2.2.2 Software Development

Objectives

2.2.2 Software Development	(a) Understand the waterfall lifecycle, agile methodologies, extreme programming, the spiral model and rapid application development. (b) The relative merits and drawbacks of different methodologies and when they might be used. (c) Writing and following algorithms. (d) Different test strategies, including black and white box testing and alpha and beta testing. (e) Test programs that solve problems using suitable test data and end user feedback, justify a test strategy for a given situation.

Introduction

Software is not cheap to build, mainly due to the high cost of developers and the time that projects can take to complete. Larger software systems, such as accounting systems for professionals, can take two or three years to make and involve hundreds of staff. Even games can take a lot of time and money to produce. For example, in 1999 a game called Shenmue produced by Sega® for the Dreamcast games console, cost $47 000 000 to develop. Most of the cost of development goes towards paying for software developers and other staff rather than hardware. When dealing with massive projects involving hundreds of people and millions of dollars, **it is crucial that formal methods are followed to ensure that projects are developed with as few issues as possible**. All software projects, to a greater or lesser extent, make use of the systems lifecycle. However, how they choose to follow the lifecycle depends on the methodology chosen. In this chapter you will learn about the key phases of the systems lifecycle as well as the key methodologies used in modern software development. It is important to note at this stage that there is no one methodology that is better than any other. Each one comes with its own set of merits and drawbacks, meaning that the methodology chosen should depend on the projects being attempted.

Waterfall Model (Systems Life Cycle)

This process is sequential and goes through the phases of conception, initiation, analysis, design, construction, testing, implementation and maintenance. It was first invented for hardware manufacture, but then was adapted for software development.

Use this site (and any other resources you choose) to research the waterfall method. *I have also included the marks available for each phase of the A2 project we will start in the summer, so it's a really good idea to have the system life cycle well understood and clear for the summer exam but also for your coursework.*

http://www.teach-ict.com/as_a2_ict_new/ocr/A2_G063/331_systems_cycle/slc_stages/miniweb/index.htm

1. Describe four reasons why an organisation may want a new IT system.

> **After a while since icstallment, the current IT system may be showing its age as it can no longewr carry out its intended task efficiently as it could and the system may be out dated so not compatable with most new technologies.**
> **There may even be new inventions that mean new features can be carried out on technology that can't be doen on current systems.**

> **If another competitor develops a technology that has an advantage over the current system of another company then the company will require a newer system with similar capabilities in order to provide the same service to customers and still be in the market.**

> **The organisation may become larger and so the previosu system indetencded for a small number of accounts/demands can't cope with the new needs of the company. A newer IT system is needed to provided resources to the high demands.**

There may be a new addition to the company that will require the needs of IT systems such as a customer support desk. The company might want to improve the quality of a repetitive task. Doing the same thing over and over is very tiring and tedious for a person. A robotic system may be able to help with this. For instance the car.

2. Describe the possible problems with new IT systems; use the following case studies as examples:
   http://news.bbc.co.uk/1/hi/uk_politics/8339084.stm
   http://news.bbc.co.uk/1/hi/northern_ireland/7484537.stm
   http://news.bbc.co.uk/1/hi/health/6663129.stm
   Notice the amount of money lost on each project…

- New systems may fail to meet performance goals or success criteria
- Systems may take longer than expected to install and are often over budget
- Systems may fail or be abandoned

Offender IT failure 'a shambles'

In 2004 the government set out a new IT project for tracking offenders in England and Wales. Its was palnned to be a large data base named C-NOMIS. THe aim of the system was to follow offenders "end-to-end" through the criminal justice system. However, by July 200t the project was still not complete and the costs had trebled. THe Committee's repost showed thqat the staff had grossly underestimated the cost of the project due to a lack of planning and the system was abandoned. However, the £161 million spent was used as the basis for the revised programme `OMIS' that was compelted in 2010.

IT failure 'causes £130m arrears'

Introduced in October 2006, the Abbacus IT system was aimed at improving rate collection and housing benefit payment. However, there were many inadequacies with the system so it could not provide an anlysis of account balances such as arrears distinguished between domestic and non-domestic property.

One of the many problems found by the Audit Office was an incident where the computer calculated Disabled Persons Allowance of £2.9m for a single ratepayer.
The error was only detected and payment stopped as part of a manual supervisory check.

This resulted in a fall in rate collection from 96.19% in 2005-06 to 91.7% in 2006-07

IT delays 'put patients at risk'

An NHS scheme aimed to allow full electronic booking across the NHS and centrally-held patient records.

