

OLLSCOIL NA hÉIREANN, GAILLIMH
THE NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER II EXAMINATIONS 2001

Masters Degree in Information Technology

CT503: SOFTWARE ENGINEERING

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Time allowed: THREE hours

Answer **any four** questions

1. An organisation wishes to appoint a software project manager. The job is to build an application that is similar to others that one of its teams has built, although this one is larger and more complex. Requirements have been documented. Describe the team structure you would recommend for this project, and your reasoning for the structure chosen? Describe the software process model you would recommend, and why you would recommend it?
[25]

2. In recent years, there has been a significant emphasis on "process maturity". The Software Engineering Institute (SEI) has developed a comprehensive model that is based on a set of software engineering capabilities that should be present as organisations reach different levels of process maturity. To determine an organisation's current stage of process maturity, the SEI uses an assessment that results in a five point grading scheme. This determines compliance with a capability maturity model that defines key activities required at different levels of process maturity.
 - (a) Outline the important characteristics of each stage of the model
[12]

 - (b) Read the attached description of the company Capella Software. Based on the information given, which stage of the SEI model would you assign to this company. Explain your reasoning. What are the key process areas that they should address to move up to the next level?
[13]

3. Approaches to Re-engineering a business include

- Systematic redesign
- Clean sheet approach
- Combination of the above approaches

(a) Describe what is meant by systematic redesign. What are its advantages and disadvantages? [10]

(b) Read the attached description referring to the Corrib Chemical Company. Which approach to re-engineering do you think they adopted? Explain your reasoning. [8]

(c) Which approach to re-engineering do you think their competitor adopted? Explain your reasoning. [7]

4. Read the following preliminary system specification for a computer aided design software development project.

The CAD software will accept 2D and 3D geometric data from an engineer. The engineer will interact and control the CAD system through a user interface that will exhibit a good human machine interface design. All geometric data and other supporting information will be maintained in a CAD database. Design analysis modules will be developed to produce required output which, will be displayed on a variety of graphics devices. The software will be designed to control and interact with peripheral devices that include a mouse, digitizer, laser printer, and plotter.

(a) Based on your reading what areas of clarification would you look for initially in the above preliminary specification? [7]

(b) Using the estimation tables provided, estimate the LOC required for the above project. [5]

(c) Assuming a labour rate of £8,000 per month and an average productivity of 620 LOC per month, calculate the estimated cost and time for the project. [5]

(d) What is the estimated cost per line of code? [3]

(e) How would you crosscheck the accuracy of your results?

(f) The accuracy of a project estimate is typically based on a number of factors. List four of the most important factors. [5]

Estimation Tables			
Sample Software Functions	Estimated LOC		
	<i>Optimistic</i>	<i>Likely</i>	<i>Pessimistic</i>
User interface and control facilities	1,500	2,400	3,500
2D geometric analysis	3,900	5,500	7,400
3D geometric analysis	4,600	6,900	8,600
Database management	2,500	3,450	5,100
Computer graphics display facilities	2,600	4,850	7,100
Peripheral control	1,650	2,100	3,550
Design analysis modules	6,400	8,400	9,900

5. (a) Distinguish between measures, metrics and indicators in software engineering. Give examples of each.

[10]

Software process metrics can provide significant benefit as an organisation works to improve its overall level of process maturity. However like all metrics, these can be misused, creating more problems than they solve. Grady argues that there are “private and public” uses for different types of process data.

- (b) Give two examples of private and public types of metrics.

[8]

Statistical software process improvement uses software failure analysis to collect information about all errors and defects encountered as an application or product is developed and used. An aspect of failure analysis is to categorise errors and defects by origin e.g. flaw in specification, flaw in logic, non-conformance to standards.

- (c) Develop a fishbone diagram to illustrate two potential causes of problems relating to specification defects under each of the headings incorrect specification, and missing specification.

