THE BCS PROFESSIONAL EXAMINATIONS
Professional Graduate Diploma

April 2006

EXAMINERS' REPORT

System Design Methods

1. *a)* The classical approach to systems development recommends that the current/existing system should be investigated and modelled first, and this should be followed by an investigation and modelling of the required/new system.

Many methods (e.g. SSADM) are based on this approach, but not everyone agrees that a detailed investigation of the current system is necessary.

i) Give at least three arguments for investigating the current system,
ii) Give at least two arguments for not investigating the current system,
iii) Give an example of a project/situation which should be based on the 'classical' approach,
iv) Give an example of a project/situation which should not be based on the 'classical' approach.
v) Under what circumstances could the current logical model and the new logical model for a system be the same? **(16 marks)**

b) Component Based Systems Development (CBSD) methods place a lot of emphasis on component reuse when developing a new system and on developing ('fabrication') of new reusable components. Identify the main stages which should be provided by a typical CBSD method. **(9 marks)**

Answer Pointers

a) (i) Possible arguments for investigating the current system (3 are required):

- Usually some of the functionality of the current system will be required in the new one
- Some of the data in the current system must be migrated into the new one
- The current system may have defects that we should avoid in the new system
- Studying the existing system will help to understand the organisation in general
- Parts of the existing system may be retained
- Investigating (and documenting) the current system is a way of reassuring the users that the analysts understand the nature of the problem fully and are competent to carry the work (6 marks)

(ii) Possible arguments for not investigating the current system (2 are required):

- Investigating and modelling of the current system usually require a lot of time and effort
- Investigating and modelling of the current system may become the main objective of the analysis (while the main objective is to develop the new system)
- A lot of documentation of the current system (physical models in particular) can be thrown away. (4 marks)

(iii) The 'classical' approach can be used when a substantial part of the current system is to be retained and also when users are unable to identify problems with the current system. (2 marks)

(iv) The 'classical' approach is not suitable when a new system is very different from the current one (e.g. as a result of business re-engineering exercise). (2 marks)

(v) Both models are the same if e.g. the new system automates a manual system (whose 'logic' is to be retained). (2 marks)

b) A typical CBSD method is likely to have 2 major processes: the solution process and the component process.

The solution process is a typical systems development process (with 'traditional' stages of Feasibility and Analysis). These stages are followed by Design and Build stage which is less 'traditional' as it seeks to 'harvest' reuse by looking for existing components which can be used to solve the problem. (5 marks)

The component process is responsible for production of components. The main stages within this process are 'traditional' Design and Build followed by Acceptance (to ensure acceptance and certification of a set of components) and Roll out (to install a set of components in the repository supporting the live user environment) stages. There should also be a stage (prior to Design and Build) to assess needs for reusable services (these may arise from the solution process(es), legacy assets, etc). (4 marks)

Examiner's Guidance Notes

For part (a), subsections (i) and (ii): Generally no problems. Reasonable arguments were given, but some arguments were 'duplicated'/repeated.

For part (a) , subsections (iii) and (iv): There were two main problems with these subsections:

1. Many candidates assumed that (iii) must be about the waterfall approach and (iv) about e.g. prototyping (i.e. a 'non waterfall' approach).
2. Many candidates gave examples of concrete applications/systems instead of giving examples of situations which require and do not require the investigation of the current system.

For part (a), subsection (v): Only a small number of correct answers were provided.

For part (b). In general reasonable answers were provided with much greater emphasis however on the 'solution' process than on the 'component' process.