One medical director said that the system was out of date and when they had to but some of the bits they were sourced through eBay because there's just no bits in this country, so it's a huge risk to the trust."

There were late delays in the project so the IT networkds became outdated causing a risk to patient care.

Progress had been slow to impliemtn new ssytems in some hospitals, those with the greatest need for new systems were being prioritised. The prject cost £12 billion.

3. Include a diagram of the System Life Cycle. You need to know the order of each stage.

The system life cycle is a process of stages which occur during the development of a new ICT system. Organisatiosn will follow the system life cycle in order to avoid costly problems that may occur with implementing new IT systems.

1. Definition
2. Investigation and analysis
3. Design
4. Implementation
5. Testing
6. Installation
7. Documentation
8. Evaluation
9. Maintenance
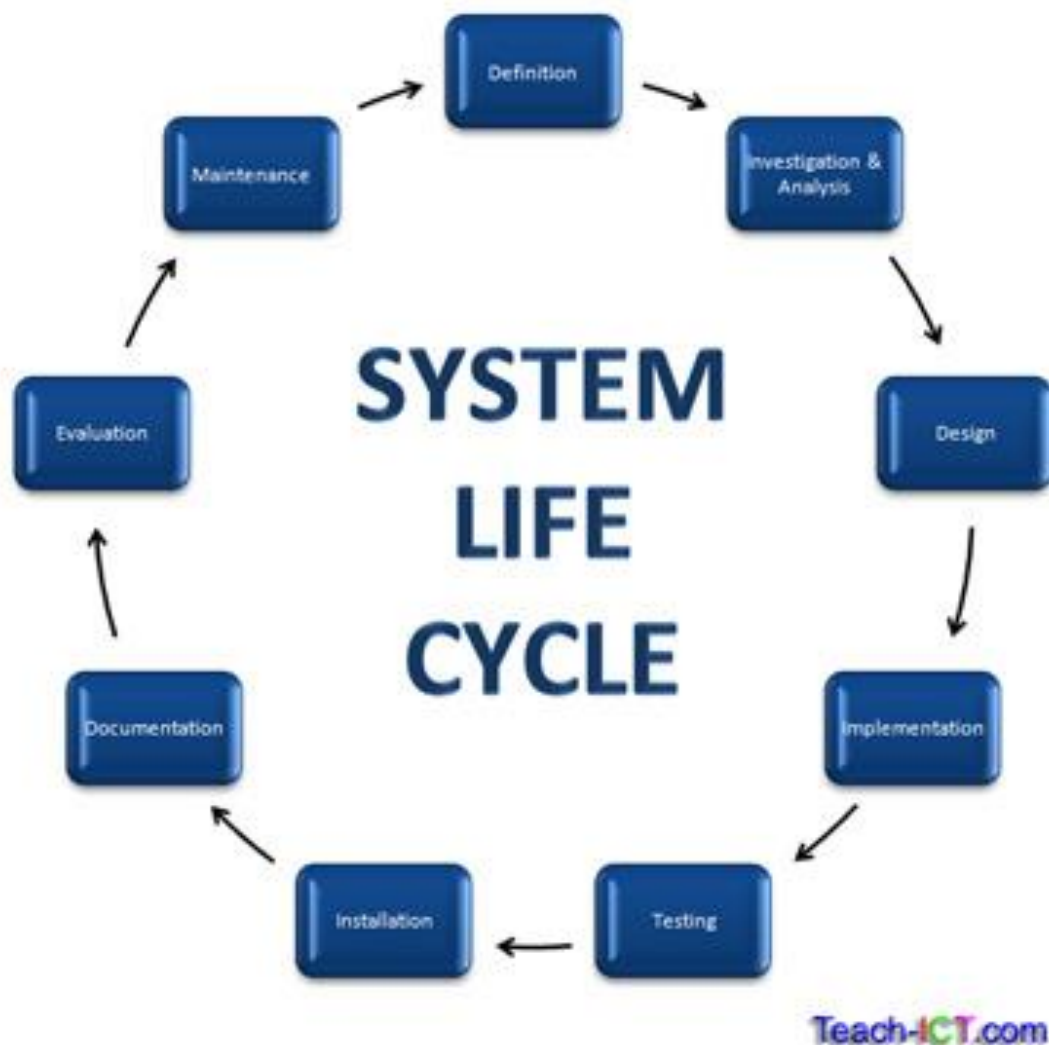
4. It is not always a linear process, why?
Since after compelting one stage, it might be necessary to return to an earlier stage and so the process is not always linear.

