BCS PROFESSIONAL EXAMINATIONS
BCS Level 6 Professional Graduate Diploma in IT

April 2008

EXAMINERS' REPORT

System Design Methods

Question 1

a) Explain with the aid of diagrams the differences between the waterfall and incremental approaches to systems development.

Which approach to systems development would you suggest for the projects characterized by:

i) precise requirements which can not be clearly prioritised,
ii) precise requirements which can be easily divided into different priority categories?

(10 marks)

b) Consider the following life cycle models: waterfall, evolutionary prototyping, throw away prototyping, incremental and spiral. How would you classify the *Rapid* method process? (See **Appendix** at end of paper). Justify your answer.

(6 marks)

c) Explain the difference between validation and verification (V&V) in software projects.

The *Rapid* method process (see **Appendix)** includes five phases: Feasibility Study, Business Analysis, Build usability and functional prototype, Refine prototype and Deliver prototype. Suggest various V&V activities/techniques suitable for different stages of *Rapid* method. Your answer should include a brief justification of your 'allocation' of V&V activities/techniques to the *Rapid* stages.

(9 marks)

Answer Pointers

a) Waterfall: A sequence of stages: Feasibility, Requirements analysis, Design, Implementation/Coding, Testing. (3 marks)
Incremental: Feasibility, Requirements analysis (to identify some of the requirements and 'assign' them to an increment), Develop system increment, Test increment, Integrate increment, Validate integrated system, If the system is not complete go back to Requirements analysis. (5 marks)

i) Waterfall. No need for prototyping, as the requirements are precise. Difficult to 'assign' the requirements to increments, as they can not be prioritised. (1 mark)
ii) Incremental. The requirements can be 'assigned' to increments (1 mark)

b) It is based on incremental and evolutionary prototyping.
Prioritised requirements (from Stage 2) are 'assigned' to increments/prototypes. Each increment/prototype gradually 'evolves' through iterations of Stages 3 and 4 into the final product which in Stage 5 is delivered to users. (6 marks)

c) Validation and verification are checking activities.
Validation is intended to show that a software does what the user requires. Verification is intended to show that the software meets its specification. (2 marks)

Feasibility study: e.g. Reviews/inspections of the Feasibility report and (possibly) Feasibility prototype testing
Business analysis: Reviews/inspections of all documentary products
Build usability and functional prototype: Reviews/inspections of all documentary products e.g. system models, Prototype testing and reviews.
Refine prototype: Reviews/inspections of all documentary products, Prototype testing and reviews, Integration testing, System testing, User acceptance testing.
Deliver prototype: Reviews/inspections of all documentary products, Integration and system testing, Operational acceptance testing. (7 marks)

Examiner's Guidance Notes

Part (a). Waterfall approach was generally well explained. For incremental approach some diagrams were wrong or missing. Many candidates suggested incremental approach for (i) and waterfall for (ii).
Part (b). Many candidates tried to 'prove' that all life cycle models are present in the Rapid method process.
Part (c). The difference between validation and verification was generally well explained. Most candidates did not properly allocate V&V techniques to the Rapid stages. Some candidates discussed techniques that are not V&V techniques e.g. fact finding techniques, modelling techniques, etc.

Question 2

a) Geographic information systems are a relatively new type of information system that allow map based data to be input, stored, manipulated and queried. Such systems can contain a variety of table based data that is geo-coded (each item of data is associated with a given geographic location). Such systems can be queried to allow for example: identification of the number of houses within a given distance from a certain point, or a certain feature such as a river; or identification of all areas at a given height above sea level, or areas with a population density in a certain range.

Outline which systems design techniques you feel would be suitable for designing geographic information systems, justifying your answer.

(15 marks)

b) The *Rapid* method (see **Appendix)** specifies the development process, but it does not force a method 'user' (i.e. developer) to use a prescribed set of systems modeling techniques. Assuming that you are required to use the *Rapid* method process in your project decide which the Unified Modeling Language (UML) techniques you would use in different stages of the process. Briefly justify your decisions.

(10 marks)

Answer Pointers

a) The following (or appropriate alternatives) would be expected:

Given that table based data is used in the geographic information systems, techniques that model data would be useful. Thus, entity relationship diagrams or class diagrams could be used to model the data that would be used in such systems and the relationships between the tables of data. The geo-coding could be used as one of the keys for such tables. (5 marks)

Use case diagrams could be used to identify and describe the queries required from the geographic information system. In addition, the different queries required by the different users of the geographic information system could be identified. (5 marks)

For complex queries, pseudo-code could be used to design the queries. Thus for example if a query involved multiple nested IF – ELSE statements, these could be clearly described and laid out so as to specify what the query needed to achieve. (5 marks)

b) Feasibility study: Possibly 'outline' Use Case Diagram and 'high level' Class Diagram.
Business analysis: Use Case Diagram, Class diagram, possibly Activity diagrams (to model business processes).
Build usability and functional prototype: Use Case Diagram (updated), Class Diagram (updated/expanded), Interaction Diagrams, possibly State Diagrams
Refine prototype: Component and Deployment Diagrams. (10 marks)

Examiner's Guidance Notes

Part (a) of this question was generally answered poorly by most candidates. A number of candidates suggested the use of inappropriate design techniques, or discussed life cycles rather than techniques.

