In this chapter you will learn to:

- understand the communication skills required to manage a system development project, such as
  - active listening
  - conflict resolution
  - negotiation skills
  - interview techniques
  - team building
- understand the need to apply project management tools to develop a system using a team approach
- appreciate the advantages of groups that function as a team, including
  - increased productivity
  - enhanced job satisfaction
  - the development of a quality system
- appreciate the need for complete documentation throughout all aspects of the system
- assess the social and ethical implications of the solution throughout the project
- apply appropriate techniques in understanding the problem
- interpret a requirements report which includes:
  - the purpose of the system
  - an analysis of an existing system
  - definition of extra requirements
- diagrammatically represent existing systems using context diagrams and data flow diagrams
- identify, communicate with and involve participants of the current system
- create a requirements prototype from applications packages that provide:
  - screen generators
  - report generators
- use a prototype to clarify participants' understanding of the problem
- conduct a feasibility study and report on the on the benefits, costs and risks of the project
- compare traditional, iterative and agile system development approaches
- create Gantt charts to show the implementation time frame
- investigate/research new information technologies that could form part of the system
- develop a solution to a problem from a prototype
- use a guided process in an application to create all or part of a solution
- use system design tools to:
  - better understand the system
  - assist in explaining the operation of the new system
  - document the new system
- determine training needs arising from the creation of a new system
- compare and contrast conversion methods
- justify the selected conversion method for a given situation
- convert from the old system to the new
- implement the appropriate information technology
- develop an implementation plan for the project
- compare the new system to the old and evaluate whether the requirements have been met
- update system documentation

Which will make you more able to:

- apply and explain an understanding of the nature and function of information technologies to a specific practical situation
- explain and justify the way in which information systems relate to information processes in a specific context
- analyse and describe a system in terms of the information processes involved
- develop solutions for an identified need which address all of the information processes
- evaluate and discuss the effect of information systems on the individual, society and the environment
- demonstrate and explain ethical practice in the use of information systems, technologies and processes
- propose and justify ways in which information systems will meet emerging needs
- justify the selection and use of appropriate resources and tools to effectively develop and manage projects
- assess the ethical implications of selecting and using specific resources and tools, recommends and justifies the choices
- analyse situations, identify needs, propose and then develop solutions
- select, justify and apply methodical approaches to planning, designing or implementing solutions
- implement effective management techniques
- use methods to thoroughly document the development of individual or team projects.

In this chapter you will learn about:

Techniques for managing a project

- communication skills necessary for dealing with others
- the consequences for groups that fail to function as a team, including:
  - financial loss
  - employment loss
  - missed opportunities
- project management tools including:
  - Gantt charts
  - scheduling of tasks
  - journal and diaries
  - funding management plan
  - communication management plan
- identifying social and ethical issues

Understanding the problem

- approaches to identify problems with existing systems, including
  - interview/survey users of the information system
  - interview/survey participants
  - analysing the existing system by determining how it works, what it does and who uses it
- requirements reports
- requirements prototype - a working model of an information system, built in order to understand the requirements of the system
  - used when the problem is not easily understood
  - repetitive process of prototype modification and participants' feedback until the problem is understood
  - can be the basis for further system development

Planning

- a feasibility study of proposed solutions, including:
  - economic feasibility
  - technical feasibility
  - operational feasibility
  - scheduling
- choosing the most appropriate solution
- choosing the appropriate development approaches
  - traditional
  - outsourcing
  - prototyping
  - customisation
  - participant development
  - agile methods
- the requirements report that:
  - details the time frame
  - details the subprojects and the time frame for them
  - identifies participants
  - identifies relevant information technology
  - identifies data/information
  - identifies the needs of users

Designing

- clarifying with users the benefits of the new information system
- designing the information system for ease of maintenance
- clarifying each of the relevant information processes within the system
- detailing the role of participants, the data and the information technology used in the system
- refining existing prototypes
- participant development, when people within the information system develop the solution
  - participant designed solutions
  - tools for participant development such as guided processes in application packages
- tools used in designing, including:
  - context diagrams
  - data flow diagrams
  - decision trees
  - decision tables
  - data dictionaries
  - storyboards

Implementing

- acquiring information technology and making it operational
  - hardware
  - software, customised or developed
- an implementation plan that details:
  - participant training
  - the method for conversion
    - parallel conversion
    - direct conversion
    - phased conversion
    - pilot conversion
  - how the system will be tested
  - conversion of data for the new system
- the need for an operation manual detailing procedures participants follow when using the new system

Testing, evaluating and maintaining

- testing and evaluating the solution with test data such as
  - volume data
  - simulated data
  - live data
- checking to see that the original system requirements have been achieved
- trialling and using the operation manual
- reviewing the effect on users of the information system, participants and people within the environment
- modifying parts of the system where problems are identified

1

PROJECT MANAGEMENT

Project management is a methodical and planned approach used to guide all the tasks and resources required to develop projects. It is an ongoing process that monitors and manages all aspects of a project's development. The overriding aim is to produce a high quality system that meets its objectives and requirements. In order to achieve this aim requires significant planning, including defining the system's requirements, setting and controlling the budget, scheduling and assigning tasks, and specifying the lines of communication between all stakeholders. To implement such project plans requires leadership skills with a particular emphasis on ongoing two-way communication between all parties, including the client, users, participants and members of the development team. It is a virtual certainty that problems will be encountered, hence maintaining an ongoing dialogue is critical if such problems are to be foreseen and their consequences avoided or at least minimised.

Project Management
A methodical, planned and ongoing process that guides all the development tasks and resources throughout a project's development.

GROUP TASK Discussion
Explain why project management should be an ongoing process that occurs throughout the whole system development lifecycle.

In many references project management is described using the 'project triangle', where time, money and scope form the three sides (see *Fig 1.1*). If any one side of the triangle is altered, the remaining two sides are affected. For example, if the time available for development is reduced then it is likely that costs will increase and the ability to achieve all requirements will decrease. Similarly the addition of extra requirements widens the project's scope and as a consequence both costs and time are likely to increase. Project management establishes and maintains a balance between money, time and scope in an effort to develop a system of the highest quality. To maintain this balance is an ongoing process throughout the system development lifecycle. Notice that in *Fig 1.1* quality is centred within the triangle – the implication being that the quality of the final system is affected by each of the three sides.

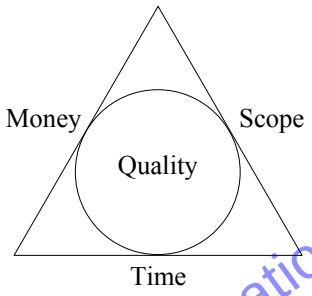


Fig 1.1
The Project Triangle

In this chapter we first examine techniques for managing projects. We then introduce system development and work through the stages of the system development lifecycle (SDLC), namely understanding the problem, planning, design, implementing and finally testing, evaluating and maintaining the system. Clearly in this course we are concerned with the development of information systems, however many of the project management tasks and processes we shall examine are common to all types of projects and systems. For example the traditional structured approach to system

development mirrors the strategy used for most other engineering projects. However, information systems are significantly and fundamentally different to most other engineering projects and hence new and different methods of development are possible and appropriate. In the Preliminary course we focussed on the traditional approach to system development, in the HSC course we introduce other development approaches, such as outsourcing, prototyping, customisation, end-user and agile development. These approaches can be used in isolation or combined and integrated to suit the specific needs of each project.

Consider the following:

When designing and building a new bridge, the design stage is by necessity quite separate and consumes far less time and cost compared to the bridge's construction – typically design consumes just 10 to 15 percent of the total budget. The bridge design must be finalised in intricate detail prior to the construction stage commencing, once construction begins even minor design alterations will prove costly. Such projects are well suited to the traditional structured approach. In contrast the design of most information systems centres on the creation or customisation of software and the use of existing hardware components. The design stage for new information systems consumes the large majority of the budget and time. In fact in IPT we do not even consider construction or building as a separate stage. Rather we build our software components during the design stage and purchase and install the hardware during the implementation stage.

GROUP TASK Discussion
Based on the above discussion distinguish between the development of large construction projects and large information system projects.

GROUP TASK Discussion
Reflect on an information system you have developed. Did you use a strict structured approach much like the bridge project described above, or did the requirements change during design? Discuss using examples.

GROUP TASK Discussion
Realistically some requirements will be added or changed during the design phase of most projects. Should such additions and changes be encouraged or discouraged? Discuss.

TECHNIQUES FOR MANAGING A PROJECT

When developing large systems a specialist project manager or even a team of project managers will be appointed to perform project management tasks. All projects require project managers; for small projects a single individual may develop the system and also take on the role of project manager.

Successful project managers possess excellent communication and planning skills. They must motivate the development team, negotiate with all stakeholders, resolve conflict and at the same time ensure the project progresses within budget and time constraints. A variety of different project management tools are available to describe and document the various techniques that will be used to manage the project. In this section we consider relevant communication skills for project managers and then describe examples of common project management tools.

COMMUNICATION SKILLS

The project manager is a leader as well as a manager. There are many different leadership and communication styles and strategies; each individual must find a mix that suits their personality but also elicits the maximum performance from each team member. Most successful managers and leaders have a range of strategies at their disposal and they adjust their style in response to feedback – even during a single interview or meeting and often in response to non-verbal clues.

Despite differences in individual management styles there are various widely used and accepted communications strategies that should be considered and incorporated into all management styles. In this section we introduce some of these strategies. Furthermore the communication management plan (which is one of the project management tools we examine in the next section) should specify methods that support rather than hinder the use of these communication strategies. For instance, large lecture style meetings stifle feedback from participants while smaller round table sessions encourage feedback.

Active Listening

A significant portion of a project manager's time is spent listening to people. This is their main source of critical information required for a project to run smoothly. Listening is not the same as hearing; to listen well requires attention and involvement. In contrast hearing is an automatic, passive and often selective process. We notice some noises and sounds whilst ignoring others – we continually hear but without effort we don't comprehend or understand.

Many of us have developed techniques for "faking" listening. For instance we maintain eye contact, nod appropriately and even respond with "Oh yeah" and "I see", we try to give the impression we are listening when in fact we are barely hearing. Most of us can accurately detect such "fake listening" using non-verbal clues. If it occurs often then our view of the person diminishes and communication suffers – not something anyone wants and certainly a negative in terms of project managers.

Effective listening skills do not come naturally for most of us; we tend to focus on the message we wish to deliver rather than understanding messages we receive. Active listening is a strategy for improving listening skills – the aim being to better receive and understand the speaker's intended message and importantly for the speaker to know that the listener has received and understood their message. Each of these strategies requires the listener to verbally respond using words that directly relate to the speakers message. You must listen to the speaker to formulate such responses.

Active listening techniques include:

- **Mirroring**

Mirroring involves repeating back some of the speaker's key words. This technique indicates to the speaker that you are interested and would like to know and understand more. In addition the speaker hears the words they have just spoken, which allows them to reflect on the appropriateness and accuracy of their message. Consider the following brief exchange.

Speaker: *I doubt we'll be able to finish by Friday.*

Listener: *You don't think you'll be able to finish by Friday?*

The listener, presumably the project manager, has not made a judgement rather they have confirmed and encouraged further information. The speaker knows the message was received and in addition they have been encouraged to elaborate. Mirroring simply repeats back the speaker's words; it does little to confirm the message has been actually understood. Therefore mirroring should be used sparingly and in

conjunction with other active listening techniques. If overused it can appear repetitive and condescending – particularly when the listener holds a position of authority over the speaker.

- **Paraphrasing**

Paraphrasing is when the listener uses their own words to explain what they think the speaker has just said. In addition the listener reflects feelings as well as meaning within their response. Paraphrasing helps the speaker understand how their message sounds to others. The listener is communicating their desire to understand what the speaker feels about the content. This encourages the speaker to continue in an attempt to refine their message. Consider the following exchange:

Speaker: *There's a lot going on at the moment, I've got relatives staying so I really can't work any overtime, two of my team are out training on another job and well, finishing by Friday, I just can't see it happening.*

Listener: *You're feeling stressed as you can't see how to finish on time because two team members are out and you can't work late.*

The listener acknowledges the speakers feelings and reflects their words. It is important not to tell the speaker what they mean, for instance avoid phrases such as "What you mean is..." or "You're trying to say…". Rather the response should reflect what you honestly think the speaker feels in a way that allows them to correct or refine any inaccuracies.

- **Summarising**

Summarising responses are commonly used to refocus or direct the speaker to some important topic or to reach agreement so the conversation can end. A summary of an important point will cause the speaker to elaborate in more detail on that point. A complete summary confirms your understanding in the speaker's mind and hence helps to bring the conversation to an end. Typical summarising statements commence with:

Listener: *"If I understand correctly, your idea is…"*

Listener: *"So we agree that…"*

Listener: *"I believe you're saying…"*

- **Clarifying questions**

Often speakers will neglect or gloss over important details. This is natural as the speaker understands their points and can often assume the listener does also. The listener asks questions or makes statements that encourage the speaker to provide more detailed explanations.

Open-ended questions are used where a free and extended response is required rather than a simple answer. Examples include:

Listener: *"What do you think about…"*

Listener: *"Can you tell me more about…"*

Listener: *"I'm interested to understand your view on…"*

On the other hand, closed questions encourage single word or short answers – often either yes or no and should be used with caution. There are times when seeking a specific answer is necessary to provide detail. Try to limit such questions to factual information gathering or final confirmation of details rather than areas where opinions and feelings are involved. For instance asking, *"When will they return to work?"* requests factual information, while questions such as *"So you won't finish on time?"* or *"So you agree, don't you?"* are somewhat confronting and hence they may discourage further discussion.

- **Motivational responses**

The purpose is to encourage the speaker and reinforce in their mind that you are indeed listening and interested in what they have to say. One common technique is to use simple neutral words such as *"I understand"*, *"Tell me more"* or *"That's interesting"* often combined with a nod of the head.

Another technique is to show that you relate to or have experienced what they are saying. In effect you place yourself in their situation in order to reinforce your acceptance of their words. This can involve some form of self-disclosure, where the listener briefly relates a similar experience. Such responses show you accept the speaker and are sympathetic or at least understanding of their situation. Possible example responses include:

Listener: *"I know what you mean, I felt like that when…"*

Listener: *"I too would be upset if…"*

Listener: *"That must make you feel great…"*

In each example the listener is seeing the situation from the speaker's point of view. This encourages the speaker to continue and also helps to establish and reinforce good relationships.

GROUP TASK Practical Activity
Split into pairs, one person being the speaker and the other the active listener. The speaker is to describe a hobby, sport or other interest whilst the listener uses active listening techniques.

Conflict Resolution

When groups or teams of people work together some amount of conflict is inevitable. This is not always a bad thing, indeed some amount of conflict is to be expected and can actually be beneficial. It is when conflicts become personal or remain unresolved that they cause problems. Team members, and in particular project managers, need to manage conflict so that issues are resolved appropriately for all concerned and in the best interests of the project.

