. Within 3 days of visiting the property the proprietor produces a fully detailed estimate and sends it to the customer. If the customer agrees the estimate, the proprietor schedules a date to start the job (this is based on the size of the job and other jobs that have already been scheduled).

A few days before the agreed start date of a job, the proprietor contacts the customer to confirm the start date, and then orders the required building materials from suppliers to be delivered on the date the job starts. At the end/completion of the job the proprietor calculates the actual cost of the job to produce an invoice which is sent to the customer. The customer has 30 days to pay the invoice.

Section A

General Comments

A reasonable range of marks for this section with most candidates obtaining a pass. None of the three questions attracted consistently low or high marks.

Question A1

Syllabus Coverage:

2.7 Business activity modelling including the use of data flow diagrams (DFDs)

The Question

A1

a) Produce a top level data flow diagram representing the management of building jobs in the BCS Builders company (described in the case study). **(20 marks)**

b) Compare the technique of data flow modelling with business activity modelling. There is no need to model the BCS Builders company scenario again, but you should describe the notation of the business activity model as part of your comparison.

(5 marks)

Answer pointers

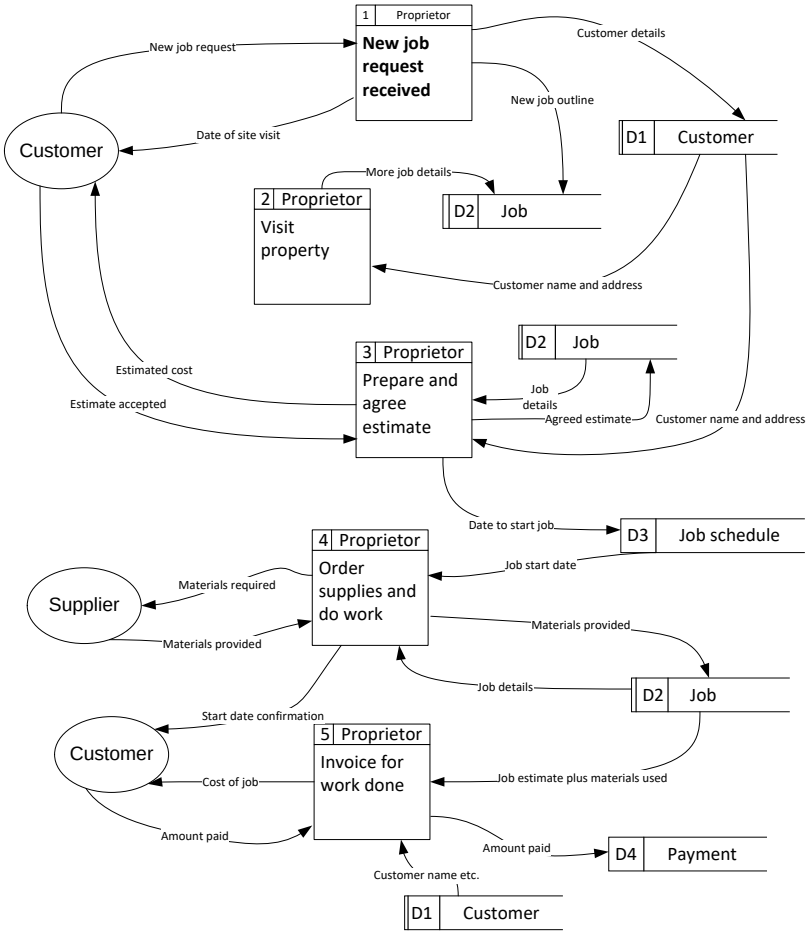
Part a)

For good representation of scenario:

Correct external entities	4
Correct data stores	4
Correct processes	5
Correct notation	5
Completeness	2

Maximum 20 marks

Note that other processes will be accepted e.g. Schedule job (included in process 3 below)



Part b)

For each correct comparison – 1 mark e.g.

- Arrows on a BAM represent sequencing between activities; on a DFD they represent data flows.
- BAM shows decision-points leading to alternative sequences of activities
- Notation for DFM is more formal than for BAM.
- A BAM shows activities; a DFD shows processes.
- A BAM does not show data in any way.
- Both models support decomposition.