[7]

6. (a) Draw a context diagram **and** a Level 0 DFD to depict the sources/sinks, data flows, processes, and data stores involved in the following system description.

[13]

- (b) Explode one of the processes in the Level 0 DFD in a Level 1 DFD.

[12]

You have been asked to create a system to automate transactions at a self-service petrol station. The petrol station has only three pumps: one for diesel, one for unleaded, and one for leaded. The station also sells food and other items. All of these items have a barcode. A separate database has been populated with the barcode, description and price of each item sold.

The cashier obtains from the customer the number of the petrol pump and enters that information into the system. The system must then interact with the computer system on the appropriate pump to get the amount of fuel purchased in litres and the cost in pounds. The cashier then scans the barcodes of the customers other purchases. The system interacts with this database to get the description and price of items scanned by the cashier. A total amount due is computed by adding together the fuel purchase and the other purchases.

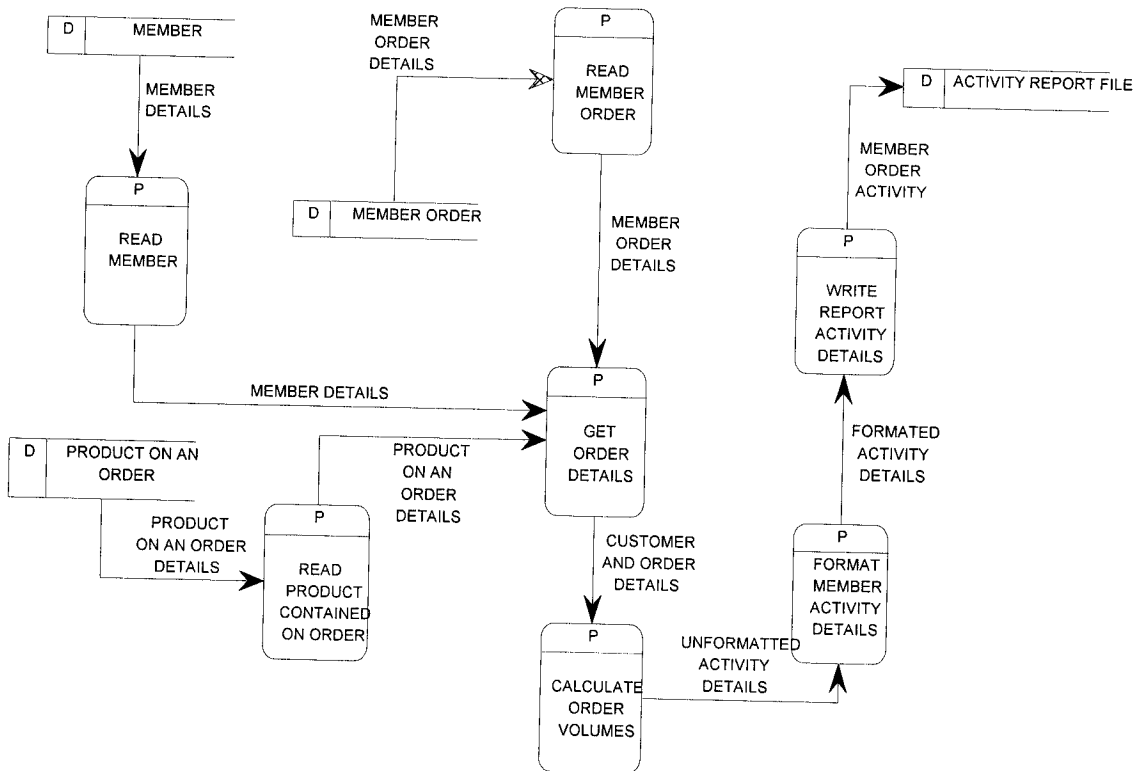
If the sale is paid with cash, the customer pays the cashier and receives the food purchased, a receipt, and any change due.