Throughout the development of information systems decisions are constantly being made. Each decision involves a choice between different alternatives. Often different people will support different alternatives for a variety of different reasons. Understandably this is likely to cause conflict. Common areas where conflict occurs include:

- Allocating limited resources to development tasks. For example the total funds and time allocated to a project must be split equitably amongst each subtask. Increasing funding or time for one task often requires a corresponding reduction for other tasks. Conflict will arise as team members attempt to argue their case for a larger share of the limited resource.
- Different goals of team members. Individuals quite naturally formulate goals based on their interests, experience and area of expertise. For instance a graphic designer may rate the visual appeal of the user interface over functionality, whilst a software developer has little regard for visual appeal when it reduces functionality.
- Scheduling of tasks. During development many tasks must be performed in sequence. The ability to commence or complete one task relying on the completion of another task. It is often difficult to precisely specify in advance how long each task will take. As a result tasks later in the development process often suffer delays and can easily become the scapegoats for time overruns.

- Personal differences between people are a significant cause of conflict and can often be the most difficult to resolve effectively. Such differences include cultural, educational, religious, age and experience. The result being different feelings, attitudes and opinions.
- Internal conflict within individuals. People can have mixed feelings about how to perform their work or they can experience conflict between their personal and work commitments. Such internal conflict often results in high levels of stress, frustration and decreased productivity. Much like personal differences between people, internal conflict is often difficult to resolve.

To resolve conflict requires more than just a decision, it requires that the decision be accepted by each of the conflicting parties. This is not to say that all parties must feel they have won, in some conflict situations it may be appropriate for neither party to win or for one to win and the other lose. The overriding aim of conflict resolution is for all parties to participate, understand and then accept the final outcome.

Some strategies that assist when resolving conflict include:

- Attack the problem not the person. First try to define the problem and explore each person's perception of the problem. Try to understand people's point of view without judging them. Active listening techniques can be of assistance.
- Brainstorming where each person expresses ideas as they come to mind. No discussion takes place at this time. Often new and innovative solutions can emerge.
- Mediation involves a third party who is removed from the conflict acting as a sounding board for the conflicting persons. Such mediators are peacemakers, whose aim is to ensure opposing parties understand and appreciate the other's feelings and point of view. The conflicting parties express their thoughts and ideas through the mediator who is then able to steer the resolution process, ensuring it remains focussed on the problem and its resolution.
- Group problem solving requires a setting where all involved are on an equal footing and are encouraged to contribute equally. Commonly the group is arranged in a circle to promote equality. Each person expresses their point of view in turn whilst other group members listen without criticism. Often new and creative solutions will emerge. Even decisions that do not result in a "win" situation for all members are more easily accepted when all points of view are understood.

Consider the following situations:

- John has just been promoted to the position of project manager. He must now manage and lead a project team that includes many of his close friends with whom he once worked as an equal.
- To develop a new information system a large group is split into a series of teams, each led by a team leader. The team leaders meet with the project manager on a weekly basis. Some team leaders are highly experienced, others are young with limited experience and others are new to the company.
- A project manager just received cost and time estimates from each of his team members. He finds the total cost and time of all the estimates far exceeds the total budget and time allocated to the project.

GROUP TASK Discussion
Identify potential causes and areas of conflict in each of the above situations. Discuss suitable strategies for resolving such conflict.

Negotiation Skills

Negotiation is something we all do as part of our day-to-day lives. For instance negotiating who will cook dinner and who will wash up. We negotiate with others to reach a compromise situation that suits both parties. The parties communicate their needs and wishes whilst listening and understanding the others needs. Negotiation should be a friendly exchange where differences are argued logically and in a reasoned manner. Successful negotiation prevents situations escalating into conflict.

Many business negotiations occur in an environment where both parties already have a vested interest in reaching agreement. For example, negotiating the cost and terms for the purchase of goods or services. Both buyer and seller wish to reach agreement. The buyer needs the product or service and the seller needs to make a sale. The negotiation process is about agreeing on price and terms. In general, negotiations commence with both parties arguing for more than they ultimately expect – in our purchasing example the buyer starts at a low price and the seller at a high price. During negotiations the parties progressively alter their positions until agreement is reached. Skilled negotiators influence the negotiation process such that they achieve the best possible deal.

The skills and techniques discussed previously for conflict resolution are also valuable during negotiations. However there are recognised techniques used by most skilled negotiators, such techniques include:

- Knowing in advance all you can about the person, product, service and/or organisation prior to negotiations commencing can prove invaluable. When negotiating with outside organisations, research the worth or market value of the product or service they offer and assess other viable alternatives. Set limits in advance so that should the negotiations begin to break down you know in advance when to back off and reassess the situation.
- Consider a range of possible acceptable arrangements in advance. Try to think of options that will appeal to the other party or that they may well bring to the negotiation table. The aim is to anticipate the other party's position and prepare a reaction in advance. For instance perhaps a seller will not compromise sufficiently on purchase price alone, however they may offer low interest terms where payments are made over time or perhaps they will include extended warranties and guarantees. It is far better to assess such alternatives in advance rather than attempting making a quick decision in the heat of negotiations.
- Approach the other party directly to make an appointment in advance. At this time ensure the other party understands the agenda; this will ensure they are able to prepare sufficiently so that negotiation and agreement will be possible. Don't get drawn into detailed discussion at this time, try to leave your comments for the actual appointment. Remember the aim is to negotiate the best deal – don't give away detail that may allow the other party to pre-empt your position.
- During negotiations it is always easier to lower your expectations than it is to raise them. In general, start the negotiations at a point that exceeds your expected outcome. This improves your bargaining power as you have room to compromise during negotiation. Furthermore the other party will feel they have negotiated a better deal when they have lowered your initial expectations.
- Successful negotiators are confident and assertive, which allows them to maintain control during the negotiation process. This is where prior research and planning is critical. If you honestly know and understand the situation then being assertive is much easier. The points you make will be delivered more confidently and you will be able to formulate logical reasoned responses more effectively.

- Establish trust and credibility before negotiations commence. Negotiation is largely about persuading the other party to compromise their position in favour of your position. A climate where each party trusts the other and feels they are credible is a cooperative one that is more likely to encourage compromise. Furthermore it is rare for negotiations to be one off situations, more likely the parties will be negotiating agreements on a regular basis.

Consider the following negotiations:

- A company has used the same outside contractor to install electrical and LAN cabling for each information system they develop. Although happy with the quality of the contractor's work, they find that quotes from competing contractors are significantly less expensive.
- Diana is an experienced database professional who has been offered a new job by a larger competitor. The competitor is offering a much higher salary and the option of working from home. Diana would prefer to stay with her current employer if they can match the offer. Her current employer does not wish to lose her. However raising her salary would present problems as other employees on the same level as Diana would justifiably expect a similar raise.
- The contract for the development of an information system specifies financial penalties should the project extend beyond the stated completion date. The project manager, after discussion with members of the project team determines that it is unlikely they will finish on time. The project manager intends to arrange a meeting with his senior management in an attempt to negotiate a solution.

GROUP TASK Discussion
For each of the above situations, identify the issues and the parties involved. Discuss how each party could best prepare prior to negotiations commencing.

Interview Techniques

Interviews are used to identify problems with existing systems, obtain feedback during development and also to recruit and assess staff performance. We will consider interviews and surveys of a system's users later in this chapter as part of the Understanding the Problem stage of the system development lifecycle. In this section we concentrate on general interview techniques and in particular on techniques used when interviewing staff. Interviews with system users and participants have a different focus – they are used to collect and then summarise information about a systems operation. Staff interviews are generally used to gather information specific to the individual team member. Such interviews occur when recruiting new staff, assessing the performance of existing staff and also as part of disciplinary procedures.

Planing and preparation is the key to successful interviews. Questions should be formulated in advance and if a panel of interviewers is used then the questions should be shared out appropriately. One commonly used technique is to prepare pairs of questions. The first asks for specific information and often begins with words such as who, what, where, which or when. The second follow-up question is more open-ended and often asks how or why. For example, asking, "What was your last project?" followed by "How did you assist in achieving the project's goals?" The first question is relatively simple to answer and aims to focus and prepare the interviewee for the follow-up question.

Pages 11 to 20

Not included in this Evaluation Copy

INTRODUCTION TO SYSTEM DEVELOPMENT

New information systems are developed when either an existing system no longer meets the needs of its users or new needs are identified that could be met by an information system. In the Preliminary course we introduced the traditional or structured approach to developing information systems. In the HSC course we extend our discussion of the traditional approach and also introduce a variety of other system development approaches.

The development of many information systems is substantially different to the development of most other engineered systems. We touched on these differences at the start of this chapter. The most fundamental differences are due to the nature of software. Design and construction of software is integrated – we actually construct software as it is being designed. Hence, the design of software can and is often altered significantly whilst it is being built and even after it is installed and operating. Although a complete redesign during or after development is still costly, it is still a relatively minor issue compared to redesigning many other products when half built or already complete. For instance it really would be a disaster to completely change the design of a building when it's half built, making such a change after the building is complete would be difficult to even contemplate. For buildings and most other engineering projects the traditional structured approach to development makes logical sense. The requirements and the design must be determined precisely prior to construction commencing. The need for such precise requirements and accurate design is less critical when developing information systems. Indeed many argue that accurately determining requirements in advance is not a realistic possibility for most information systems. Furthermore, for most operational information systems correcting design errors and implementing new requirements is a routine maintenance task. It is for these reasons that various different system development approaches have emerged and are appropriate when developing information systems.

GROUP TASK Discussion

Design errors do occur with all types of products. Contrast the recall of a motor vehicle to correct a small problem with an update to a software application to correct a small bug or security flaw.

In this chapter we consider various approaches for developing information systems including the traditional approach, outsourcing, prototyping, customisation, participant development and also agile methods of system development. In general, the traditional or structured approach requires each stage to be completed before the next commences. Outsourcing is where external specialists are contracted to develop part of the system. Prototyping is when an existing prototype is refined over time and evolves into the final system. Customisation is where existing information technology is modified to meet different requirements. Participant development is when people who are or will be part of the system develop the system. Agile methods are used to refine a system whilst it is operational.

An appropriate selection of approaches should be selected and integrated to suit the particular needs of each project. For some projects a strict traditional approach may well be suitable, whilst for others an integrated combination of approaches is appropriate. Regardless of the final approach used, a similar set of development activities will still be present, however they will likely be performed in different sequences and with different emphasis. In this chapter we work through these development activities in the order dictated by the traditional structured approach whilst pointing out differences when using other approaches.

GROUP TASK Discussion
Consider each of the development approaches mentioned above and decide whether it could be suitable for use as part of the development approach for other products and projects. Use examples of possible products or projects to justify your decisions.

The traditional structured approach to system development specifies distinct stages or phases. These stages combine to describe all the activities or processes needed to develop an information system from an initial idea through to its final implementation and ongoing maintenance. The complete development process is known as the 'System Development Life Cycle (SDLC)' or simply the 'System Development Cycle (SDC)'. In this text we will use the abbreviation SDLC. The SDLC is closely linked to the concept of structured systems analysis and design, where a series of distinct steps are undertaken in sequence during the development of systems.

During each traditional stage of the SDLC a specific set of activities is performed and each stage produces a specific set of outputs. These outputs are commonly called 'deliverables'. For example, a funding management plan is an example of a deliverable that describes the management of the project's budget. In general the deliverables from each stage of the SDLC form the inputs to the subsequent stage. For example, the initial requirements report provides crucial input data when formulating the cost feasibility of a solution.

The particular stages or phases within the SDLC differ depending on the needs of the organisation and also on the nature of the system being developed. As a consequence different references split the SDLC into slightly different stages. In the IPT syllabus the SDLC is split into five stages, namely

1. Understanding the problem,
2. Planning,
3. Designing,
4. Implementing, and
5. Testing, evaluating and maintaining.

In the remainder of this chapter we discuss the activities occurring during each stage. The overall activities performed are similar regardless of the number of distinct stages. The five stages specified in the IPT syllabus describe one method of splitting the SDLC, but of course there are numerous other legitimate ways of splitting the SDLC into stages.

Consider the following sets of SDLC stages

The SDLC policy (1999) of the U.S. House of Representatives specifies and describes the following seven phases:

1. Project Definition
2. User Requirements Definition
3. System/Data Requirements Definition
4. Analysis and Design
5. System Build
6. Implementation and Training
7. Sustainment

The HSC Software Design and Development (SDD) course focuses on the creation of software rather than total information systems. In terms of information systems the development of software is just one part of the solution. In the SDD syllabus the version of the SDLC used is called the Software Development Cycle and is split into the following five stages:

1. Defining and understanding the problem
2. Planning and design of software solutions
3. Implementation of software solutions
4. Testing and evaluation of software solutions
5. Maintenance of software solutions

Many Systems Analysis and Design references use SDLC stages similar to one of the following:

1. Investigation	1. Planning	1. Requirements
2. Design	2. Analysis	2. Analysis
3. Construction	3. Design	3. Design
4. Implementation	4. Build	4. Construction
	5. Implementation	5. Testing
	6. Operation	6. Acceptance

GROUP TASK Discussion
Compare and contrast each of the above lists of SDLC stages with the stages specified in the IPT syllabus.

GROUP TASK Research
Use the Internet or other references to obtain at least two further examples of SDLC stages. Do the IPT stages agree in principle with the stages from your examples?

GROUP TASK Discussion
In most examples of the SDLC, including IPT, the word 'implementing' refers to the installation of the final system. However in the SDD course 'implementing' refers to building or coding the software.
Can you explain this anomaly? Discuss.

Consider the following:

David Yoffie of Harvard University and Michael Cusumano of MIT studied how Microsoft developed Internet Explorer and Netscape developed Communicator. They discovered that both companies did a nightly compilation (called a build) of the entire project, bringing together all the current components. They established milestones, release dates and enforced them. At some point before each release, new work was halted and the remaining time spent fixing bugs. Both companies built contingency time into their schedules, and when release deadlines got close, both chose to scale back product features rather than let milestone dates slip.

GROUP TASK Discussion
Identify project management techniques apparent in this development scenario. Is this system development approach suitable for developing all types of information systems? Discuss.

Before we begin examining each stage of the SDLC in detail let us briefly identify the activities occurring and the major deliverables produced during each stage of the IPT syllabus version of the SDLC. The data flow diagram in *Fig 1.5* shows each stage as a process, and the deliverables as the data output from each process. The deliverables from all previous stages are used during the activities of each subsequent stage. To improve readability these data flows have not been included on the diagram. For example the Requirements report is produced when Understanding the problem and is then used and perhaps updated during all subsequent stage, not just the next Planning stage. The grey circular arrow behind the diagram indicates the traditional sequence in which the stages are completed. Project management efforts are ongoing throughout the SDLC.

Users are included on the diagram as their input is central to the successful development of almost all information systems. Indeed it is often ideas from users, and in particular participants, that initiate the system development process in the first place. Furthermore, the needs of users largely determine the requirements of the new system. As a consequence feedback from users is vital during the SDLC if the requirements are to be met and are to continue to be met.