Maximum 5 marks

Examiners' Guidance Notes

This question was attempted by 50% of candidates, most of whom obtained a pass mark for the question. The average mark was 12/25 or 48%. The evidence shows in Part (a) a significant minority of candidates made the mistake of representing some dataflows as processes. Some candidates presented activity or context diagrams instead of a Level 1 DFD but most candidates had the right idea. Some candidates did not attempt Part (b) and most who attempted it did not give an illustrative example to make the difference between Activity Models and DFDs clear.

Question A2

Syllabus Coverage

1.2 Role of business analysts, system analysts

1.4 Adaptation of methodologies

2.1 Stakeholder analysis

2.2 Requirements gathering techniques

The Question

a) Two common techniques for gathering requirements are interviews and workshops. Choose ONE of these techniques and describe how an analyst would prepare for it and carry it out. **(15 marks)**

b) For the technique you have chosen in Part (a) discuss its advantages and disadvantages for requirements gathering. **(10 marks)**

Answer pointers

Part a)

Interview Preparation

- Identify stakeholders to interview
- Identify what information each interviewee may provide
- Organise venues, times and durations

Interviewing

- Introduce yourself and explain purpose of interview
- Ask questions – discuss area under investigation
- Take notes/record interview
- At end, summarise points covered
- Explain next steps
- Ask if and how you can make further contact

Workshop Preparation

- Decide objective and sub-objectives to be achieved
- Identify and invite all interested stakeholders
- Understand interest and concern of each stakeholder
- Plan workshop structure and techniques to be used
- Arrange venue and time to suit all stakeholders

Facilitating the Workshop

- Discuss objective and issues
- Make sure all participants have an opportunity to make an input
- Keep the discussion on track
- Take notes/record key points
- Summarise key points and decisions at the end

Up to 2 marks for each point described

Maximum 15 marks

Part b)

Interview:

Advantages

- Allows a relationship to be built with stakeholders
- Important information can be discovered
- New issues brought to light
- Appreciation of political factors in the organisation
- Opportunity to understand the context of new system

Disadvantages

- time consuming for interviewer and stakeholders interviewed
- May require travel if stakeholders dispersed
- Information is opinion of only the interviewee

Workshop:

Advantages

- More complete understanding of issues and problems from all stakeholder viewpoints
- Quicker to have all stakeholders together than individual interviews
- Inclusion of stakeholders helps reach consensus and buy-in

Disadvantages

- Time consuming to organise
- Difficult to find a time to suit all stakeholders
- Stakeholders must have authority to make decisions

Up to 2 marks for each point made.

Maximum 10 marks

Examiners' Guidance Notes

This question was attempted by 85% of candidates, most of whom obtained a pass mark. The average mark was 14/25 or 56%. Although the question allowed candidates to consider workshops the evidence shows the majority chose to consider interviews as their requirements gathering technique. In Part (a) most candidates provided a full discussion of interview techniques often running to many pages. The answers to Part B were generally good with most candidates identifying cost as the only significant disadvantage with interviews.

Question A3

Syllabus coverage

1.1 Systems development lifecycle and position of SAD within it

2.8 Use of prototyping, particularly as a method of requirements elicitation

6.1 Usability issues

6.2 Interface design

The Question

a) Explain how Graphical User Interface (GUI) design techniques may be used in different phases of the System Development Life Cycle (SDLC) **(6 marks)**

b) It is important that software systems work with clean, valid data. How can the User Interface be designed to help ensure that data entered by the user is valid? **(19 marks)**

Answer pointers

Part a)

A good answer would consider an SDLC based around the evolution of a suitable GUI. This might include the following stages:

GUI Requirement Gathering - The designers should list all functional and non-functional requirements of a GUI. This can be taken from the user and their existing software solution.

User Analysis - The designer studies who is going to use the software GUI. The target audience matters as the design details change according to the knowledge and competency level of the users. If the user is technically competent, advanced and complex GUI can be incorporated. For a novice user, more information is included on how to use the software.

Task Analysis - Designers have to analyse what task is to be done by the software solution. Tasks might be represented in a hierarchical manner taking one major task and dividing it further into smaller sub-tasks. Tasks provide goals for GUI presentation. Flow of information among sub-tasks determines the flow of GUI contents in the software.