Definition and Feasibility

5. The role of the analyst in the definition stage is to scope out the problem to establish there is a problem to solve. Describe the **methods used by the analyst**.

The very first aprt of the system lfie cycle is to define the problem. The system analyst must determine why the new system is needed and so idsentify the problem. The methods include:

- Interviews with management to get their viewpoint
- Interviews with staff to understand the limitations of the current system

6. The analyst would then do a **feasibility study**. Before you read this page think about the initial questions he would need answers to, now check the page and write brief notes on the 9. Questions.

Once the analyst has decided there is a significant enough problem to require a new system they then alayse the economics of the implementationof a new system to decide whether to go ahead with the development or not.

Some questions that will need to be answers:

The cost: How much will the new system cost to develop?

Budget: Would there be enough money available in the budget to develop the new system?

Time: How long would it take to make the system form start to finish?

Skills: Does the company have employees with the skills required or does it need to hire a software specialist development firm to do it?

Harware to develop: Does the company possess the necessary hardware to develop the system?

Software: Does the company have the necessary software to develop the system?

Training: What would the training implications be once the system had been developed?

Technical feasibility: After finding out what is required is it technically possible to create the system?

7. The feasibility study will then be presented to the organisation, for the management to consider possible solutions. List the 3 main possible outcomes and describe the impact of each.

The system analysis will consider all of the answers from the feasibility study and come up with a number of alternative solutions to present to management. THe analyst may suggest as possible solutions:

a) The Company does nto change anythings –
   Benefit = No disruption to business and no initial cost
   Performance = No change, system remains out of date. Process becomes increasingly less efficient.

b) Company makes alterations of half the system:
   Benefit = THe best parts of the system are retained while least efficient sections are redesigned to enhance performance and so costs are reduced while remaining relatively up to date.
   Cost = Moderate with training costs
   Performance = Improvement of about 30%

   c) Complete overhaul
      Benefit = Reduces company cost base as it is more profitable
      Cost = High, since new quipment and software is needed. THe staff also need training.
      Performance = 70% improvement over the old system.

8. Is this an easy decision for management? explain your answer.

No since many factors must be considered. It si a blance betweent he cost of implementing a new system, half a system or not at all against the performance and benefit of the new system. If management decide to stick with the current system, the SLC will stop here.

Investigation and Analysis (10 marks)

9. How is the investigation and analysis phase different to the definition phase of the cycle?

THe definition phase colelcts information to identify is there is a significant enough problem to require a new system. THe investigation and analysis stage is aware fo the problem and uses all the collected information obtained through interviews, questionnaires, observations and paper trails to determine the requirements for the new IT system.

10. What does the analyst find out about the old and proposed system?

1. A full written analysis of the current system, the processes and the problem it causes
2. Detailed user requirements for the new system

These documents will be used by the system developers and so must be clearly written, broken down into relevant stages and contain all of the necessary details for them to create the new system.

11. Describe in detail the five different methods an analyst may use to investigate the old and proposed system.

1. Face-to-face Interviews

The analyst will conduct interviews with selected staff who use the current system so that they can identify the main problems with the current system and get a detailed overview of how things work. They will also ask the users for any suggestions on how to improve the way things work.

2. Observation

The analyst will observe staff using the system and note down all the interactions start ot finish to identify areas for improvement.

3. Questionnaires

Questionnaires allow the analyst to obtain the views of a large number fo people that use the current system to get improvements. THe disadvantage is that it will not provide as much detail as a face to face interview would do.

4. Examination of business documents

Most organisations have business documents and written processes/procedures realting to the current IT system. These documents detail how the system works and the processes which users should follow. THe analyst will examine these all in detail.

5. Paper trail

Following information from the point it enters the system and observing what outputs are created at each point in the system.

12. Describe the types of diagrams the analyst may use to describe the system.

The findings are translated into a set of specific diagrams which represent how the system will work and the processes required. The main diagrams are:

System diagrams	These show the relationships between various systems in the company and maybe ones out of the company if relevant. It shwos how they interact and what it depends on.
Data Flow Diagrams	Most systems deal with information in one way or another. This diagram seeks to show hwo the data flwos through a system with branches, and reconnections, inputs, outputs, processes etc.
Process diagrams	People within a company have different hierarchies and handle data differently. They have a process. THe process diagram aims to show how,when,where and why people interact with a system. e.g. an employee makes an expense claim. First of all their manager counter-signs the claim. It then goes to the account manager who authorises payment and so on...This is 'process flow' in action.