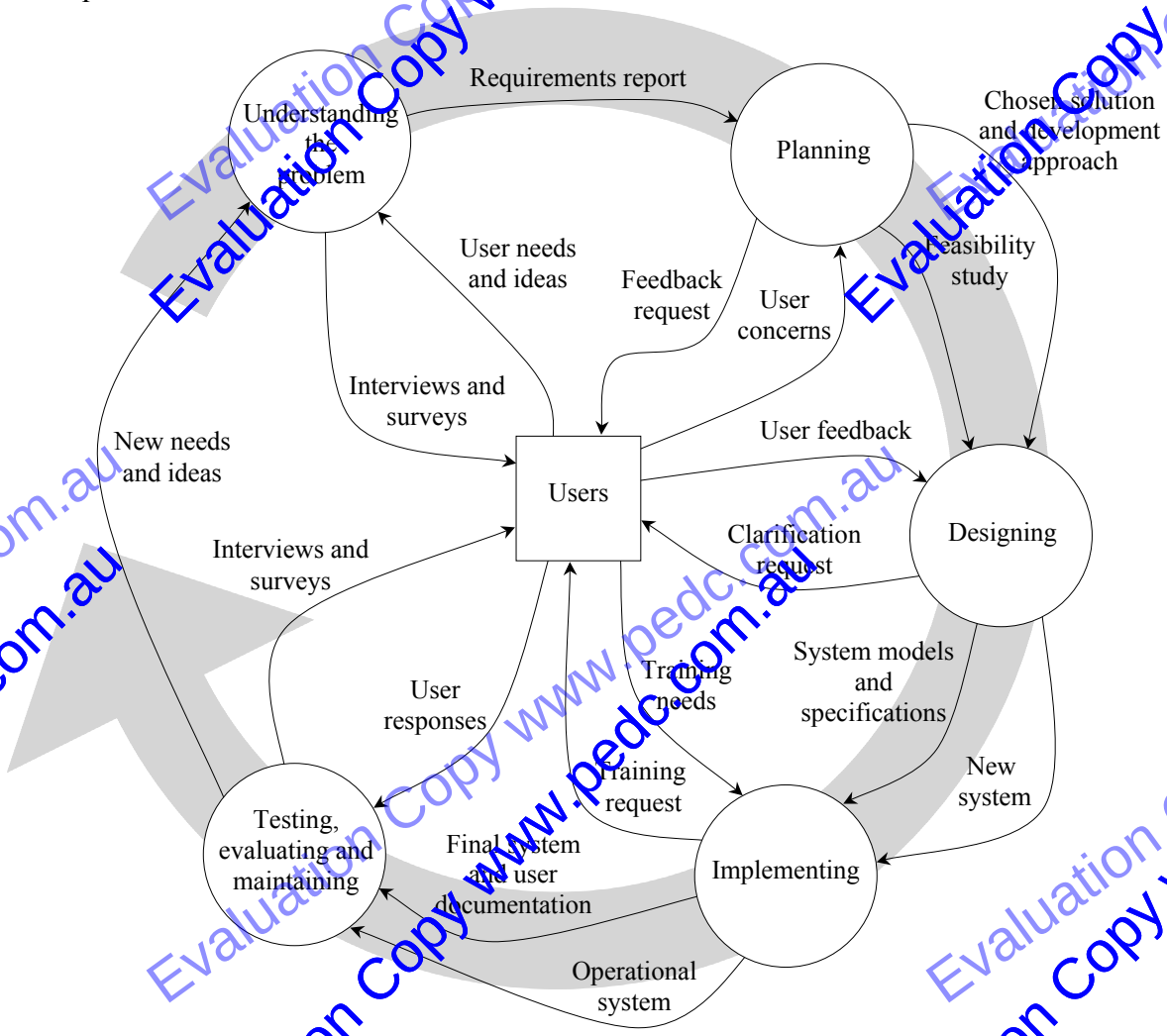
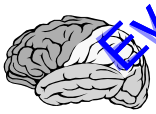


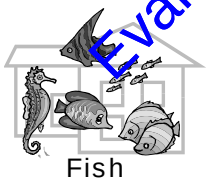
Fig 1.5
The version of the System Development Lifecycle (SDLC) used in IPT

GROUP TASK Discussion
The above diagram implies some activities during the SDLC. Identify and discuss the general nature of the activities occurring during each stage.



Consider Pet Buddies Pty. Ltd.

To illustrate the activities occurring and the deliverables produced during the SDLC we will use a pet care business called 'Pet Buddies Pty. Ltd.'. This example scenario will be referred to throughout this chapter as we develop an information system for the business. A brief introduction to Pet Buddies follows:



Pet Buddies Pty. Ltd.

Expert Home Pet Care – Breeder Specialists

Company Background

Iris and Tom Cracker have been breeding exotic, and valuable, parrots for more than 20 years. It had always been difficult for Iris and Tom to find suitable people to care for their birds when they went away on business trips or holidays. Numerous businesses existed that provided satisfactory home care for pet dogs and cats, however exotic birds were another matter. In 1999 Iris and Tom formed the business 'Bird Buddies' to fulfil this need.

Initially Bird Buddies concentrated on providing expert home care to aviculturists (bird breeders) – most of their business being generated through local aviacultural clubs. It soon came to their attention that similar problems existed for breeders of reptiles, fish and also dogs and cats. In early 2001 the name Bird Buddies was changed to Pet Buddies. As Iris and Tom had limited experience with these other species they began to contract expert reptile, fish, dog and cat personnel. Each of the experts employed is a successful and experienced breeder in their own right.

Pet Buddies has grown substantially since 1999 to the point where in 2004 they employed more than 25 different experts and serviced some 600 customers. Currently Iris and Tom are unable to provide home care services themselves as their entire day is more than filled with the administrative and management aspects of running this thriving business.

Customer Service Guarantee

- All experts are honest, genuine and motivated specialists with extensive experience keeping and/or breeding similar animals to your own.
- A specialist veterinarian for your species is on call at all times.
- We are aware of the value of many exotic animals, hence we guarantee confidentiality in regard to the number and type of animals you keep. (Optional insurance is available upon request.)
- We guarantee to perform all activities (e.g. feeding, medication, cleaning, exercise regime) specified on your accepted application form.
- Direct contact between customers and experts is encouraged. We believe quality of service and peace of mind is closely linked to frequent communication between each of our experts and our customers.

Fig 1.6
Pet Buddies Pty. Ltd. company background and customer service guarantee.

GROUP TASK Discussion
Identify the central needs that are fulfilled by Pet Buddies Pty. Ltd. How are these needs being met? Discuss.

GROUP TASK Discussion
Brainstorm a list of possible ideas that could be implemented within a new information system for Pet Buddies.

UNDERSTANDING THE PROBLEM

The primary aim of this first stage of the SDLC is to determine the purpose and requirements of a new system. Once the requirements have been established then an accurate Requirements Report can be produced. The Requirements Report is therefore the primary deliverable produced by this stage – it defines the precise nature of the problem to be solved. In essence this stage determines what needs to be done.

Systems Analyst
A person who analyses systems, determines requirements and designs new information systems.

A systems analyst is responsible for analysing existing systems, determining requirements and then designing the new information system. They are problem solvers who possess strong analytical and communication skills. In relation to 'understanding the problem to be solved' the systems analyst completes and/or manages each of the activities specified in *Fig 1.7*. Notice that each of these activities contributes to the creation of information needed to define the requirements for the new or modified system. For example, interviewing/surveying existing system users and participants provides the information required so that the systems analyst can produce models of the existing system. Requirements prototypes can be used to obtain further information relevant to the production of the Requirements Report. Note that we are concentrating on a traditional structured approach, hence each of the activities and deliverables provides additional input needed to create the subsequent deliverable. There is a logical sequence to the order in which the activities and the production of deliverables occurs.

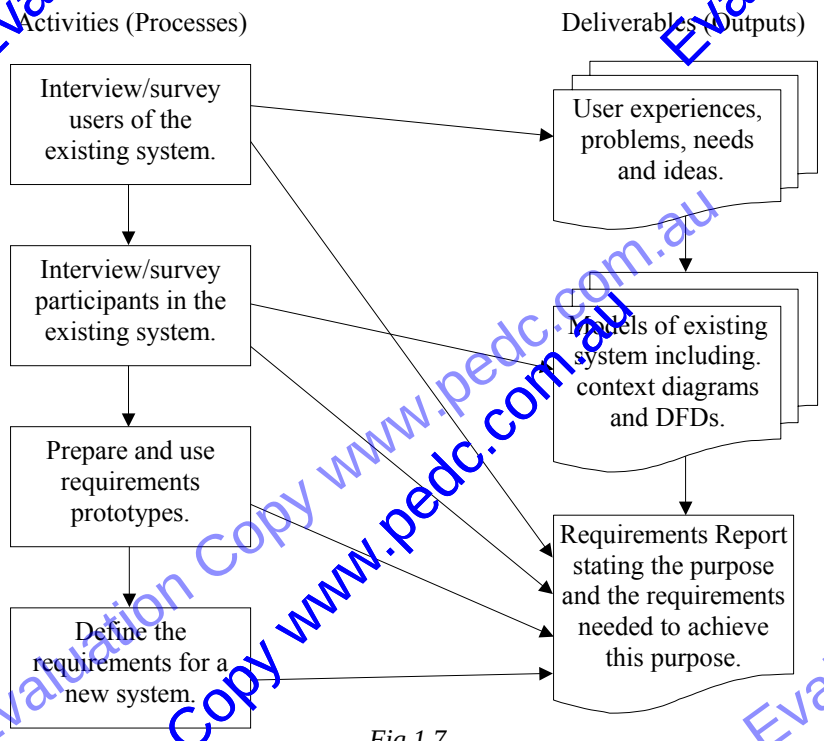


Fig 1.7
Activities performed and deliverables produced during the 'Understanding the problem' stage of the SDLC.

GROUP TASK Discussion
A lot of effort is directed towards understanding the operation of the existing system. Why do you think this is necessary? Discuss.

Before we commence discussing the detail of each activity specified in *Fig 1.7* it is worthwhile discussing what a requirement is, and how requirements relate to the system's purpose. In general terms, a requirement is a feature, property or behaviour that a system must have. If a system satisfies all its requirements then the system's purpose will be achieved. In practice a system's requirements are a refinement of the system's purpose into a list of achievable criteria.

Requirements
Features, properties or behaviours a system must have to achieve its purpose. Each requirement must be verifiable.

A successful project achieves its purpose, and furthermore this purpose is achieved when each requirement has been met. Therefore it is necessary to verify that all requirements have been met if we are to evaluate the success of the project. For this to occur all requirements must be expressed in such a way that they can be verified or tested. Consider the statement 'Customers should receive a response in a reasonable amount of time after submitting a request'. This is a satisfactory objective and may well form part of the system's purpose, however it is difficult to verify if it has been achieved. It is a subjective statement and is therefore unsuitable as a requirement. Now consider the statement 'The system shall generate a customer quotation within 24 hours of the system receiving a customer's quotation request'; this statement can easily be tested and is therefore a suitable requirement. In essence it must be possible to test and verify that a requirement has or has not been met.

GROUP TASK Discussion
System requirements should address aspects of all the components of an information system, including participants, data/information, information technology and also information processes.
Why do you think this is necessary? Discuss.

INTERVIEW/SURVEY USERS OF THE EXISTING SYSTEM

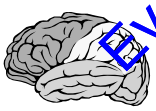
In the majority of information systems the purpose of the system is primarily concerned with fulfilling the needs of its users – users being the people who utilise the information created by the system. For example, the objective 'Customers should receive a response in a reasonable amount of time after submitting a request' aims to fulfil the need of users, who are customers, to receive timely responses. It follows that such knowledge is critical when trying to understand the problem to be solved.

Interviews and surveys are the primary tools for collecting user experiences and problems with the existing system, and also for identifying their needs and any new ideas they may have to improve the system. It is common to conduct a survey of a sample of users – the larger the sample the more statistically reliable the results will be. Unfortunately surveys, by their very nature, must be constructed in advance. This means the questions tend to draw out particular information that the survey designer feels is relevant. Furthermore, it is likely that even open-ended questions will only be answered within the context of the existing system. For example, when modifying an existing website the open-ended question 'Do you have any suggestions for inclusion in the new website?' is included in a user survey. The intention of the question is to gather new user needs. In reality many people will not respond at all to open ended questions and those that do respond are likely to address improvements to the current website rather than suggestions outside the scope of the existing system. The results of surveys are often more useful for highlighting existing problems rather than revealing new needs and ideas that are not currently being addressed.

New needs and ideas are more likely to reveal themselves via personal and informal interviews conducted with users in their own environment. Unfortunately conducting such interviews is time consuming and expensive. Interviews can also be conducted with small focus groups of users where particular aspects of the system critical to these users can be informally discussed.

Be aware that what people say they need and what they actually need is often different. Furthermore, users often express the relative significance of their needs incorrectly. For example, a user may express a strong need for a particular report to be generated more rapidly. In reality this report may only be used on a weekly basis, hence saving a minute or so becomes relatively insignificant. Such issues are potential problems with both surveys and interviews. In an attempt to verify user needs, many systems analysts directly observe sample users whilst they work with the existing system. This can only occur when an existing system is already in use and operating. For completely new systems requirements prototypes can be built so that possible user needs can be verified using a simplified version of the new system. Requirements prototypes are more often used with system participants rather than general users. We discuss requirements prototypes in more detail later in this section.

Once the collection of data from users has been completed the systems analyst must organise the data into a form suitable for analysis; spreadsheets or simple databases are common tools. The data is then analysed to determine and prioritise problems with the new system, identify user needs and also to document any new ideas. A report summarising all this information can then be produced. This report forms the essential deliverable resulting from the interviewing/surveying of users.



Consider Pet Buddies Pty. Ltd.

Iris and Tom, the owners of Pet Buddies, have contracted Fred to advise them about possible options in regard to improving the efficiency of their existing information systems. Fred, who is a systems analyst, explains the sequence of activities he will perform, beginning with identifying the experiences and needs of their users. In this case the users are comprised of two distinct groups, the customers and the experts.

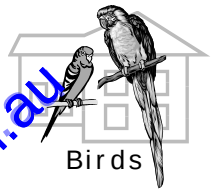
The customers are indirect users of the system, whilst the experts are direct users who are also system participants. Each group will have different experiences and needs and hence requires separate consideration. Iris, Tom and Fred agree that it makes sense to consult the experts once the needs of the customers have been established.

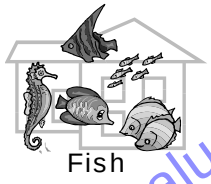
After consultation with Iris and Tom, Fred creates the one page 'Customer Satisfaction Survey' reproduced in *Fig 1.8*. A copy is mailed to all 600 of Pet Buddies existing customers. A stamped self-addressed envelope is included with each survey in an attempt to increase the response rate.

GROUP TASK Discussion

The survey created by Fred (see *Fig 1.8*) aims to encourage each customer to provide comments. Identify features on the survey that encourage comments and explain why Fred would wish to encourage comments.