Part (b) of this question was generally answered well, with most candidates being able to associate appropriate UML techniques with the stages in the methodology.

Question 3

a) Many organizations do not follow a complete systems design method but instead use just some of the techniques from a systems design method or a collection of techniques from different systems design methods.

Explain why this happens.
(15 marks)

b) The *Rapid* method (see **Appendix**) is suitable for projects and applications/systems which have certain characteristics related to users, functional and non-functional requirements, complexity and time constraints.

Suggest five or more such characteristics and justify your suggestions.
(10 marks)

Answer Pointers

a) Many systems design methods include a large number of techniques. However, given the time and financial constraints in most IT departments, it might not be considered efficient in terms of time and funds to follow all the techniques in a systems design method. (5 marks)

Particularly for smaller IT development projects and most IT maintenance projects, it might not be appropriate or practical to use all the techniques in a systems design method, since not all of them would be relevant to a given project. (5 marks)

IT staff who have moved from other companies might be familiar with different systems design methods and techniques, and might wish to continue to use the systems design techniques with which they are familiar. (5 marks)

b) Rapid method can be used when the system has the following characteristics:

–is interactive i.e. users interact with 'system functions'
–has clearly defined user groups
– is not computationally complex
–is time-constrained
–has requirements that can be prioritised
–has requirements that are unclear or subject to frequent change (10 marks)

Examiner's Guidance Notes

Most candidates answered part (a) well, and showed appreciation of the use of methodologies in practice.

Part (b) was generally answered well by most candidates.

Question 4

a) You are an IT manager in a UK university computing department. You have recently recruited four computing graduates to work in the computing department and are considering their training needs in systems design methods. Your training budget is limited, but the graduates should be fully trained in systems design methods as soon as possible. The options you have identified for training the graduates include:

- Attendance on an external professional short course.
- Undertaking a year long module in systems design methods at the university.
- Undertaking a continuing professional development course at the university in the evenings over a twelve week period.
- Self study using text books.
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Any courses run by the university will be free for university staff.

Discuss how you would choose to train the graduates in systems design methods.

(12 marks)

b) Every organization that wants to introduce a RAD/Agile method has an existing culture and accepted working practices. Therefore the introduction of the new method (e.g. *Rapid* method – see **Appendix**) must be carefully planned and managed to achieve a successful outcome.

Suggest a plan of action for introducing *Rapid method*. Your plan should include at least 6 'actions'.

(13 marks)

Answer pointers

a) An external professional short course in systems design methods would allow the graduates to be trained quickly, however, given the cost of such courses, it might not be possible to adopt this approach given the limited training budget available. (3 marks)

The year long module in systems design methods in the university would be free, however there is a requirement for the graduates to be trained as soon as possible. (3 marks)

The 12 week continuing professional development course would get the graduates trained relatively quickly, however, there could be objections from the graduates concerning having to attend evening classes. This would also be a cheap (free) option. (3 marks)

Self study would be relatively cheap, and therefore within budget, however self study from text books can be time consuming. It would also have to be determined whether the graduates were given study time during working hours or were expected to study at home during their own time. (3 marks)

b) Six (or more) actions should be specified. The actions are as follows:

The reasons for introducing Rapid must be understood and the business case for Rapid should be developed – to justify its use.

Philosophy and concepts of Rapid should be communicated to all concerned (initial training courses, etc)

The current development practices and procedures should be examined and compared with the Rapid approach

Using the same comparison, the areas that will need to be changed should be identified

Gain support and commitment for all the activities in the plan

The first suitable project should be identified

The project team should be trained (technical courses)

The development environment should be set up (13 marks)

Examiner's Guidance Notes

Most candidates answered part (a) well, showing an understanding of the different training options.

Most candidate answered part (b) well, however, some candidates discussed the methodology rather than a plan for introducing the methodology.

Question 5

a) Give two (or more) reasons for comparing and evaluating systems design methods.

(4 marks)

b) NIMSAD (Normative Information Model-based Systems Analysis and Design) is a well known framework for comparing and evaluating systems design methods. NIMSAD suggests that evaluation of a method involves evaluation of the Method Context (the problem situation), the Method User (the intended problem solver) and the Method itself (the problem solving process). Why is the evaluation of all three aspects necessary? Give three criteria that may be used to evaluate the Method Context and three to evaluate the Method User.