GUI Design & implementation - Designers use information about requirements, tasks and user environment to design the GUI with working or dummy software in the background. It is then self-tested by the developers.

Testing - GUI testing can be done in various ways. An in-house inspection with direct involvement of users or release of a beta version more widely are a two of them. Testing may cover usability, compatibility, user acceptance etc.

Maximum 6 marks

Part b)

The answer to Part (b) should include some/all of the following:

Completeness Check: If required information is missing the form should be returned unprocessed to the user.

Format Check: Ideally numeric fields should not permit users to enter text. Some fields, such as email addresses, have a particular structure that should be checked.

Range Check: This should permit only numbers between correct values and may include checks for "reasonableness" – e.g. birthdates for living people over 110 years in the past.

Cross checking: This ensures the consistency of different inputs e.g. the make and model of a vehicle, gender and title.

Check digits. Adding one or more digits to a reference number which are calculated from the other digits. This is designed so that transposing two digits, for example, changes the result of the check digit calculation, and thus invalidates the number.

Checking consistencies with data already held e.g. that a customer reference relates to an existing customer

Auto-completion using existing database details to populate a field e.g. addresses derived from post codes

Providing menus of alternative valid inputs e.g. pull-down selection lists

Non-keyboard input e.g. bar-code reading, RFID

Up to 3 marks for each valid point

Maximum 19 marks

Examiners' Guidance Notes

This question was relatively unpopular only being attempted by 35% of candidates, most of who obtained a low pass mark for the question. The average mark was 11/25 or 44%. The evidence shows that many candidates restricted the discussion to functional prototyping in Part (a). The answers to Part (b) tended to be very specific – often with sketches of (for example) a specific button or list box being provided as illustrative examples.

Section B

General Comments

Questions 4 and 5 were much more popular than Question 6. The best results were achieved for Question 4. The Question 5 and Question 6 results were worse but reasonable.

Question B4

Syllabus Coverage

4.2 Normalisation and de-normalisation.

4.1 Conversion of ERM into a relational schema

4.5 Data migration issues, for example, mapping between equivalent items in new and old applications

3.4 Entity relationship modelling

The Question

This question refers to the case study described above (i.e. BCS Builders). The table below shows an example of a list of jobs which have been carried out recently.

Job code: G3	**Job description**: General- internal	**Customer No.:** 23	**Customer name:** J Smith
	Material code: B2	**Material name:** Bricks- standard	**Quantity:** 100 packs
	Material code: C3	**Material name:** Cement - Portland	**Quantity:** 40 kg
	.....	.....	.....
Job code: B2	**Job description**: General -bath	**Customer No.:** 12	**Customer name:** G Holmes
	Material code: T3	**Material name:** Tiles-standard	**Quantity:** 10 packs
	....	.....	....
Job code: K1	**Job description**: Basic -kitchen	**Customer No**.: 17	**Customer name:** B Brown
	Material code: P8	**Material name:** Paint –prof.	**Quantity:** 10 litres
	.....	.....	.....
	……	…….	……..

a) Normalise the table to produce a set of relations in the Third Normal Form. You must show all of your working explaining each step. **(14 marks)**

b) Draw an Entity Relationship Diagram (ERD) using the relations in part a). **(6 marks)**

c) Give a brief explanation of de-normalisation in database design. **(5 marks)**

Answer Pointers

a) The steps of normalisation are shown below:

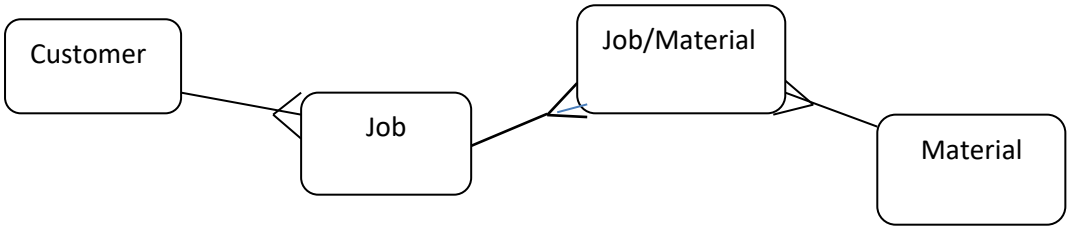
UNF	1NF	2NF	3NF	Relations
Job code Job description Customer No. Customer name Material code Material name Quantity	<u>Job code</u> Job description Customer No. Customer name <u>Job code</u> <u>Material code</u> Material name Quantity	<u>Job code</u> Job description Customer No. Customer name <u>Job code</u> <u>Material code</u> Quantity <u>Material code</u> Material name	<u>Job code</u> Job description Customer No.* <u>Customer No.</u> Customer name <u>Job code</u> <u>Material code</u> Quantity <u>Material code</u> Material name	Job Customer Job/Material Material

For correct 1NF with explanation (remove repeating groups) 3 marks
For correct 2NF with explanation (remove part key dependencies) 4 marks
For correct 3NF with explanation (remove non-key dependencies) 4 marks

For correct relations **3 marks**

Maximum 14 marks

b)



For correct relationships and their multiplicities **4 marks**
For correct entities **2 marks**

Maximum 6 marks

c) A relational normalised database imposes a heavy access load over physical storage of data even if it is well tuned for high performance. **De-normalisation** is the process of attempting to optimise the read performance of a database by adding redundant data or by grouping data.

Maximum 5 marks

Examiners' Guidance Notes

Nearly 97% of candidates attempted this question and the substantial majority of them achieved a pass mark for their answers.

Many answers for Part (a) were good and the majority of candidates were able to demonstrate practically the normalisation process. There is evidence that some candidates however did not provide proper explanations and did not show primary and foreign keys.

Part (b) was answered generally well. Some candidates were unable to demonstrate relationships (with cardinalities of relationships in particular). Some candidates produced ERDs which were inconsistent with the normalised relations/tables.

Part (c) caused many problems. Only a few candidates properly explained the purpose of de-normalisation.

Question B5

Syllabus Coverage

5.1 OO Concepts: classes and objects; encapsulation, interfaces, inheritance, polymorphism, message passing.

5.2 Relating objects: associations and aggregations etc.

5.3 Static modelling including UML class diagrams

The Question

a) Provide a brief explanation of the following concepts in object orientation:

(i) Class and object,
(ii) Encapsulation,
(iii) Message passing.

(7 marks)

b) Consider the following extra information about the BCS Builders company described above:

"There are two types of suppliers of building materials: local suppliers and foreign suppliers. The following data are stored about each local supplier: Supplier No, Supplier name, Email address, Town.

The attributes of each foreign supplier are: Supplier No, Supplier name, Email address, Country, Currency.

An object of class Supplier Order consists of an order header followed by order lines."

Explain the following relationships between classes using examples from the BCS Builders system to illustrate your answers:

(i) Association,
(ii) Aggregation or Composition, and
(iii) Generalisation/Inheritance.

The examples should show relevant fragments of a class diagram.

Explain also the differences between generalisation/inheritance and aggregation relationships between classes. **(18 marks)**

Answer Pointers

a) Proper explanation of class and object. **3 marks**
Proper explanation of encapsulation. **2 marks**
Proper explanation of message passing. **2 marks**

Maximum 7 marks

b) Explanation of association **2 marks**
Example of association (e.g. between Customer and Job) **3 marks**

Explanation of aggregation **2 marks**
Example of aggregation (e.g. object of class Supplier Order 'consists' of Header, iteration of Order_Lines) **3 marks**

Explanation of inheritance/generalization **2 marks**
Example of inheritance/generalization (e.g. Supplier – superclass with two subclasses: Local supplier, Foreign supplier) **3 marks**

Explanation of the differences between generalisation and aggregation. **3 marks**

Maximum 18 marks

Examiners' Guidance Notes

This question was attempted by about 80% of candidates and the majority of them achieved a pass mark

Part (a) was answered reasonably well. However, the evidence shows that many candidates were unable to provide a proper explanation of encapsulation.