After 2 weeks Iris and Tom have received a total of 315 completed surveys. Iris feels this is a rather poor response rate, however Fred informs her, that in his view the response rate is exceptional as he anticipated approximately 30% would be returned – he also mentions that response rates for emailed surveys are usually less than 10%.





Pet Buddies Pty. Ltd.

Expert Home Pet Care – Breeder Specialists

Customer Satisfaction Survey

Dear Jack and Jill,

We are constantly looking for ways to improve the quality of our services. To do that, we need to know what you think. As a valued customer, we'd really appreciate it if you would take just a few minutes to respond to the handful of questions below.

Please return your completed survey in the included stamped self-addressed envelope or fax to 9912 3456.

Please tick "Outstanding" or "Needs Improvement" and then comment:

	Outstanding	Needs Improvement
Booking your home care service		
Feedback and communication with your expert		
Confidence in your expert's abilities		
All activities were accomplished well		
Flexibility of home care service		
Confidentiality and privacy		
Value for money		

Thankyou!

Fig 1.8
Customer Satisfaction Survey for Pet Buddies Pty. Ltd.

Fred's task is to organise the survey responses in such a way that they can be analysed to identify a list of customer needs. He enters the responses into a database that is linked to a copy of Pet Buddies existing customer database. This enables Fred to analyse the survey responses according to animal type, location, expert, length of home care, frequency of home care, cost and so on. The aim is to identify if particular customer problems and needs are specific to particular aspects of Pet Buddies' services. For example, "Are repeat customers' needs and problems different to the needs and problems experienced by first time customers?" or "Do keepers of reptiles have different experiences and needs compared to those keeping birds?"

GROUP TASK Discussion
Identify the information technology needed by Fred to perform the analysis detailed above.

During his analysis Fred intends to telephone some of the customers who responded to the survey, his aim being to confirm any problems they mention and also to obtain further specific details.

GROUP TASK Discussion
Identify reasons why Fred would choose to telephone some customers to confirm and obtain more specific details.

Fred will use the information to establish a set of user needs, which will then form the basis for the creation of a set of achievable user requirements. Let us assume Fred has created a list of user needs and he is now formulating user requirements. One of these needs together with the associated user requirements follows:

Customers need reassurance that all specified activities are indeed being completed.

- The system shall ensure experts have a complete list of required activities for each customer.
- The system shall generate 'completion of activities' reports for customers.
- The system shall maintain a record of how often a customer is to receive a 'completion of activities' report.
- The system shall alert management if a 'completion of activities' report cannot be generated on time.

GROUP TASK Discussion
Notice how the above need includes the word 'need', similarly each requirement commences with the words 'The system shall'. The use of these specific words is not necessary, however it is a technique Fred finds useful. Why do you think Fred uses this technique? Discuss.

INTERVIEW/SURVEY PARTICIPANTS IN THE EXISTING SYSTEM

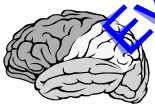
Participants within existing systems will have an understanding of the part of the system with which they primarily interact. They are able to identify problems and often they also have ideas in regard to solving these problems. Furthermore, participants are a vital source of information in regard to the detail of the information processes occurring within the existing system. Notice that in *Fig 1.7* the results of participant interviews and surveys are used to create models of the existing system as well as to create the final requirements report for the new system.

System analysts often perform task analysis activities with participants. Task analysis involves writing down each step performed to complete a particular task. The time taken to complete each step is noted together with the inputs required and the outputs produced during the task's completion. Such information provides a basis for the creation of system models, such as data flow diagrams.

Although system participants are familiar with the procedures required to perform their specific tasks, they are often not aware of how the system actually performs these tasks or how these tasks contribute to the larger information system. For example, data entry operators are unlikely to understand the various information processes that utilise the data they enter. As a consequence data entry operators may comment that some data items have no relevance to the information system. It is the job of the systems analyst to determine the correctness of participants' responses.

Pages 31 to 40

Not included in this Evaluation Copy



Consider Pet Buddies Pty. Ltd.

Selected sections of the final Requirements Report developed by Fred for Pet Buddies are reproduced below in *Fig 1.15* and *Fig 1.16*.

1. Introduction

Pet Buddies provides professional confidential expert home care services to breeders and keepers of birds, reptiles, fish, dogs and cats. Many of their customers are professional large-scale breeders who maintain extensive animal collections. The value of their customer's collections range from $5000 up to $10 million, the average value being approximately $40,000.

1a. System Purpose

The purpose of this system is to:

- automate the generation and distribution of activity reports.
- personalise contact between customers and experts during home care services.
- improve the accuracy of quotations for home care services.

1b. Pet Buddies' Customers Needs

Pet Buddies' Customers need:

- reassurance that all specified activities are being completed.
- feedback on problems encountered during home care services.
- to be confident in the ability of the expert performing their home care service.
- to be confident that details of their animal collection and its location remain confidential.

1c. System Scope

The system will:

- collect sufficient data to enable accurate quotations to be produced.
- collect data required to generate the activity reports.
- generate activity reports at the correct times.
- facilitate the display of activity reports to customers.
- ensure customer data is secure.

The system will NOT:

- create or generate quotations.
- include or provide functionality in regard to invoicing of any other financial functions of the business.
- perform any marketing functions.

Fig 1.15
Pet Buddies Requirements Report Introduction

GROUP TASK Discussion

It is clear from the above introduction that the proposed system addresses just some of Pet Buddies' information system needs. Suggest and discuss possible reasons why this decision may have been made.

GROUP TASK Discussion

Presumably much of the existing system will remain in operation. Identify and describe possible consequences for the new system in terms of its development and also in terms of its operation.

3. System Requirements

3a. Physical

The system shall:

3a.1. use mobile devices weighing less than 5kg.
3a.2. use mobile devices that operate for at least 9 hours without accessing mains power.
3a.3. include hardware components that are replaceable within 24 hours.
3a.4. include hardware components that regulate their own temperature without the need for external cooling.
3a.5. include components with a minimum life expectancy of greater than 2 years.
3a.6. use computer communication hardware compatible with Pet Buddies existing gigabit Ethernet LAN.

3b. Performance

The system shall:

3b.1. provide activity reports to customers within 60 minutes of the necessary data being received by the system.
3b.2. enable experts to submit data for activity reports from any location, including whilst on the customers premises.
3b.3. include the facility for Pet Buddies management to at their discretion check and/or edit the content of any activity report prior to its release to a customer.
3b.4. include the facility for Pet Buddies management to specify that all activity reports from a particular expert or to a particular customer must be approved by Pet Buddies management before release to customers.
3b.5. alert Pet Buddies staff immediately an activity report becomes overdue.
3b.6. provide the facility for customers to provide feedback on the content of activity reports at any time, including immediately after receiving an activity report.
3b.7. alert Pet Buddies management immediately customer feedback specified in 3b.6 is received.
3b.8. include the facility for the system to collect and store all quotation data directly from experts within 60 minutes of the expert determining such data.
3b.9. alert Pet Buddies management immediately quotation data specified in 3b.8 is received.
3b.10. reuse the collected quotation data to generate outlines for use during the production of activity reports.
3b.11. collect data from experts on the total time taken to complete each home care service.
3b.12. generate statistical reports on demand that compare the actual time taken to perform each home care service with the estimated time on the quotation. Reports can be generated for individual customers, individual experts, individual animal types and/or within specified date ranges.

Fig 1.16
Section 3a and 3b of Pet Buddies Requirements Report.

GROUP TASK Discussion
How does each of the above requirements assist in the achievement of the system's purpose? Discuss.

GROUP TASK Discussion
The security and data/information sections of the Requirements Report have not been reproduced above. Develop a list of possible requirements that these two sections of the report would likely include.

Consider Pet Buddies Pty. Ltd.

Fred intends to submit the Requirements Report to various businesses to obtain ideas, and quotations, in regard to possible solutions. Fred advises Iris and Tom that before this occurs they need to determine some idea of a budget and also some idea of when the system should be operational. This information is required to enable Fred to explore possible solution options that meet the requirements, including budget and time constraints.

After discussion, Iris and Tom inform Fred that the budget should be set based on the principle that development costs will be recovered within 2 years of the system becoming operational. In essence the cost of the new system should be covered by increased company profits within 2 years. Fred, although he agrees, points out various other considerations. For example, he points out that Iris and Tom will have more time for leisure and/or business development and marketing activities. He also mentions the likely increase in capital value of the business due to a lowered reliance on their personal skills and knowledge – in essence the business will be more self-sufficient as an independent entity.

FORUM

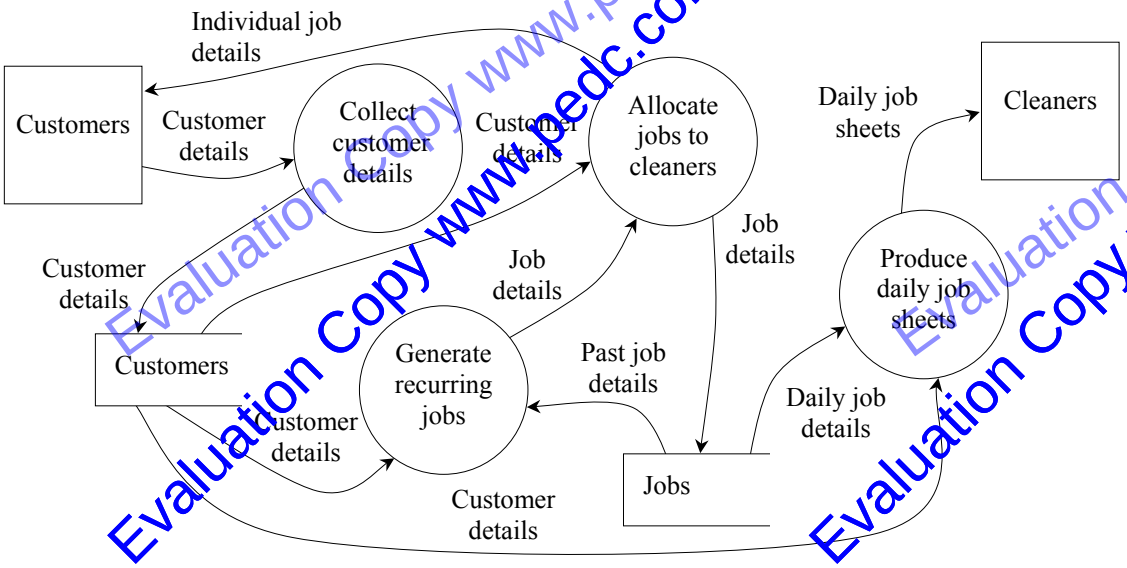
GROUP TASK Discussion

Is it always necessary for the budget and the date of system completion to be known prior to considering possible solution options? Discuss.

HSC

HSC style question:

A cleaning business currently uses a manual system to collect customer information and allocate jobs to each of its cleaners. They are investigating the possibility of computerising their existing system. The data flow diagram below models the existing manual information system. Currently each process is completed manually by one of the system's participants.



(a) Two different symbols on the data flow diagram refer to customers. Compare and contrast the use of these two symbols using specific examples from the data flow diagram.

(b) Cleaning jobs are allocated on a priority basis. All customers are allocated a certain priority, higher priority customers having their job completed first. Recurring jobs are allocated a particular time and all other jobs must be allocated around these times.

Using the data flow diagram together with the above information describe the likely contents of the data flows labelled 'Customer details' and 'Job details'.

(c) Propose suitable techniques that could be used to identify problems present within the existing manual system.

Suggested Solution

(a) The customer's entity refers to the actual human customers who are the source of the customer details used during the collection process. The customer's data store is a file that contains details of each of the business's customers. Both deal with customer data, but one is the source of this data whilst the other is a storage area for the data – probably a filing cabinet.

(b) The 'Customer Details' data flow would contain a customer's name, address, phone number, how long the job will take, any unusual aspects to the job, preferred day of the week and/or time, and also whether it is a recurring job. If it is a recurring job then the frequency and priority of the job would be included.

The 'Job Details' data flow passes data regarding each individual cleaning job that is assigned to a cleaner. This would include the date, time and duration of the job together with the customer's contact details and the cleaner who has been assigned the job.

(c) A simple customer satisfaction survey form could be created and distributed to existing customers. Perhaps the cleaners could leave the survey after they complete each job. The survey would ask customers to comment on both negative and positive aspects of the cleaning business – including questions about their experiences booking jobs and also whether their job was completed at a convenient time. Each cleaner could also be surveyed to obtain information about any problems with regards to their daily job sheets.

Once the surveys have been completed the results will need to be analysed to identify significant problems. This list of problems could then be distributed to each of the participants so they are able to express any ideas they have in regard to possible solutions. In additions the participants can also be asked about any other problems they perceive. Interviews with participants could take place so that their ideas and possible solutions can be explored in more detail.

In the new computerised system most of the information processes will be automated. Hence a requirements prototype would be a valuable aid for ensuring all of the current manual processes are addressed and also for introducing the general nature of the proposed system to the participants.

Comments

- In an HSC or Trial HSC examination part (a) would likely attract 2 marks, part (b) would attract 3 marks and part (c) would attract approximately 4 marks.
- In part (b) it is important to notice that the Customer Details includes details of recurring jobs in addition to name, address and phone numbers.
- A variety of different suitable techniques could have been proposed in part (c).

SET 1B

1. The person who determines requirements and designs new information systems is best described as a:
   (A) Project manager.
   (B) Participant.
   (C) System analyst.
   (D) Engineer.

2. Feedback from users should occur during which stages of the SDLC?
   (A) Understanding the problem and planning stages.
   (B) Designing and implementing stages.
   (C) Testing, evaluation and maintaining stage.
   (D) All stages of the SDLC.

3. Which type of information is more likely to be obtained from interviews compared to surveys?
   (A) New ideas and needs.
   (B) Details of existing issues.
   (C) Current procedures for completing tasks.
   (D) Responses from many users.

4. Tools for diagrammatically representing existing systems include:
   (A) requirements reports and requirements prototypes.
   (B) interviews/surveys of users and participants.
   (C) application packages and requirements definition packages.
   (D) context and data flow diagrams.

5. During testing and evaluation the requirements report is used to:
   (A) determine the most suitable method for converting from the old to the new system.
   (B) design the information processes that will form part of the new system.
   (C) determine the feasibility of possible solution options.
   (D) verify all requirements have been met.

6. An explanation of what the system will and will not do helps to define the:
   (A) needs of users.
   (B) system scope.
   (C) system purpose.
   (D) characteristics of participants.

7. In IPT, which of the following lists of SDLC stages is in the correct sequence?
   (A) Understanding the problem, planning, designing, implementing, testing, evaluation and maintaining.
   (B) Understanding the problem, designing, planning, implementing, testing, evaluation and maintaining.
   (C) Understanding the problem, implementing, designing, planning, testing, evaluation and maintaining.
   (D) Planning, understanding the problem, designing, implementing, testing, evaluation and maintaining.