Question 2

2. *a)* Systems modelling techniques can be used to model different aspects of information systems. Consider:

i) the following 'aspects' of a typical system:

- User-system interactions/external communications
- Functionality of a system
- Structure of a system (e.g. systems data)
- System dynamics (behavioural aspect)

ii) the following modelling techniques:

- Sequence diagram
- Context DFD (Data Flow Diagram)
- Class diagram
- Use Case diagram
- Entity Life History (ELH)

Which modelling technique(s) would you use to model the above aspects? Justify your answers. **(12 marks)**

b) Consider a simple order processing system which allows customers to place and cancel orders.

i) Draw a DFD and a Use Case Diagram modelling this situation. **(2 marks)**

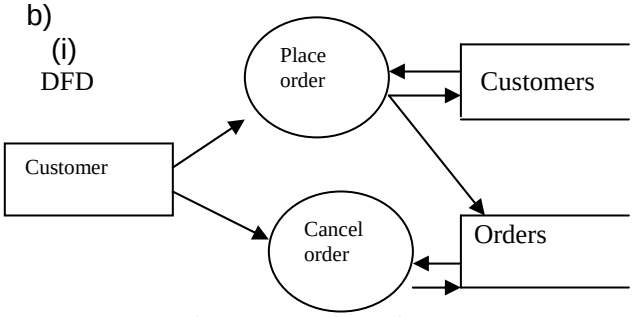
ii) Discuss similarities and differences between both diagrams. **(6 marks)**

iii) Which modelling technique in your opinion is semantically 'richer' and why? **(5 marks)**

Answer Pointers

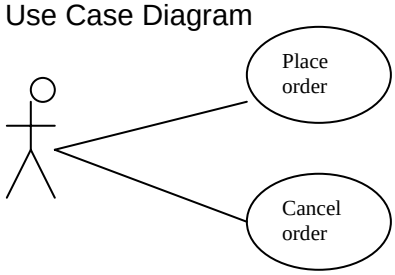
a) Sequence diagram :user-system interaction (the leftmost part of the diagram), system dynamics
Context DFD : user-system interaction
Class diagram : structure of the system
Use Case diagram: primarily functionality, user-system interaction
ELH: system dynamics
N.B. Brief explanations should be provided. (12 marks)

b)
(i)
DFD



No need to name data flows! (1 mark)

Use Case Diagram



(1 mark)

(ii) Main similarities:

- Both show functional requirements (services which should be provided by the system)
- Both show users/actors of these services

Main differences:

- DFDs show flow of data
- DFDs show data stores (repositories)
- DFD can show system's functionality at different levels of detail ('levelling')
- Use cases and processes differ (use cases are descriptions of the functionality from the users' perspective, while processes represent functionality from the system's perspective). (6 marks)

(iii) From the above discussion DFDs seem to be 'richer' sematically: they show flow of input and output data and flow of data 'inside' the system, data stores etc. DFDs can also show system's functionality at various levels of detail ('levelling'). (5 marks)

Examiner's Guidance Notes

For part (a): In general ok i.e. candidates managed to 'allocate' appropriate modelling techniques to different 'aspects' of the system.

For part (b), subsection (i): No serious problems with a Use case diagram, but many candidates have drawn a context DFD instead of an 'event'/'function' level DFD.

For part (b), subsection (ii): Most candidates managed to identify the main similarities and differences between Use case diagrams and DFDs.

For part (b), subsection (iii): Many candidates discussed advantages (and disadvantages) of use case diagrams and UML instead of discussing which technique is 'richer' sematically.

Question 3

3. *a)* The software house for which you work has recently begun to develop safety critical applications. You have been asked to introduce a systems design method for the development of safety critical applications. Discuss what type of method you would implement, and how you would go about introducing such a systems design method into your software house. **(15 marks)**

b) Discuss the situations in which reverse engineering may be appropriate and those in which it may not be appropriate. **(10 marks)**

Answer Pointers

a) A formal method would probably be the most appropriate type of systems design method for safety critical applications development since a formal method can provide a validation of the designs produced for such applications, since the mathematical logic of the designs can be examined. (6 marks)

The implementation of a formal method into an organisation that had not previously used such a systems design method would probably require the following:

Detailed training for the IT staff in the use of the formal method. (3 marks)

It might also be necessary to explain to the IT staff why formal methods need to be used. (3 marks)

It might be necessary to give some staff training in the mathematical concepts used in formal methods. (3 marks)

b) Reverse engineering might typically be appropriate in the following circumstances:

When porting an application from one programming language to another, or one operating system to another, or one hardware platform to another. (4 marks)

When large scale changes are required to an application, and the documentation for the application and the coding of the application are in a poor state. (4 marks)

Reverse engineering might typically be inappropriate in the following circumstances:

When only minor changes are required to an application system. (2 marks)

Examiner's Guidance Notes

For part (a) most candidates gave reasonable answers, however some candidates appeared unaware of the need for formal methods for such systems.