(9 marks)

c) Avison and Fitzgerald provide a number of 'ideal-type' criteria that might be considered in assessing systems design methods. Some of these criteria are: relevance of application, life cycle coverage, effective communication, separation of analysis and design, visibility of product, designing for change. Use these criteria to assess/evaluate *Rapid* method (see **Appendix)**.

(12 marks)

Answer Pointers

a) An academic reason – to better understand the nature of methods in order to perform classifications and to improve future information systems development
A practical reason – to choose a method, part of one, or a number of methods for a practical application, a group of applications, or for an organisation as a whole .
(Avison, Fitzgerald) (4 marks)

b) In addition to the quality of a methodology itself, effective application of a methodology also depends on the personal qualities of the methodology user, and the nature of the problem to which it is applied; for example past experience of the methodology user and whether the nature of the problem is technical or social could affect the outcome of the problem-solving process. (3 marks)

Method context:
any THREE of the following and brief explanation for each
The clients and their understandings, experiences, commitments
The problem owners, their concerns, and problems
The situation the method user is facing
The ways in which the method might help the situation
The culture and politics of the situation
The views of stakeholders concerning 'reality'
The dominant perceptions in the problem situation e.g. are they technical, political, social, etc? (3 marks)

Method user:
Any THREE of the following
The method user's beliefs, values, and ethical positions
The relationship of the above to that assumed or demanded by the method
The way in which mismatches in the above two may be handled or reconciled
The method user's philosophical views
The method user's experience, skills, and motives in relation to those required by the method (3 marks)

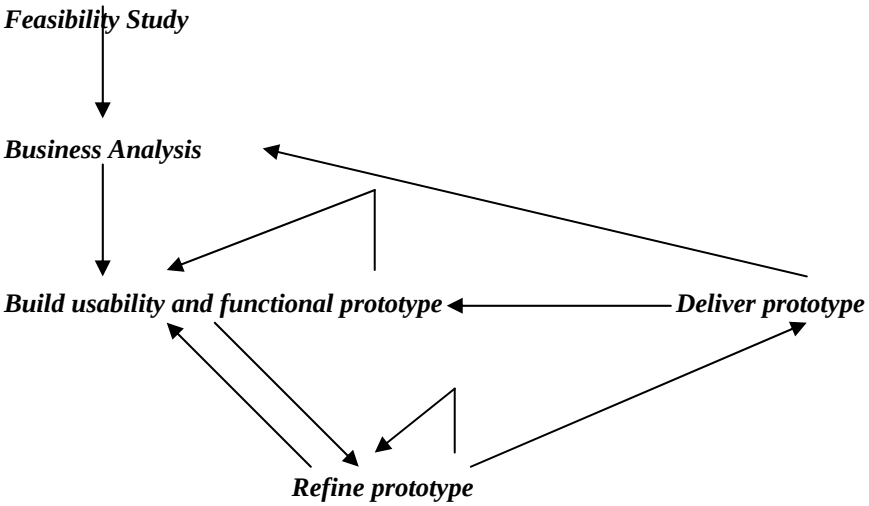
c) Relevance of application: suitability of the method is examined (in Feasibility study)
Life cycle coverage: full coverage from feasibility to installation
Effective communication: the method involves users and developers who work together
Separation of analysis and design: two separate stages
Visibility of product: evolutionary prototypes are used
Designing for change: this issue is partly addressed in Refine prototype stage (that deals with various non-functional requirements). (12 marks)

Examiner's Guidance Notes

Part (a). Most candidates identified practical reason(s), but were unable to identify academic reason(s).
Part (b). Most candidates managed to provide a partial explanation of the NIMSAD's approach and also managed to identify some criteria suitable for the evaluation of the Method Context and the Method User.
Part (c) was generally answered well by most candidates.

APPENDIX (for use in Questions 1b, 1c, 2b, 3b, 4b, 5b)

Rapid is a RAD/Agile method.
The method includes the following stages: Feasibility study, Business analysis, Build usability and functional prototype, Refine prototype, Deliver prototype.
The development process is as follows (see Figure below).



The stages are briefly described below.

Feasibility Study. Scope the development in terms of proposed solutions and produce both a business case and first-cut project plan. Find out who/what the system will interact with. Examine the suitability of the method for your project.

Business Analysis. Examine the business processes to be automated, their information needs, the user groups involved and their respective needs and wishes. Prioritize requirements and plan prototypes to deliver.

Build usability and functional prototype. Develop the usability and functional prototypes as well as system models. The developed prototypes are reviewed by different user groups.

Refine prototype. Engineer the prototype to a sufficiently high standard. The prototype should meet various non-functional requirements (e.g. efficiency, maintainability, etc).

Deliver prototype. The prototype is installed in the live environment and (if applicable) integrated with previously developed prototypes. If the system is not completed then go back to Build usability and functional prototype (or in some situations to Business Analysis).