13. What is a user requirements document?

A document outliging the requirments of the system – the specificatiosn that the users wants the system to be capable of. These must be measurable and objective – not bague statements lieka s fast as possible but e.g. send an invoice within 10 seconds.

14. Write a user requirement for a new school database system, remember the requirement must be measureable.

- The database msut be secure from unauthorised access.
- The database and its contents may only be stored within the local area network and are not to leave the school premises.
- The database may only be edited by one user at a time to keep integrity of data.

- The database msut have basic functions to allow for the addition or removal or modificationof data.

15. The user is very important and in your project lots of credit is given for when you show the user has lots of involvement. So it's good to understand why it is so important to have them on board. Describe why you write a user requirements list.

So that in the testing stage it can be used to check that all the user's desires are emt by the new system and so it will perform as expected. It is used as a contract between the project managers and clients. The user requirement document ensures that the user is kept in mind when developing the system so it keeps in regard what they actually want. This will:

Eliminate misunderstandings,　Reduce errors,　　　Gain user agreement

The analyst will listen to the users' needs and then produce a non-technical user requirement document (maybe including charts/diagrams to explain understanding). This is then show to the user for their views and improvements. It usually takes several iterations of the User Requirements Document as users further explain to the analyst what they need. Getting it right the first time is a rare thing!

16. Describe why projects sometimes go wrong, include 'mission creep'.

1. The system may not be accessible or right to the user. For instance, a system designed for the public may not include all types of customers, it may be too complicated or long-winded for people.
2. With the lifetime of the project, the user requirements may alter. This becomes a big problem with alrgeer projects as they end up becoming more and more complicated as people want it to do more and more things. Sometimes this is called 'mission creep'.

Design (15 marks)

17. What tasks are carried out as part of the design stage?

Now that the project manager and the client have agreed on the requirements (Requirements Specification) it is time to define how the project is going to be carried out. The design phase will nvolve planning the development of the new system so it will meet the user requirmeents.

The following tasks must be taken out:

Project Planning	Project planning regards people involved in the project: how many, where and when are they needed. It also considers that those people will require resources to carry out their jobs: such as computers, offices etc. There are a multiple different project planning tools to effectively plan out the project, timescale and the resources required. These include: **Gantt Charts** **Critical Path Analysis (CPA)** **Project Management Software**
System requirements specification	This document will address: Data capture methods for the system Data inputs to the system

	Data outptus from the system
	Data processing within the system
	The file structure for the data storage
	The user interface (layout/buttons/error messages)
	The operating system to be used
	The hardware to be used to run the new system.
Data Dictionary	A data dictionary defines the:
	Tables, fields, records and relationships.
	Constants, varaibles and data structures
	Validations required in the system
	Quesry structures
Testing documentation	Using the system requirements specification document along with the user requirement document – both pre produced by the analyst – are used to create a test plan to test the key parts of the system once developed.
Prototyping	A protoype is a mdoel that resembles what you will finally create without having to worry about all finite details – it captures only the essential detail to confirm the design is likely to work.
	A software prototype is often written in short-hand form of English = Pseudocode

Implementation (15 marks)

18. Implementation is the software development part of the systems life cycle. Describe the tasks carried out by the developers in this stage.

Once the new system has gone through the design phase, the developers may begin to code the new software and develop the new system. This could be a be completely bespoke with every line beign coded by a specialist or it could be a piece of `off the shelf' software that is to be customised.

THe specialists will follow the system requirement exactly and won't derivate from the specification without consulting the analyst.

The things that are developed are the:
- Tables and data structures
- Validation routines
- Data capture forms
- Data input forms
- Automated processing routines (i.e. macros)
- Queries
- The user interface (buttons, text, screen, help messages)
- Printing outputs

Testing (10 marks)

19. What is the difference between a beta tester and a user tester

A team of testers will have been chosen before release to test that the system functions and meets all the specification points in the user and system requirements. The team is known as a selection of beta testers. The team will not do much testing in the context of user-friendliness. A separate team of end front users will make u[another team called user testers. These will ensure the system is user-friendly once the beta testers have finished.