Part (b) was answered reasonably well. Some candidates however were unable to give proper and correct examples of relationships between classes. A small number of candidates also had problems with definitions/explanations of relationships between classes (association and aggregation in particular). Also, a small number of candidates did not draw relevant fragments of class diagrams. Only a small number of candidates were able to properly explain the differences between generalisation and aggregation.

Question B6

Syllabus Coverage

5.4 Dynamic modelling including UML interaction diagrams (e.g. sequence, communication/collaboration diagrams) UML statecharts.

The Question

a) Discuss briefly the purpose of sequence diagrams. **(2 marks)**

b) Produce a sequence diagram for the use case 'Create supplier order' in the BCS Builders system described above. A brief description of this use case is given below.

"A list of all suppliers is displayed by the system. The proprietor selects one supplier and the system displays the supplier's details, creates the 'partial' supplier order, and displays the list of all building materials provided by this supplier. The manager selects materials from the list which are added to the order. Finally, the new order details are displayed". **(13 marks)**

c) Produce a state machine/chart for the class Job in the BCS Builders system. You may assume that objects of this class are affected by the following 'events' (listed below in alphabetical order):

- archive a job – to remove the specified job from the system,
- cancel a job – to cancel an already scheduled job
- complete a job
- confirm a job
- schedule new job.

(10 marks)

Answer Pointers

a) The purpose of sequence diagrams. **2 marks**

Maximum 2 marks

b) The sequence diagram should have the following elements:

Actor – Manager/Proprietor **2 marks**

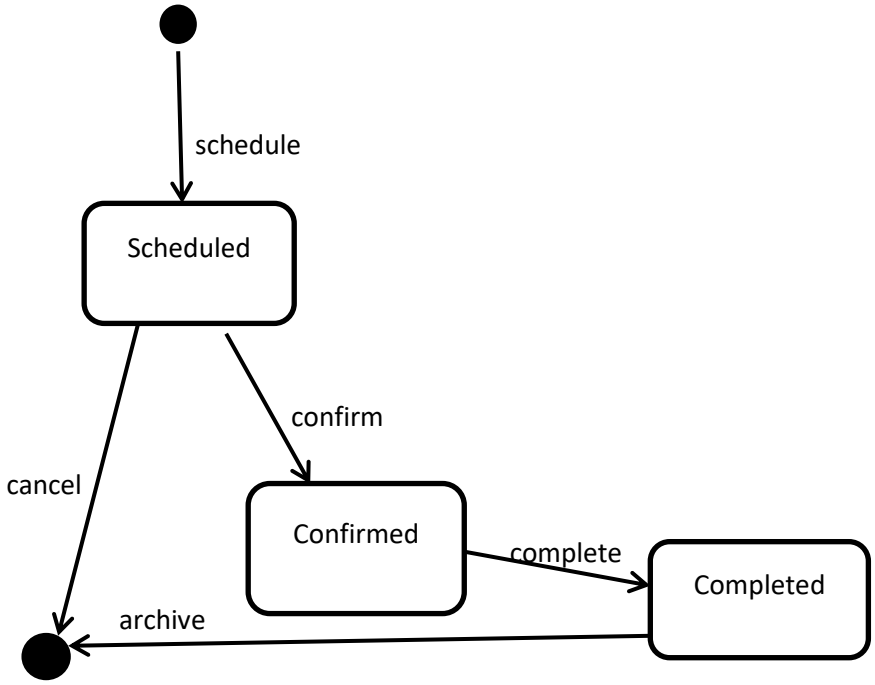
Classes/Objects: Supplier (updated), Supplier_Order (new object is created), Material (accessed) **5 marks**

Right messages/operations **4 marks**

Loops (to show lists displayed by the system) **2 marks**

Maximum 13 marks

c)



correct state nodes	**3 marks**
initial and final states	**2 marks**
correct transitions	**5 marks**

Maximum 10 marks

Examiners' Guidance Notes

Only a small number of candidates (35%) attempted this question. However, the majority of candidates who attempted this question achieved a pass mark. Some answers were excellent.

Part (a) was answered reasonably well.

There is evidence that most candidates who answered part (b) identified the right actor, but only a small number of candidates identified the right classes/objects and messages.

Part (c): a substantial number of candidates produced reasonable state charts/state machines.