8. A simulation of a new system built to understand the system's requirements is known as a:
   (A) Requirements Report.
   (B) Requirements Prototype.
   (C) Requirements Model.
   (D) Evolutionary Prototype.

9. Features, properties or behaviours a system must have to achieve its purpose are called:
   (A) requirements.
   (B) needs.
   (C) decisions.
   (D) processes.

10. When using a traditional system development approach the main deliverable from the "Understanding the problem" stage is the:
    (A) Interview and surveys.
    (B) Feasibility study.
    (C) Operational system.
    (D) Requirements report.

11. Define each of the following terms.
    (a) survey (b) interview (c) requirement (d) system purpose

12. Describe the content of a typical requirements report.

13. Explain how the requirements report is used during the system development lifecycle.

14. Assess the value of requirements prototypes compared to surveying and interviewing users and participants.

15. Explain why it is necessary to analyse the operation of existing systems when developing new systems.

PLANNING

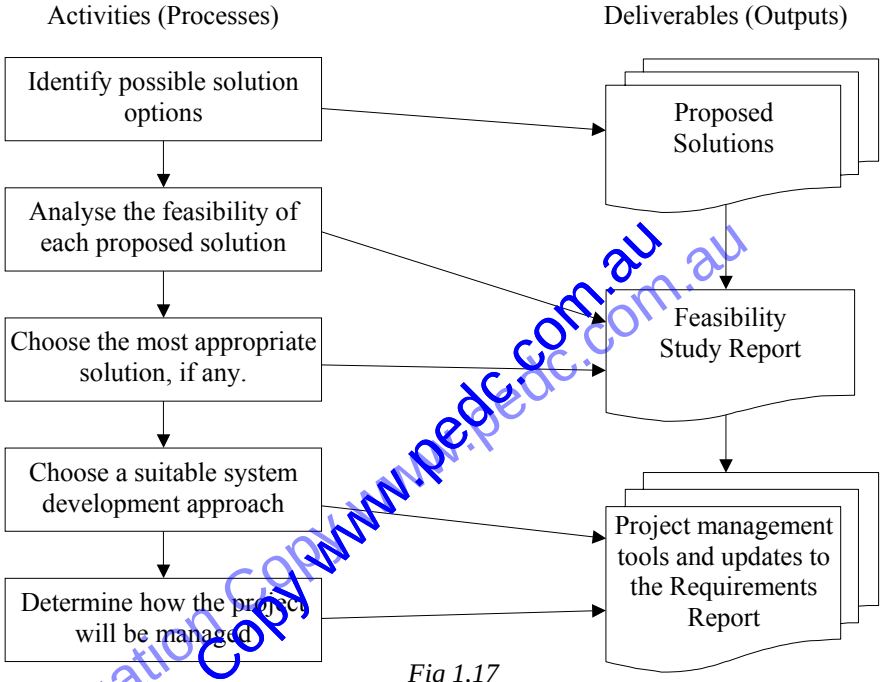


Fig 1.17
Activities performed and deliverables produced during the 'Planning' stage of the SDLC.

In this, the second stage of the system development cycle, the aim is to decide which possible solution, if any, should be developed and then decide how it should be developed and managed. In other words the feasibility of developing the new system is analysed to create the Feasibility Study Report. Assuming an appropriate solution is found then a system development approach can be determined that is suited to developing that solution. Finally project management tools are used to document the detail of how the project will be managed and the Requirements Report is updated to include and reflect details of the chosen solution and system development approach.

FEASIBILITY STUDY

Feasible
Capable of being achieved using the available resources and meeting the identified requirements.

So what is a feasibility study? Consider making some large purchase – say a new car, a new computer or some new piece of furniture. Prior to making such a purchase you ask yourself various questions. What kind do I want? What features do I want? Will it do what I need it to do? What will it cost and can I afford it? Will it require maintenance and what will that cost? And finally should I actually buy it? In essence you are performing an informal mini-feasibility study. Asking and answering similar questions is the essence of all feasibility studies. The ultimate aim is to determine the feasibility of each possible solution and then recommend the most suitable solution. Remember it is possible, and reasonably common for no feasible solution to be recommended, meaning the existing system will remain.

The feasibility of each possible solution must be assessed fairly – the Requirements Report plays a major role in this regard. Without a common set of requirements it would be difficult to make a fair comparison between different solution options. This presents a new problem – if a number of solutions are able to meet the requirements then on what basis can a decision be made? The 'Feasibility Study' is also concerned with addressing criteria upon which the answer to this question is based.

Feasibility studies generally examine each possible solution option in terms of the following four feasibility criteria:

GROUP TASK Discussion
A solution that meets each of the requirements within the requirements report must be the preferred solution. Do you agree? Discuss.

- technical feasibility
- economic feasibility
- schedule feasibility
- operational feasibility

Let us examine each of these areas and consider questions that should be addressed under each area as part of a feasibility study.

Technical Feasibility

The technical feasibility of a solution is concerned with the availability of the required information technology, its ability to operate with other technology and the technical expertise of participants and users to effectively use the new technology. For example, a new off-the-shelf state-of-the-art software application may, according to its specifications, meet the system's requirements, however without a large customer base there are likely to be concerns in regard to continuing support and upgrades. Furthermore few people will be trained in the use of the application. This means it will be difficult to replace trained personnel during the system's future operation.

Questions used to determine a solution's technical feasibility include:

- Do we currently possess the necessary technology?
- Is the technology readily available?
- How widely used is the technology?
- Are existing users of the technology happy with its quality and performance?
- Will the technology continue to be upgraded and supported in the future?
- Will the technology operate with other existing and possible future new or emerging technologies?

GROUP TASK Discussion
Identify from whom and how answers to each of the above questions could be obtained.

GROUP TASK Discussion
How could the answers to the above questions be compiled in order to compare the technical feasibility of different solution options? Discuss.

Economic Feasibility

The economic feasibility of each solution option is determined by performing a "Cost-benefit analysis". This involves calculating all the costs involved in the development and implementation of each solution option. On the surface it would appear that the least expensive option to develop and implement would be the most economically feasible, however this is not always the case. There are various other factors that contribute to the economic feasibility of a solution and should be considered as part of a cost-benefit analysis. Let us consider such factors and then discuss issues that should be considered when analysing the economic feasibility of a solution.

- **Factors affecting a solution's economic feasibility**

Development costs

- Cost of the development team
- Systems analyst and other consultancy fees
- Software costs to purchase or build the software
- Hardware costs to purchase, lease and/or assembly the hardware
- Infrastructure costs such as new buildings, communication links and power.
- Installation of the system
- Training participants and users
- Converting from the old system to the new system

Ongoing operational costs

- Hardware maintenance and repair costs
- Software licences and upgrade
- Maintenance of infrastructure that supports the system
- Salary/wages for participants
- Support costs for users, including ongoing training
- Consumables such as toner cartridges and paper

Tangible benefits (that can relatively easily be assigned a dollar value)

- increased sales
- cost reductions
- increased efficiency
- increased profit on sales
- more effective use of staff time

Intangible benefits (that are difficult to assign a dollar value)

- increased flexibility of the system
- higher quality products or services
- improved customer satisfaction
- better staff morale

GROUP TASK Discussion
Explain how a dollar value could be determined for each of the tangible benefits list above.

GROUP TASK Discussion
Discuss possible techniques for determining a dollar value for the intangible benefits listed above.

- **Issues to consider during a cost-benefit analysis**

Cost-benefit analysis, as the name implies, compares all the costs with all the benefits in an attempt to determine the total return on the money invested into the new system. One would imagine that if the benefits, in dollar terms, exceed the costs then the system is economically feasible – unfortunately things are not quite so simple! Cost-benefit analysis aims to determine the real benefits of each solution option. The techniques used are the same as those used by economists to analyse investments.

Issues to consider include:

- The money spent on the new system could have been invested elsewhere; hence the benefits of the new system must also exceed the benefits that would have been realised without the new system. In accounting terms the Net Present Value (NPV) is determined. A positive NPV indicates a good investment, and the largest

NPV indicates the best investment. Negative NPV values indicate investments that should not be developed further.

- Comparing the percentage profitability of each solution option rather than just the absolute profit. This is known as return on investment (ROI) analysis. ROI describes the percentage increase of an investment over time.
- When will the new system have paid for itself? This is known as the 'break-even point' – the point in time where the new system has been paid for and it begins to make a profit. For example, in *Fig 1.18* solution option A has a break-even point of 2 years whilst solution option B has a break-even point of 3.5 years. The period of time prior to the break-even point is called the payback period.

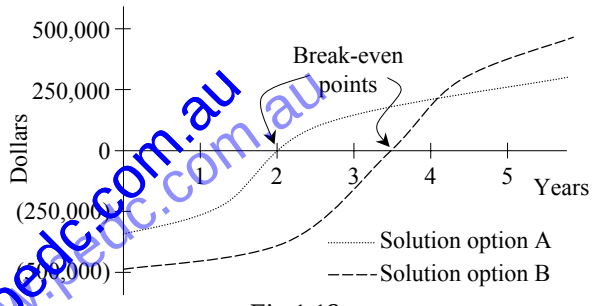


Fig 1.18
Break-even analysis is used to determine when each solution option becomes profitable.

Solutions with a high NPV, high ROI and short payback period will be the most economically feasible. Unfortunately all these measures are based on future predictions, hence they can never be determined with complete accuracy. Furthermore, different clients will have different needs that will affect the relative importance of each measure when determining the economic feasibility of solutions to particular problems.

GROUP TASK Discussion
The most profitable solution is not always the most economically feasible solution. Do you agree? Justify your answer using examples.

Schedule Feasibility

Schedule feasibility is largely about whether the solution can be completed on time. The project plan, and in particular the Gantt chart, will specify the deadlines for completion of each development task. Schedule feasibility aims to determine if such deadlines can be met. It should also examine the consequences should some tasks and even the entire project fail to meet its specified deadlines.

Questions used to determine a solution's schedule feasibility include:

- How long will it take to obtain the required information technology?
- If new personnel need to be employed then how long will that take?
- How long will it take to retrain existing team members?
- Will retraining affect the ability of staff to complete existing tasks on time?
- Are the deadlines mandatory or are they desirable?
- If the project runs over time what are the consequences?
- Is it possible to install an incomplete solution should deadlines not be met?
- How can development of the solution be monitored to verify deadlines are indeed being met?

GROUP TASK Discussion
Identify from whom and how answers to each of the above questions could be obtained.

Operational Feasibility

Operational feasibility aims to evaluate whether each solution option will work in practice rather than whether it can work. It considers support for the new system from management and existing employees. In essence a solution option is likely to be operationally feasible if it meets the needs of the participants and users of the system.

Questions used to determine a solution's operational feasibility include:

- Do existing staff support the solution option?
- Do management support the solution option?
- Does the nature of the solution 'fit in' or conflict with the nature of other systems that will remain in place?
- Will the nature of work change for participants?
- Are participants open to change or resistant to change?
- How do the end-users feel about the delivery of information from the new system?
- Do participants already possess the technical expertise?
- Do users already possess the technical skills to use the technology?
- Is training and support available and will it remain available?

GROUP TASK Discussion
Identify from whom and how answers to each of the above questions could be obtained.

GROUP TASK Discussion
How could the answers to the above questions be compiled in order to compare the operational feasibility of different solution options? Discuss.

Consider Pet Buddies Pty. Ltd.

Fred has now researched possible solutions and has determined two solution options. A brief outline of each option in regard to the production of activity reports is reproduced below:

Pet Buddies' solution option A

1. Each expert is provided with a personal digital assistant (PDA) device. The expert enters activity report data into their PDA using the device's handwriting recognition capabilities.
2. Each expert then connects their PDA to the Internet via their mobile phone and emails the text data to a dedicated email address at Pet Buddies.
3. Software at Pet Buddies receives the message, notifies Iris and Tom and stores the data in a database linked to the customer's name.
4. The message generated for Iris and Tom provides them with an option to view and edit the report. In all cases they must indicate their approval before the report is made available to the customer.
5. To retrieve activity reports the customer phones Pet Buddies and is connected to a computerised voice mail system. The voice mail system collects the customer's ID number and then gives the customer the option of listening to activity reports or having them faxed.

Pages 51 to 60

Not included in this Evaluation Copy

Details of the specific communication strategies and techniques are specified within the communication management plan. Journals and diaries are used to document each communication and the funding management plan will detail the mechanisms for reallocating money as requirements emerge and change.

Consider Pet Buddies Pty. Ltd.

Fred's feasibility report strongly recommends solution option B (refer page 50 – 51) and Iris and Tom agree. Fred will negotiate the purchase of all required hardware and also the voice mail software. He will also upgrade and modify Pet Buddies existing database to suit the requirements of the new system. Development of the speech recognition software will be outsourced to a specialist software development company. Fred feels a traditional approach should be used by the outsourced specialist, as the software does not interact directly with users; rather it obtains all input from the audio files in the database and outputs text files back to the database. Fred now has sufficient information to create a workable schedule including each of the project's subtasks.

GROUP TASK Discussion
With reference to Pet Buddies Solution Option B (page 51), identify the major tasks Fred needs to include on a Gantt chart for the project. Discuss a suitable sequence for completing these tasks.

GROUP TASK Discussion
Is a single system development approach appropriate for developing the new Pet Buddies systems? Discuss various alternatives.

GROUP TASK Discussion
Why would Fred choose to outsource development of the speech recognition software? Do you agree that a traditional development approach is suitable for developing this software? Discuss.

HSC style question:

The Australian federal government is considering implementing a new system for doctor's patients to claim their Medicare rebates for doctors who do not bulk bill their patients.

The existing system works in the following way:

- a patient goes to their doctor for a consultation
- the patient receives an account (bill) from their doctor
- the patient pays the doctor's account and receives a receipt
- the patient takes (or posts) their receipt to a Medicare office
- the receipt is processed by the Medicare office
- the patient receives a rebate (partial re-imbursement) from Medicare.

The new system would amend the current system so that the doctor's surgery would be connected via a Wide Area Network to the Medicare office and as a result the processing of the account would occur at the surgery directly following the payment of the account. Patients would receive their rebate by direct deposit from Medicare into their bank account immediately after the account has been paid.

(a) Describe THREE specific issues that should be considered when assessing the feasibility of the new system.

(b) Assuming the new system is to be developed, recommend and justify a suitable system development approach.

Suggested Solution

(a) No doubt there are a large variety of different billing software packages used by different doctors and some doctors may still use manual systems. How will the new system interface with such a broad range of systems? Is it technically feasible for such a large and diverse range of systems to be accommodated?

The new system removes work from Medicare offices and also from the end-user patients. Essentially this work is transferred to the Doctor's surgery staff (and also the new software). There are no direct advantages for the Doctor's surgeries and hence they are unlikely to embrace the new system. This could result in operational problems, as the primary participants will be resistant to changes brought about by implementing the new system.

Each Doctor's surgery throughout the country will require a secure communication link and associated communication hardware. Purchasing and installing this equipment will be costly. However perhaps more significant will be the ongoing maintenance of the network and hardware. Although Medicare offices will require less staff to process rebates, more technical staff will need to be employed. Such issues will affect the economic feasibility of the new system.