20. What does a beta tester do?

Test that the system functions and meets the user and system requirements. They may do some testing with the user interface friendliness.

21. Include an example of one test.
For a customer input form there may be a section to input an email address. THe system should ensure the email ends with @....com and has no spaces.
Test data: 547538   Expeced result: Fail – should not be able to accept this as an email

If the system fails a certain test, the testers fill in a form with the details to pass onto the developers.

22. What are the three different types of test data?

The test plan is a detailed document which a team of testers must follow carefully. It will set out every single test they are to do on the system, what data they should enter and what result they should expect to obtain.

Best testers rare those that know nothing about the system and so will test the data that the developers are not expecting.
Examples of test types are:

Testing selection: Not all parts of the system will be tested since there are just such huge numbers of combinations of inputs that could be entered so the testing team will select a practical number of testing inputs that are most likely to be helpful.

Testing data:
Data within the normal range fo expected values
Data that is on the extreme limits of the range but should be entered
Data that should fail (erroneous data) should be tested.

Iterative testing:
If the user requirement docuent is changed part way through then this causes delays and is costly as certain tests must be repeated.

Installation

23. Describe in detail the four different methods of installation.
Direct   This is where the company literally switches off the old system and turns on the new one.
Benefits = New system is immediately made available
         Often cheapest method of installation
         No need for cuplication of data sets

Disadvantages = Most risky method since there is no backup system so problems that may occur may
                 causes time delays where there are no systems in use.

All data must be transferred to the new one before the old one is switched off.
There will be a period of u[heaval while the system is new and staff don't know how to use it.

Parallel A more popular method where both new and old systems are ran in parallele for sometime to ensure it is safe to switch the old one off. Then eventually the odl system is switched off at an inactive time.

Advantages: Less risky as there is a backup system to fall back on.
Less stress for the staff as they still have the security of the old system
Staff can take their time to learn how to use the new system.

Disadvantages: Time consuming as the data needs to be synced across both systems
If the systems become out of sync then it can make things complicated and cause data loss.
Extra cost of running and maintaining the two systems.

Phased The new installation occurs in small itnervals as new modules are integrated onto the backbone of the old system. Any problems encountered can be amended easily.

Advantages: Less risk of the whole system going wrong as only small parts will be affected.
                Staff are introduced to changes at intervals

Disadvantages: This method may take a long time
                As new parts are integrated the users may ask for changes that delay the next integration stage.
It may be difficult/not compatable to integrate old and new.

Pilot
This is where the new systems are only installed and tested in a small number of departments or branches. They sue the system and report any problems to the analyst. Once the organisation is confident enough, it rolls out the system across the whoel organisation.

Advantages: Only a small part of the organisation is affected and the rest uses the old system.
        Any poblems or issues are identified without affecting the whole company.
        When the rollout occurs, staff from the pilot departments can train the other staff.

Disadvantages: Even though it is only iontroduced to a small number fo departments, they may still experience the same problems concerned with direct changovers.
Those staff with the new system may not be able to share data to those using the odl system.
Extra work for the IT staff who have to support two departments

Documentation and training

24. Describe the documentation that the analyst needs to provide with the new system.
Once all testing has finished, a detail document containing information on how the user can use the system is passed onto the user

Paper based user documentation are in the form of a booklet/pdf file.

The typical format of a paper-based user document includes
- Table of contents

- Short introduction or overview of the system
- Brief technical details such as the hardware and software requirements to run the system
- User Guide : this is the bulk of the document
- Glossary of technical terms
- Troubleshooting: usually a simple list of things to check before calling for further help
- Index

Evaluation and maintenance (20 marks)

25. What two key questions are asked in the evaluation?

Has the finished solution met all the requirements ?
Does the finished solution solve the problem?

26. Name and describe the three kinds of maintenance.

There are three kinds of maintenance needed:

Corrective maintenance

Corrective Maintenance is where problems are identified after the system has been installed. A fault report is raised and sent to the developers to fix. The update is then passed to some testers to ensure the fault is fixed. The fix is then released to the live system.

Corrective maintenance can also involve fixing hardware faults or replacing equipment as necessary.

Adaptive maintenance

This type of maintenance often occurs as a result of external influence or strategic changes. For example, when the government changed the VAT rate from 17.5% to 20%.

Perfective maintenance

Once the system has been in place and running for sometime, the end user will find minor tweaks or improvements that could bee integrated to improve the system. They are not significant enough to replace the system so the maintenance team will adapt the system to suit.