If the sale is paid with a credit card, the cashier scans the card using a special scanner to read the account number. The system must then make a call via modem to a central credit card agency computer to verify that the account is OK and that the balance is sufficient to cover the transaction. If the card is OK and the balance is sufficient, the system tells the bank to debit the total from the customer's account. The system must print a receipt listing the items purchased, the total amount due, and the customer's credit card number. The customer is given the food purchased and a customer copy of the credit receipt. The original credit receipt is forwarded by post to the bank that handles all credit card transactions. If the card is not OK or the balance is insufficient the transaction is cancelled completely.

(25)

7. (a) The following DFD illustrates a program that has been designed to produce order activity details for members of a mail order club. Using Transform Analysis, and hiring a new boss, convert the DFD into a Structure Chart, showing all relevant data couples and flags.

(25)



8. You are asked design a system to automate some of the current internal operations of a travel agency.

The system is required to maintain customer details and take bookings for travel. Only the travel agency staff will use the system. Bookings may be for airline flights or cruises. Different information (e.g. start date, duration, price, flight no., number of seats, etc.) must be recorded, depending on the booking type. All users of the system should be able to add new customers, modify their details, and enter bookings for customers. Some business customers will use a business account and have the amount added to the outstanding amount on their account at the time of booking. All other customers must pay in full at the time of booking. A business customer can make a partial or complete payment of the balance owed on an account at any time.

Creation of new business accounts can only be done by the Administrator user (of which there can be only one), although any user can add a customer to an existing business account. Each customer can only belong to at most one account, however.

- (a) Draw a Use Case Diagram for the system.

(10)

- (b) Draw a Class Diagram for the system, putting in as much detail as possible. Make note of any assumptions you make or additional detail which you feel is necessary.

(15)

CAPELLA SOFTWARE

Capella Software designs and develops bespoke systems for Unix platforms, and markets and supports a package (Retserver) for the retail sector which it developed ten years ago.

Capella employs 80 people based mainly in the company's development centre. It has a sales office in London staffed by six people. Last year it had a turnover of £4.25 million.

John McCabe, Managing-Director was a co-founder of the company ten years ago. His background is in sales and marketing. John is interested in quality as a management issue. He met with a client recently - someone he had dealt with for five years - who said that, in future, they would buy only from suppliers with quality certification. John defends the company's general record on quality, but admits to a number of problems. He believes that the company learns from its mistakes. There are arrangements to review failures of quality. John is satisfied that he would be told about any serious quality issues.

Stephen White, Technical Director. For a number of years before joining John to set up Capella, Stephen worked as a senior programmer with a leading software development company. During his early years with Capella, Stephen developed the original versions of Retserver and is still the principal expert on the system within the company. Stephen has read a lot about quality. He supports the concept, but suspects that the impetus to do more about quality is being driven by marketing considerations. The Retserver system, which Stephen wrote, is documented. Four of his key programmers can find their way around it, and if they get into difficulties Stephen can help them out. Stephen always uses the waterfall life cycle model. He feels that it represents the only view of the software development process. He admits that this model can sometimes cause problems, but stresses the importance of system testing and acceptance testing for finding and removing remaining defects. "If there are quality problems in Capella, they can usually be traced to the Sales Department" says Stephen. "How can we deliver on totally unrealistic promises?"

Jane O'Reilly, Sales Director is a sales and marketing graduate. Jane has no direct software development experience. Jane is an enthusiastic supporter of the quality initiative. She has been in the "firing line" too often when the company failed to deliver on her commitments to clients. Jane believes strongly that most of the company's quality problems can be traced to the Technical Department. "What we need in the company is a programme of quality audits to find out what these guys are up to" says Jane. "Customers like to change their minds" she says. "They can't be expected to commit to a tight specification just because it suits programmers". She feels also that the Technical Director is too cautious when it comes to taking chances with innovative solutions. "It's often necessary to dive in at the deep end" says Jane.