For part (b) most candidates could explain when reverse engineering was appropriate and when it was not.

Question 4

4. *a)* Compare the benefits and drawbacks of using object oriented and structured design methods for e-commerce systems. **(10 marks)**

b) There are a large number of different types of systems design methods in existence, ranging from socio-technical methods that cover the social as well as the technical aspects of systems development; through engineering based methods that concentrate on the technical design of systems; to formal methods that adopt mathematical language to express designs in a more formal and less ambiguous manner. Discuss THREE possible reasons why such a large variety of systems design methods exist. **(15 marks)**

Answer Pointers

a) Object oriented system design methods can model the user interaction with an electronic commerce system through the use of use case diagrams. Database tables used in an electronic commerce system could be modelled using object diagrams. Object oriented design methods make implementing the designs in object oriented programming languages more straightforward. (5 marks)

Structured methods provide a straightforward and reliable database modelling technique in the form of entity relationship diagrams that would be useful for modelling any databases used in the electronic commerce system. However, structured methods are typically weaker at modelling user interfaces. (5 marks)

b) Some systems design methods such as formal methods aim to provide unambiguous designs that can be validated mathematically and so assist in the development of highly accurate and reliable systems. This requires the use of mathematical notation. (5 marks)

Socio-technical systems design methods aim to cater for systems development projects where the determination of requirements may not be straightforward, for example where there are multiple stakeholders with potentially quite different views regarding the requirements for the project. (5 marks)

Engineering based systems design methods such as object oriented approaches and structured approaches are relevant to the majority of systems development projects where the requirements can be identified without too great a difficulty, and where there is not a requirement for formal validation. (5 marks)

Examiner's Guidance Notes

For part (a) most candidates discussed relevant benefits and drawbacks of using object oriented/ structured design methods for such systems.

For part (b) most candidates were aware of the different types of systems design methods.

Question 5

5. *a)* Outline THREE ways in which an organisation could attempt to assess the benefits obtained through introducing a new systems design method. **(10 marks)**

b) Outline the types of software tools that could be used to support systems design activities, explaining the potential benefits that they could provide. **(15 marks)**

Answer Pointers

a) One approach to assessing the benefits obtained through introducing a new systems design method might be to compare the overall cost of developing a system using the new method with the cost of developing a similar system using the old method (or no method). (4 marks)

Another approach might be to compare the cost of maintaining a system developed using the new systems design method with the cost of maintaining a similar system developed using the old method (or no method). (3 marks)

Another approach might be to compare the number and frequency of implementation and post implementation problems encountered in systems developed with and without the new systems design method. (3 marks)

b) Project management tools that can produce project plans and schedules (e.g. gannt and pert charts) for design activities. Project management tools allow monitoring and tracking of design activities. (5 marks)

Documentation tools can allow easy development, storage, retrieval and maintenance of system design documentation. Documentation tools are useful for keeping systems design documentation up to date for future software maintenance activities. (5 marks)

CASE tools can automate aspects of the development of design documentation and can in some cases generate code from the designs produced. CASE tools can often check for consistency between different design diagrams and documents, thus improving quality control, and helping to enforcing design standards in the design process. (5 marks)

Examiner's Guidance Notes

For part (a) most candidates discussed appropriate mechanisms for assessing the benefits. However, some candidates simply discussed how to introduce a new design method.

For part (b) most candidates could discuss the different types of software tools available for supporting systems design activities.