(b) The communication network software and hardware would be best developed using a traditional structured approach. The hardware at each Medicare office and at each Doctor's surgery can be largely of the same design. Because there are no doubt thousands of Doctor's surgeries and hundreds of Medicare offices it is worth the effort to ensure the system is as reliable and secure as is possible. Furthermore the requirements for the network information technology can be specified in advance and only limited technical user interaction is required.

The software to interface with the new system and the account systems used by Doctor's surgeries could be developed using a prototyping approach. Each completed prototype can be sent for testing and feedback to sample Doctor's surgeries and also to software companies that develop software for Doctor's surgeries – in effect these are the actual people most affected. In this way the prototypes can be modified so they evolve in response to feedback and the software companies can modify and also verify that their products will operate with the new Medicare system.

Comments

- In an HSC or Trial HSC Examination both parts (a) and (b) would likely attract 3 to 4 marks each.
- In part (a) there are numerous other issues that could be discussed. For instance, ongoing training and support for new surgeries and surgeries that change their billing systems. The system requires patients to have a bank account and to be willing to have the account details within the system – some patients may have privacy concerns. Under the previous system patients could visit Medicare to obtain their rebate prior to paying the bill, under the new system patients must pay the account first, which requires them to have sufficient funds available.
- In part (b) a number of different system development approaches could legitimately be recommended and justified. It is likely that better responses would combine a number of development approaches to form a system development approach tailored to the development needs of this specific system.

SET 1C

1. Cost-benefit analysis is part of assessing each solution's:
   (A) technical feasibility.
   (B) economic feasibility.
   (C) schedule feasibility.
   (D) operational feasibility.

2. The ability of participants to effectively use new information technology is part of assessing each solution's:
   (A) technical feasibility.
   (B) economic feasibility.
   (C) schedule feasibility.
   (D) operational feasibility.

3. Determining whether a solution can be developed within the available time is part of assessing each solution's:
   (A) technical feasibility.
   (B) economic feasibility.
   (C) schedule feasibility.
   (D) operational feasibility.

4. Support from users and participants for each solution is considered when assessing each solution's:
   (A) technical feasibility.
   (B) economic feasibility.
   (C) schedule feasibility.
   (D) operational feasibility.

5. Altering an existing solution occurs when using which development approach?
   (A) Agile.
   (B) Outsourcing.
   (C) Prototyping.
   (D) Customisation.

6. Using outside specialists to develop all or part of the solution is known as:
   (A) Customisation.
   (B) Prototyping.
   (C) Outsourcing.
   (D) Agile methods.

7. System development methods that acknowledge the changing nature of requirements during development include:
   (A) prototyping and customisation.
   (B) prototyping and agile methods.
   (C) traditional and agile methods.
   (D) outsourcing and customisation.

8. Which approach does NOT require detailed user documentation to be produced?
   (A) Traditional approach.
   (B) Prototyping approach.
   (C) Participant development approach.
   (D) Agile approach.

9. Planning and designing just before the solution is created is a characteristic of:
   (A) agile methods.
   (B) traditional system development.
   (C) customisation.
   (D) outsourcing.

10. Each stage of the SDLC is completed in sequence when using which system development approach?
    (A) Traditional.
    (B) Prototyping.
    (C) Outsourcing.
    (D) Participant development.

11. Define each of the following.
    (a) feasible (b) deadline (c) payback period (d) NPV

12. Outline factors affecting a solution's:
    (a) economic feasibility
    (b) technical feasibility
    (c) operational feasibility
    (d) schedule feasibility

13. List characteristics of each of the following development methods.
    (a) Traditional
    (b) Outsourcing
    (c) Prototyping
    (d) Customisation
    (e) Participant development
    (f) Agile methods

14. Contrast the traditional system development approach with:
    (a) prototyping
    (b) agile methods

15. During the planning stage the feasibility study is completed, then the most appropriate solution is selected, followed by determining a suitable system development approach and finally planning how the project will be managed and updating the Requirements Report.
    Discuss reasons why these activities are performed in this particular sequence.

DESIGNING

This third stage of the system development lifecycle (SDLC) is where the actual solution is designed and built. This includes describing the information processes and specifying the system resources required to perform these processes. The resources used by the new information system include the participants, data/information and information technology (see *Fig 1.22*). Information technology includes all the hardware and software resources used by the system's information processes. Some new information systems may require completely new hardware and software, whilst others may utilise existing hardware and software to perform new information processes – in fact any combination of new and existing information technology is possible, it depends on the requirements of the new system and the needs of its information processes.

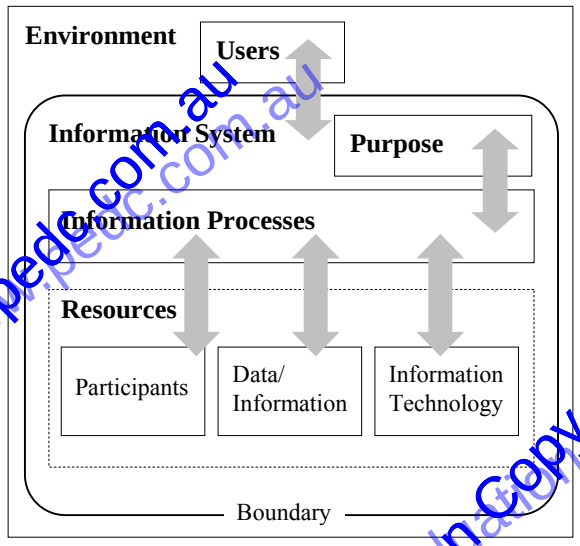


Fig 1.22
Diagrammatic representation of an information system

The design process will differ according to the system development approach used. However for all approaches designing involves identifying and describing the detail of the new system's information processes. System models are created, using tools such as context diagrams, data flow diagrams, decision trees and tables and also storyboards. During the modelling process, the data and information used and produced by the system is determined and clearly defined within a data dictionary. Once the processing and data/information is understood the particular information technology that will perform these processes can be accurately determined. Depending on the individual system and the selected development approach, it may be necessary to have new software developed, existing software modified or specific hardware components assembled. Furthermore, specifications and suppliers for required outside communication lines, network cabling, furniture, off-the-shelf software and standard hardware are determined in preparation for negotiating their purchase and/or installation. Agreements with regard to outsourced development should be finalised early so that their development can progress. Hardware or software that will be customised will need to be purchased in advance. Throughout the entire design process consultation with both users and participants should be ongoing. It is essential that the needs and concerns of all people affected by the final operational system remain central to the design process.

GROUP TASK Discussion
Discuss techniques appropriate to different system development approaches that ensure user and participant's needs and concerns are not overlooked during the design stage.

GROUP TASK Discussion
Precisely when detailed system models are required varies depending on the system development approach. Discuss such differences with particular reference to the traditional, prototyping and agile approaches.

SYSTEM DESIGN TOOLS FOR UNDERSTANDING, EXPLAINING AND DOCUMENTING THE OPERATION OF THE SYSTEM

The vital link between all the system's resources is the information processes, which will operate within the new system. Describing the detail of such processes is critical to all aspects of the design – including hardware purchases. As a consequence detailed models of the solution should be produced. In this course we examine a variety of design tools, namely context diagrams, data flow diagrams, decision trees and tables, data dictionaries and storyboards. It is vital to understand how to create, read and use the tools, as they will be utilised numerous times throughout the remainder of this course. In this section we introduce each tool with emphasis on their use as tools to assist in the design of new systems. In future chapters they will also be used to assist in understanding and explaining the operation of numerous existing systems.

Context Diagrams

Context diagrams represent the entire system as a single process. They do not attempt to describe the information processes within the system; rather they identify the data entering and the information leaving the system together with its source and its destination (sink). The sources and sinks are called "external entities". As is implied by the word external, these entities are present within the system's environment. Context diagrams are really top-level data flow diagrams and are often known as level 0 data flow diagrams.

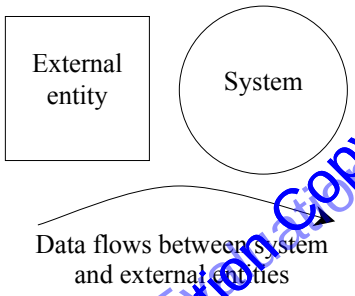


Fig 2.3
Symbols used in context diagrams.

Squares are used to represent each of the external entities. Common examples of external entities include users, other organisations and other systems. These entities are not part of the system being described, as they do not perform any of the system's information processes. Rather the system acquires (collects or receives) data from each source entity and/or the system supplies (displays or transmits) information to each sink entity. The entire system is represented using a circle, with labelled data flow arrows used to describe the data and its direction of flow between the system and it's external entities. Data flows from each source into the system, and data (information) flows from the system to each sink.

Each data flow label should clearly identify the nature of the data using simple clear words. Remember each data flow describes data not a process, for example if a user enters a password then an appropriate data flow label would be "User password", not "Enter password". Furthermore in this example each user is the source of a single password, so "User password" is a more appropriate label than "User passwords". If many data items flow together then a plural label would be more appropriate, however in most systems this is a rare occurrence.

The systems participants require special consideration as they are part of the system – participants are a special class of user who carry out the information processes within the system. As participants are part of the system they are not automatically included as external entities. It is only when the participants also supply the system with data or receive information from the system that they become external entities – in essence they are also acting as more general users. For instance, within the new Pet Buddies system Iris and Tom are clearly participants, they initiate and perform many information processes. However Iris and Tom view the draft activity reports, make edits to these reports and approve each activity report. It is often helpful to try to separate data and processes within your mind. The system displays (process) each

draft activity report (data) to Iris and Tom hence they are a sink. The system collects (process) edited activity data (data) and approval for activity reports (data) from Iris and Tom hence they are also a data source. All data entering the system and all data (information) leaving the system must be included on the context diagram. All processes performed by the system are part of the single system circle and are not detailed on the context diagram.

So how does a context diagram assist the design process? Context diagrams indicate where the new system interfaces with its environment. They define the data and information that passes through each interface and in which direction it travels. Descriptions of this data and information is further detailed within a data dictionary. Ultimately the data entering the system from all its sources must be sufficient to create all the information leaving the system to its sinks.

Consider Pet Buddies Pty. Ltd.

Recall that solution option B (refer page 51) has been accepted. Fred is now commencing work on the design of the new activity report creation system. He has developed the context diagram reproduced in *Fig 1.24* below.

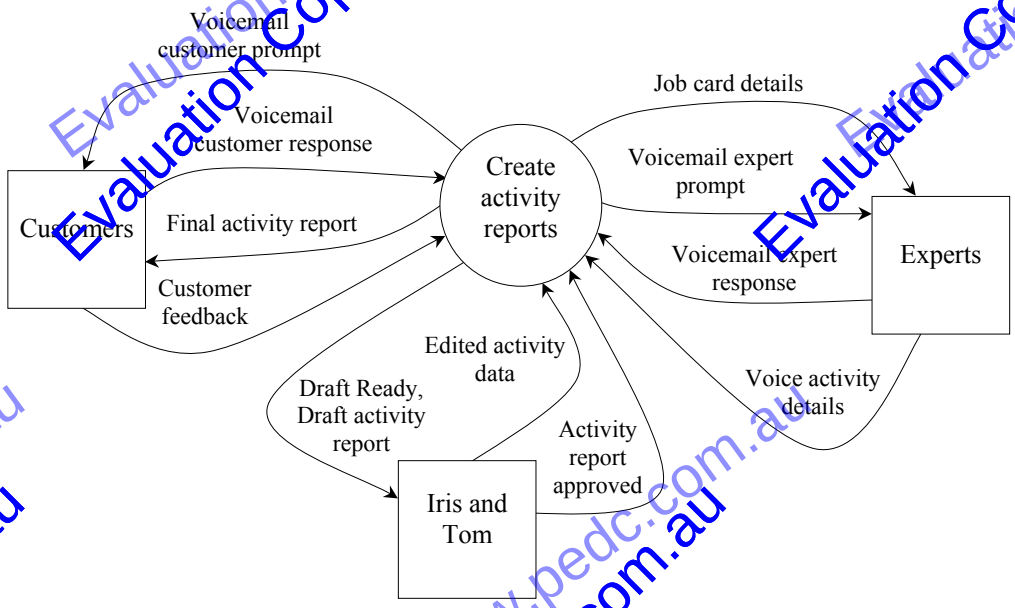


Fig 1.24
Context diagram for Pet Buddies new information system.

GROUP TASK Discussion
Analyse the above *Fig 1.24* context diagram in relation to the Option B solution outline on page 51.

Data Dictionaries

Data dictionaries are used to detail each of the data items used by the system. They are tables where each row describes a particular data item and each column describes an attribute or detail of the data item. Clearly the name or identifier given to the data item must be included, together with a variety of other details such as its data type, storage size, description and so on.

Data dictionaries are often associated solely with the design of databases where they are used to document details of each field. Commonly such details include at least the field name, data type, data format, field size, description and perhaps an example.

However data dictionaries are also used in conjunction with many design tools. For instance a data dictionary can be used to specify details of each data flow used on context and data flow diagrams. The details specified for each data item should be selected to suit the purpose for which the data dictionary is created. Context diagrams describe an overall view of the system and hence specifying the data type, a description and perhaps an example will likely suffice. When designing a database much more detailed specifications are needed, including the previously mentioned details and possibly other additional detail such as data validation, default value, whether it is key field and so on. Software developers also use data dictionaries to document all the variables and data structures within their code.

Consider Pet Buddies Pty. Ltd.

Fred has created the following data dictionary to document his context diagram.

Data Flow Name	Media/Data type	Description
Job card details	Hardcopy text	A printed report containing the customer's details and the activities to be completed by the expert during each home care visit.
Voicemail expert prompt	Analog Audio	Synthesised voice used to prompt expert for input.
Voicemail expert response	Numeric	Response from expert entered using telephone keypad.
Voice activity details	Analog Audio	Analog voice recording via expert's telephone.
Draft ready	Boolean	Used to alert Iris and Tom that a draft activity report is waiting for editing and approval.
Draft activity report	Digital Audio	Digital recording of a total activity report prior to its approval.
Edited activity data	Digital Audio	Voice recording from Iris or Tom to replace portions of the draft activity report.
Activity report approved	Boolean	Approval for activity report to be made available to the customer.
Voicemail customer prompt	Analog Audio	Synthesised voice used to prompt customer for input.
Voicemail customer response	Numeric	Response from customer entered using telephone keypad.
Final activity report	Analog Audio, or Facsimile	The final activity report received by the customer. Could be over the telephone or could be a faxed version created by the speech recognition engine and associated software.
Customer feedback	Analog Audio	Analog voice recording via customer's telephone.

Fig 1.25
Data dictionary accompanying Pet Buddies' context diagram.

GROUP TASK Discussion
With reference to the *Fig 1.24* context diagram, identify the outputs from the new Pet Buddies system. Analyse each output to determine the inputs that are processed by the system to produce each of these outputs.