Mary Ryan, Project Leader has worked with Capella for almost nine years. Mary has been a project leader for five years. Mary has training in project management, and uses MS project. Mary admits that she estimates effort for new projects with difficulty. "I compare estimates from my previous project estimating efforts, but not always successfully". I re-estimate later on in the project. I use line of codes (LOC) extensively for sizing. Mary involves customers in projects, and is a strong believer in joint reviews with the customer. She says "We've always used test plans for software testing, and they work out fairly well". Mary is concerned about the software release and hand-over process. "I don't think we always make it clear enough to the customer that

they should carry out acceptance testing" she says. "Many of them feel that the software should be bug-free when they get it".

Tom Keenan, Analyst/Programmer is a recent computer science graduate and has worked with Capella Software for less than a year. Tom supports the quality initiative and feels that it directly affects his job. "It's really a problem for the quality assurance people" says Tom. "They test the systems and find the problems - quality is their responsibility". Tom works closely with Mary Ryan, the project leader, as he develops his code. They usually have a kick-off meeting at which Mary describes what is needed. She typically has a functional specification describing the proposed system, which they discuss together. If there are gaps, Tom makes notes and works with these as he builds the system. When it comes to coding, Tom is free to use his own preferred style. No-one tries to impose a standard on him. "You can't impose standards on craftsmen" says Tom.

What irritates Tom most? "Having to change my code, when the customer changes his mind". Changes come mostly from Mary Ryan, but sometimes they can come from Jane O'Reilly or the customer. "Sometimes it's not clear who's making the change". Tom is disappointed that he has not been given a chance to use CASE tools. "I used some of these tools at college and think they would be worth trying here - but no one seems to have time". Another major gripe for Tom is the use of contract programmers by Capella. "When these guys have gone, we're left to tidy up the mess" says Tom. "It's sometimes difficult to find their programs - they can be buried in unexpected places" he says. The annoying thing is that we keep bringing the same guys back".

Ann Davis, Help Desk Support, is responsible for taking support calls from customers. She also has secretarial and administration responsibilities. When Ann takes a support call, she tries to find a programmer to take the problem. "That's not always easy" says Ann. "In some cases, it's difficult to get anyone to accept the call". I usually follow-up on support calls to ensure that they are properly dealt with. "When I've passed it to the programmers it's their problem". What does Ann feel about quality in Capella? "I think that there are a lot of improvements that could be made. People have lots of good ideas - but it takes time to get things done.

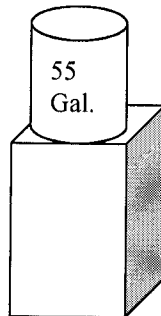
CORRIB CHEMICAL COMPANY

The Corrib Chemical Company (CCC) made caustic chemicals for the breaking apart of wood pulp. They went about a re-engineering project using a combination of work-flow, technology and people. Their consultants started by going out to ask customers what CCC should do, and customers gave them their views.

Corrib Chemical Company

Corrib Chemical Company

Order	-	Sales
Produce	-	Production
Package	-	Distribution
Credit	-	Finance
Ship	-	Shipping
Invoice	-	A/R. Supplier
Collect	-	Collection
Empty	-	Cleaners



Customer

Customer Needs

- Shorter Order
- Faster Delivery
- Higher Quality
- Lower Price
- Greater Safety Stock

Customers wanted shorter order cycle, faster delivery time, higher quality in the chemistry and the packaging, greater on site safety stock, and environmentally safer chemicals and containers. CCC took that information and re-engineered their own processes.

Sure enough they found cross functional bottlenecks among sales, production, distribution, finance, shipping, accounts receivable, collections, and cleaners. After 6 months of work CCC cut order time in half, delivery time down by 30%, significantly increased product quality, held price, and designed a new 55 gallon spill-free drum.

They were surprised to find that their sales at 5 key customers began dropping, not growing.

Their main competitor had also completed a re-engineering project!!