GROUP TASK Discussion
Describe the nature of the interfaces between the system and each of the three external entities. Refer to both the context diagram (*Fig 1.24*) and the data dictionary (*Fig 1.25*) to justify your responses.

Data Flow Diagrams (DFDs)

DFDs do not attempt to describe the step-by-step logic of individual processes within a system. Rather they describe the movement and changes in data between processes. As all processes alter data then the data leaving or output from a process must be different in some way to the data that entered or was input into that process. This is what all processes do; they alter data in some way. The aim of DFDs is to represent systems by describing the changes in data as it passes through processes. For example a process that adds up numbers receives various numbers as its input and outputs their sum. On DFDs there is no attempt to describe how the numbers are summed. Rather the emphasis is on where the numbers come from and where the sum is headed.

To represent the data moving between processes we use labelled data flow arrows. The label describes the data and the direction of the arrow describes the movement. Processes are represented using circles. The label within the circle describes the process. As processes change data the labels used should imply some action – verbs should be used, such as create, update, collect, to emphasise that some action is performed.

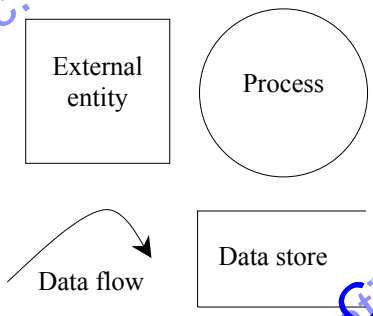


Fig 1.26
Symbols used on data flow diagrams.

The final symbol used on DFDs represents data stores. A data store is where data is maintained prior to and after it has been processed. In most cases a data store will be a file or database stored on a secondary storage device, however it could also be some form of non-computer storage such as a file within a filing cabinet. An open rectangle together with a descriptive label is used to represent data stores. Data stores allow the system to pause or halt between processes and they also allow processes to occur in different sequences and at different times. In effect processes are freed to execute independently of each other. Consider a typical process that collects data from a user and stores it within a data store. This single process can execute many times simultaneously whilst at other times it sits idle. The data is maintained within the data store where it can be retrieved and used by other processes when and as they require.

Context diagrams are top-level data flow diagrams, also called level 0 DFDs. They specify all external entities with the complete system represented as a single process. A level 1 data flow diagram expands this single process into multiple processes. A series of Level 2 DFDs are drawn to expand each level 1 DFD process into further processes. Level 3 DFDs similarly expand each level 2 process and so on. A series of progressively more and more detailed DFDs refine the system into its component sub-processes. Eventually the lowest level DFDs will contain processes that can be solved independently. Breaking down a system's processes into smaller and smaller sub-processes is known as 'top-down design'. The component sub-processes can be solved and even tested independent of other processes. Once all the sub-processes are solved and working as expected they combine to form the complete solution.

On some level 1 and lower-level DFDs the external entities are included, whilst on others they are not. If a context diagram has already been produced or external entities have been included on a higher-level DFD then it is common practice to omit the external entities from the derived lower-level DFDs. A similar practice is also true for data stores, however in the interest of improved clarity it is more common to reproduce data stores on lower-level DFDs. To improve clarity it is also permissible to include the same external entity or data store multiple times within the same DFD.

For instance, in *Fig 1.27* below the "Widget Sales Team" entity is included twice simply to improve readability. This DFD could easily be reformatted using a single "Widget Sales Team" entity with both data flows attached.

On most DFDs the processes are numbered in addition to their labels. Consider the example level 1 DFD in *Fig 1.27* – it contains the three processes, 1. Filter sales records, 2. Calculate widget statistics and 3. Produce widget sales graphs. Three level 2 DFDs would then be produced – one for each process in the level 1 DFD. *Fig 1.28* shows an expansion of process 2. Calculate widget statistics into a level 2 DFD containing four processes. These four processes are numbered from 2.1 to 2.4 – the 2 indicating their connection to process 2 on the level 1 DFD. If process 2.1 required further expansion into a level 3 DFD then its processes would be numbered 2.1.1, 2.1.2, 2.1.3 and so on.

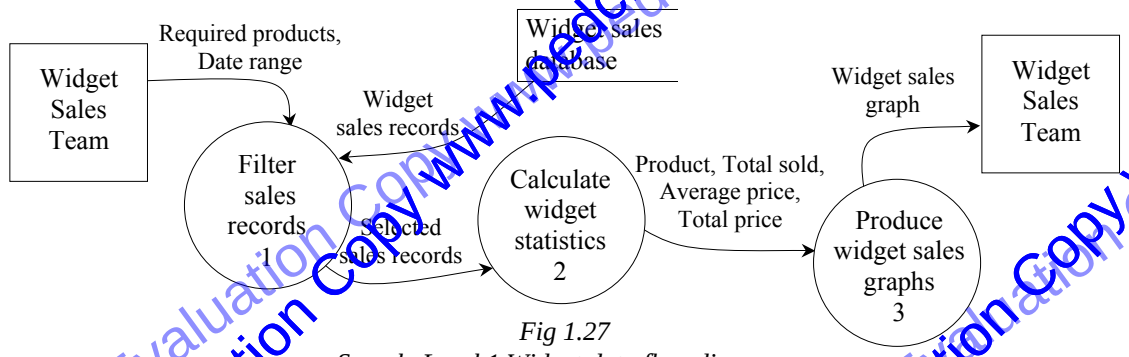


Fig 1.27
Sample Level 1 Widget data flow diagram.

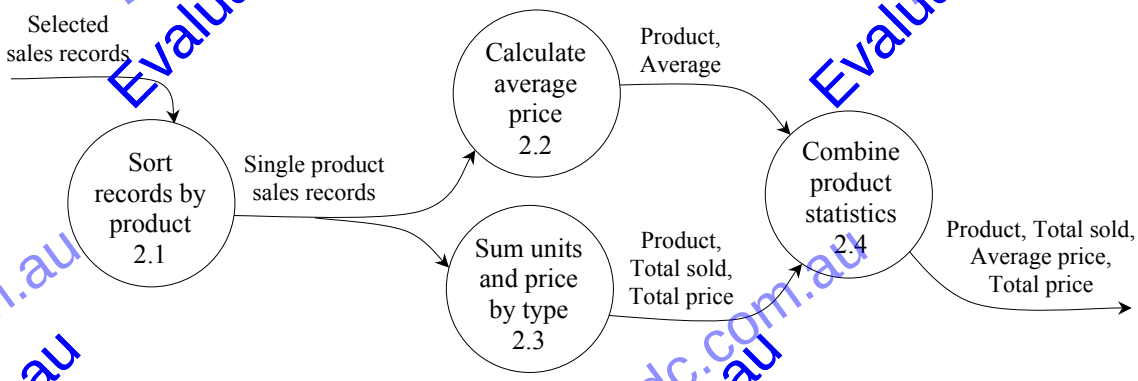
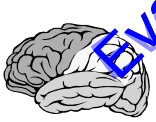


Fig 1.28
2. Calculate widget statistics DFD.

Consider the following DFD summary points:

- All processes must have a different set of inputs and outputs.
- All lower-level DFDs must have identical inputs and outputs as the higher-level process they expand.
- External entities and data stores can be reproduced on lower-level DFDs.
- External entities must be present on context diagrams (level 0 DFDs) but are optional on lower-level DFDs.
- A single output data flow can be the input to multiple other processes.
- Labels for processes should include verbs that describe the action taking place.

GROUP TASK Activity
Identify examples within *Fig 1.27* and *Fig 1.28* above that illustrate each of the above dot points.



Consider Pet Buddies Pty. Ltd.

Fred has further refined the context diagram in *Fig 1.24* into the more detailed level 1 DFD reproduced below in *Fig 1.29*. Within the DFD Fred has deliberately split the system into four independent processes. Once operational each of these processes can occur at different times or they could occur at the same time. For instance, process 1 outputs "Draft ready", which is used to alert Iris and Tom via a message displayed on their screens that an activity report is awaiting approval, however there is no requirement that they respond to this message and complete process 2 immediately.

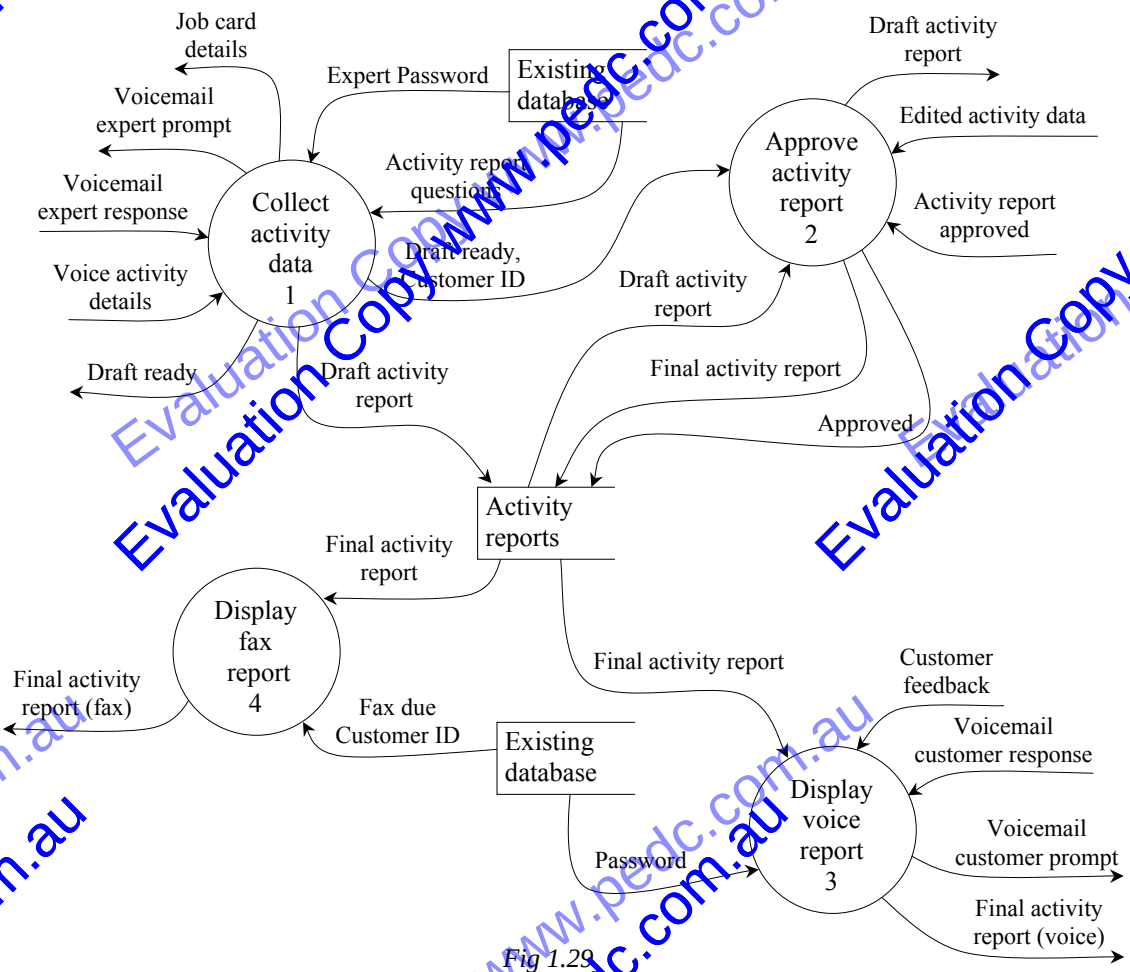


Fig 1.29
Pet Buddies level 1 DFD.

Process 1 and 3 will be performed by the voicemail application. Essentially process 1 involves the expert recording their responses to each question in the activity report. The resulting audio files are stored in the customer's mailbox within the activity reports data store. At this stage they are marked as drafts – process 2 approves these drafts. In process 3 customers essentially access their mailbox and listen to their messages, which are the final voice activity reports. Process 4 periodically checks for any fax reports that are due. When such a report is identified it is converted to text and faxed to the customer.

As the voice mail software operates using multiple phone lines, it is possible for multiple experts and customers to be using the system at the same time. That is, both process 1 and 2 can be executing simultaneously multiple times.

Process 4 requires the digital audio files to be converted into text and then faxed. The development of the software for performing this process is to be outsourced to a

Pages 71 to 80

Not included in this Evaluation Copy

GROUP TASK Discussion
Guided processes are often composed of a sequence of steps. Outline typical steps required to complete each of the above guided processes.

HSC style question:

A bank's loan approval system uses the following decision table as the basis for deciding on the type of loan granted to home buyers. Each home buyer submits their income and the purchase price, whilst the bank's existing system provides the current total in the home buyer's accounts together with their repayment history.

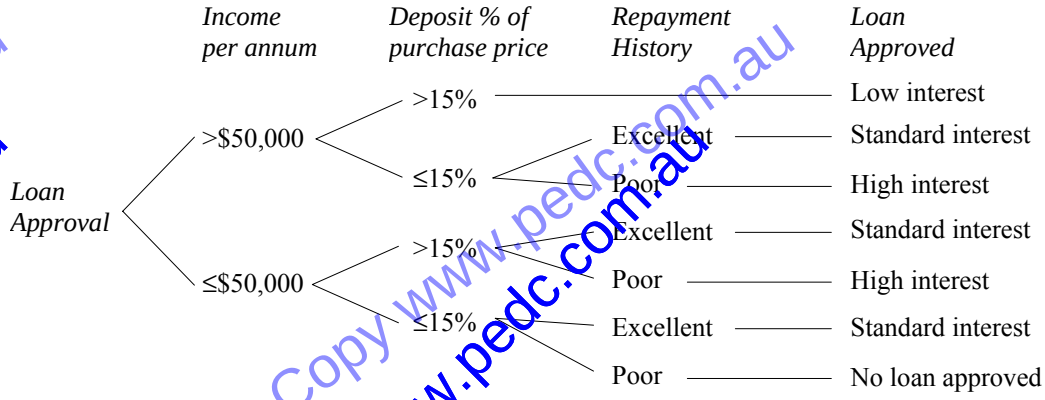
Conditions	*Rules*							
Income >$50,000 per annum	✓	✓	✓	✓	×	×	×	×
Deposit >15% of purchase price	✓	✓	×	×	✓	✓	×	×
Excellent repayment history	✓	×	✓	×	✓	×	✓	×
Actions								
Approve low interest loan	✓	✓	×	×	×	×	×	×
Approve standard loan	×	×	✓	×	✓	×	✓	×
Approve high interest loan	×	×	×	✓	×	✓	×	×

(a) Construct a suitable decision tree for this decision.

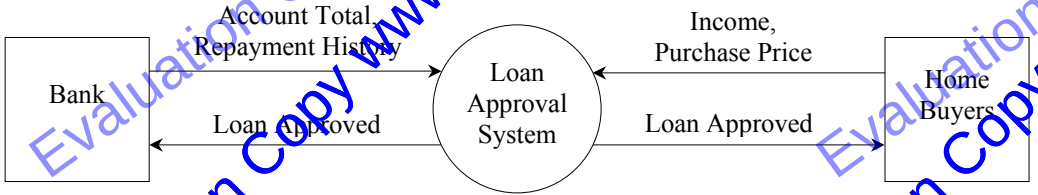
(b) Construct a context diagram for the bank's loan approval system.

Suggested Solution

(a)



(b)



Comments

- In an HSC or trial HSC examination each part would likely attract 3 marks.
- In part (a) 8 rules have been reduced to 7. Using different sequences of conditions will yield slightly different rules. Is there a solution using less than 7 rules?
- In part (b) it is reasonable to assume both Bank and Home Buyer are informed of the Loan Approved.

SET 1D

1. Which of the following lists includes the resources used to perform the system's information processes?
   (A) Context diagrams, data flow diagrams and data dictionaries.
   (B) Participants, information technology and data/information.
   (C) External entities, processes and data flows.
   (D) Hardware and software.

2. Data flows on context diagrams always:
   (A) flow from a process into another process.
   (B) flow from an external entity into the system.
   (C) describe the processes occurring to transform data into information.
   (D) describe data moving to and from the system and its external entities.

3. A data flow diagram contains four processes that are numbered 4.2.1, 4.2.2, 4.2.3 and 4.2.4. What level data flow diagram is this an example?
   (A) 1
   (B) 2
   (C) 3
   (D) 4

4. What is the best reason why the outputs from a process must be different to the inputs into the process?
   (A) All data flows must have different labels.
   (B) All processes alter data in some way.
   (C) To simplify the construction of data dictionaries.
   (D) This is a requirement when constructing data flow diagrams.

5. Which tool would be most useful when designing the user interface?
   (A) Context diagram
   (B) Data dictionary
   (C) Decision tree or table
   (D) Storyboard

6. Which of the following best defines a sink?
   (A) An external entity that is not part of a system but supplies data to a system.
   (B) People who receive information from the system.
   (C) A process that gets input from the system but does not supply data to the system.
   (D) An entity that is external to the system which receives information from the system.

7. A table describing details of each data item processed by a system is known as a:
   (A) context diagram.
   (B) data dictionary.
   (C) data flow diagram.
   (D) decision tree.

8. Within a system, which of the following allows processing to pause?
   (A) External entities
   (B) Data flows
   (C) Processes
   (D) Data stores

9. In a decision table, rules are represented:
   (A) by each horizontal row.
   (B) by each vertical column.
   (C) as a sequence of conditions.
   (D) as sets of actions.

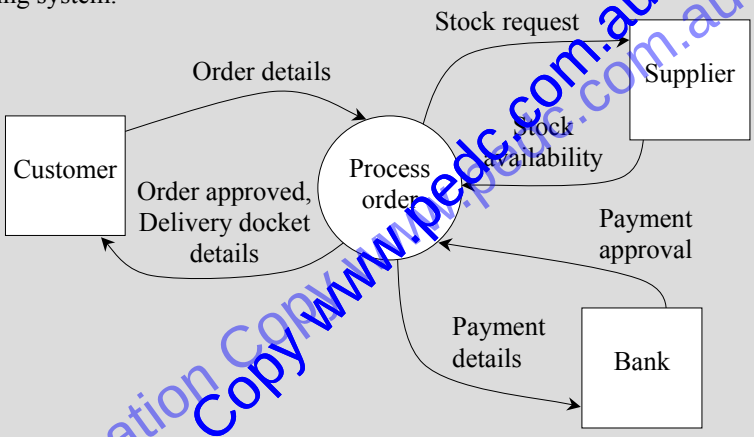
10. A decision is made based on whether an account is overdue, if the total owing on the account is greater than $1000 and whether the customer is "Trusted". Which of the following is TRUE when constructing a decision tree for this decision?
    (A) Exactly 8 unique branch sequences are required.
    (B) At least 8 unique branch sequences are required.
    (C) 4 unique branch sequences are required.
    (D) A maximum of 8 unique branch sequences are required.

11. Define each the following and describe how they are included when constructing context and/or data flow diagrams.
    (a) External entities
    (b) Processes
    (c) Data flows
    (d) Data stores

12. Identify and describe factors that should be considered when choosing or designing information technology that affect the ability of the hardware or software to be maintained.

13. Construct a context diagram for the following systems.
    (a) A handheld GPS system gets location data from satellites and the final destination from the user. The system then directs the user to their destination.
    (b) A booking system is being developed for an upcoming conference. The system receives online bookings from conference delegates, sends payment details to PayPal for processing and approval, and then sends each delegate an email to confirm details of each booking has been made and payment has been completed.

14. Consider the following context diagram that models the flow of data to and from a company's ordering system.



To process an order the order details are used to determine the total cost of the order using data from the company's product orders database. This database is also used to determine if the warehouse already holds sufficient stock of each product. If new stock needs to be ordered then a stock request is sent to the appropriate supplier who returns details in regard to availability of the product. Assuming all products are available the system sends the payment details to the bank for processing and approval. Orders are only approved and stored in the orders database if all products are available and payment has been approved. When all products are present in the warehouse the order is delivered together with a delivery docket.

(a) Expand the context diagram into a level 1 data flow diagram.
(b) Create a data dictionary for your level 1 data flow diagram.
(c) Construct a decision table to model the decision to approve or not approve each order.

15. A salesman is developing a customer database to store details of each of their potential and actual customers. When a customer phones the salesman first wishes to check if they are already in the database. This involves searching on the customer's name, phone number and also on their address. If any of these details match then the existing record is updated as needed. If no match is found then a new record is created. Each record includes the customer's surname, first name, phone number, email address and postal address.
    (a) Design a screen or screens for this system using a storyboard. If your design includes more than one screen ensure you include the navigational links between the screens.
    (b) Construct a decision tree to model the decision resulting in actions to either add a new record or update an existing record.
    (c) Create a data dictionary for the customer database.

IMPLEMENTING

This fourth stage of the system development lifecycle is where the new system is installed and commences operation. The old system ceases operation and is replaced with the new system. There are various different methods for performing this conversion. However, all these conversion methods require a similar set of tasks to be documented and then completed prior to the system commencing operation. The details are specified within an implementation plan. Typical implementation steps include:

1. Installing network cabling and outside communication lines.
2. Acquiring and installing new hardware and software.
3. Configuring the new hardware.
4. Installing and configuring the software.
5. Converting data from the old system to the new.
6. Training the users and participants.

GROUP TASK Discussion
Do the 6 steps above need to be completed in the precise order they are listed? Justify and explain your answer.

In this section we first consider the content of a typical implementation plan, we then consider four common methods of implementing or converting from an old system to a new system. Finally we discuss techniques for training users and participants to operate and understand the new system.

IMPLEMENTATION PLAN

Many people and organisations are involved in the implementation of most new information systems. For example organisations that supply and deliver the hardware, technicians who install communication and other hardware and the people who install, configure and test the operation of the software. There also trainers who teach the participants to use the new system and also the participants themselves. All these people must be organised so they complete their tasks in the correct sequence and at the correct time. For this to occur requires planning.

A typical implementation plan should consider and document in advance solutions to the following questions:

- How and when the participants are to be trained to operate the new system. Will there be formal training sessions in advance of the system being installed? Will the training be onsite or offsite? Will specialist trainers be employed or will members of the development team perform this function? Will an operational manual be produced that details specific procedures participants should follow? How will other work be completed whilst participants are being trained?
- The method of converting from the old system to the new system. Is it acceptable for no system to operate during installation? Should or can both old and new systems remain operational until the operation of the new system is ensured? What happens if something goes wrong during conversion? What conversion tasks need to be completed and in what order? How will conversion affect other systems that are operating? Can conversion occur outside normal working/office hours?
- How the system will be tested. Is sample data available for onsite testing? When and which parts of the system will be ready for testing? Consider testing each system component independently as it is installed, then test the larger system as components are connected. Schedule and plan for testing throughout installation –

both hardware and software testing. Consider creating a backup plan in the event some components fail.

- Conversion of data for the new system. Often data within the existing system will need to be converted to operate with the new system. Are automated processes available to simplify such data conversion? How long will data conversion take? How accurately can the data be converted? Will the existing system remain operational? Does the new system access and process the same data as the existing system? If so will the old processes affect the new, or the new processes affect the old? What happens to data that is processed whilst data conversion takes place?

The implementation plan should address the above issues. Think of the implementation plan as a project plan that identifies the tasks, people, processes, timing and also cost of the system's implementation.

GROUP TASK Discussion
Consider the implementation of an information system into a new fast food outlet. The system includes a LAN with six point of sale terminals and five other computers and printers. The system uses proprietary software used by all stores within the fast food chain. Discuss the implementation plan for this system with reference to the above points.

METHODS OF CONVERSION

There are a number of methods of introducing a new system and each of these methods suits different circumstances. Usually implementation of a new system includes converting from an old system to the new system.

We consider the following four methods of conversion:

- Direct conversion
- Parallel conversion
- Phased conversion
- Pilot conversion

Direct Conversion

This method involves the old system being completely dropped and the new system being completely implemented at a single point in time. The old system is no longer available. As a consequence, you must be absolutely sure that the new system will operate correctly and meet all of its requirements. Furthermore full and complete testing at the time of installation is needed to confirm that all components are indeed operating as expected. It is particularly important to anticipate and plan for possible faults – perhaps ensuring replacements are readily available or having duplicates on hand for any critical components.

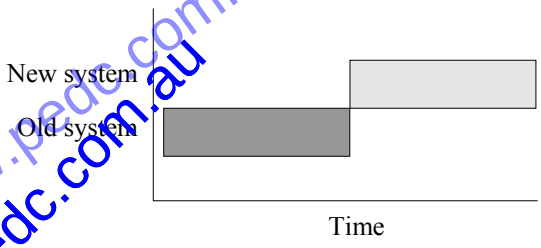


Fig 1.36
Direct conversion method of implementation.

The direct conversion method is used when it is not feasible to continue operating two systems together, for example it may be impractical for large amounts of data to be entered into two systems. Any data to be used in the new system must be converted and imported from the old system. Often neither system operates whilst this conversion takes place – a suitable quiet time should be chosen or perhaps temporary manual processes can be used. Participants must be fully trained in the operation of the new system before the conversion takes place.

Parallel Conversion

The parallel method of conversion involves operating both the old and new systems together for a period of time. This allows any major problems with the new system to be encountered and corrected without the loss of data. Parallel conversion also means users of the system have time to familiarise themselves fully with the operation of the new system. In essence, the old system remains operational as a backup for the new system. Once the new system has been fully tested and is found to be meeting requirements then operation of the old system can cease. The parallel method often involves double the workload for participants as all tasks must be performed using both the old and the new systems.

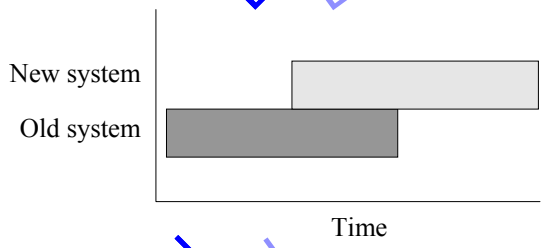


Fig 1.37
Parallel conversion method of implementation.

Parallel conversion is especially useful when the processing is of a crucial nature. That is, dire consequences would result if the new system were to fail. By continuing operation of the old system, the crucial nature of the data is protected.

Phased Conversion

The phased method of converting from an old system to a new system involves a gradual introduction of the new system whilst the old system is progressively discarded. This can be achieved by introducing new parts of the new product one at a time while the older parts being replaced are removed.

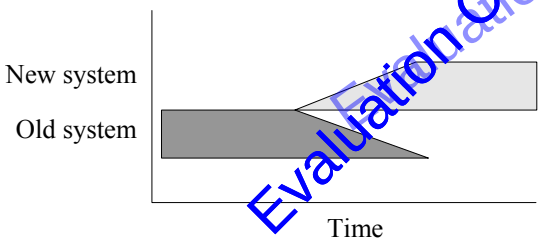


Fig 1.38
Phased conversion method of implementation.

Often phased conversion is used because the system, as a whole, is still under development. When agile methods are used to develop the software a phased conversion is often appropriate. Completed sub-systems are released to customers as they become available. Phased conversion can also mean, for large organisations, that the conversion process is more manageable. Parts of the total system are introduced systematically across the organisation, each part replacing a component of the old system. Over time the complete system will be converted.

Pilot Conversion

With the Pilot method of conversion the new system is installed for a small number of users. These users learn, use and evaluate the new system. Once the new system is deemed to be performing satisfactorily then the system is installed and used by all. This method is particularly useful for systems with a large number of users as it ensures the system is able to operate and perform correctly in a real operational setting. The pilot method also allows a base of users to learn the new system. These users can then assist with the training of others during the systems full implementation. The pilot conversion method can be used as the final acceptance testing of the product. Both the developers and the customer are able to ensure the system meets requirements in an operational environment.

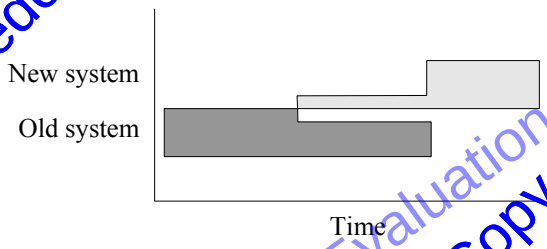
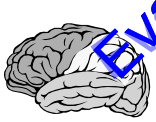


Fig 1.39
Pilot conversion method of implementation.



Consider the following scenarios:

1. A large restaurant is implementing a new information system. There are essentially four sub-systems that interface together to operate the functions of the restaurant – point of sale, accounting, wages and ordering/stocktaking.
2. Chemsoft is a company that specialises in information systems to support the operations of pharmacies. They currently have around 4000 chemists using their system. Chemsoft constantly works on upgrading their software to include new functions and correct bugs. As each upgrade is completed, it needs to be distributed to each chemist for installation. In general upgrades are produced and need to be distributed approximately 3 times per year.
3. A bank is introducing a new Automatic Teller Machine into many of its suburban branches. This new ATM includes a colour touch screen together with various enhanced security features. The software that controls the ATM has been thoroughly tested.
4. Five new computer-controlled life support systems have been purchased by a hospital for use in their intensive care unit. The systems have been used successfully in hundreds of hospitals across the world. The life support systems monitor a patient's temperature, blood pressure and various other vital signs. When an irregularity is detected, the medical staff are alerted electronically. However, the medical staff at the hospital are sceptical, they wish to continue manually monitoring each patient's vital signs and recording them on a paper chart on the end of each patient's bed.
5. Digital mobile phone networks are now the only type of mobile network available in Australia. Digital mobile networks were introduced in Australia in the early 1990s, however the old analog mobile networks were only taken out of service in the late 1990s. Both systems operated together for some 5-10 years.

GROUP TASK Discussion
Identify and justify a suitable method of converting the old system to the new system for each of the above scenarios. Note that it is possible for any combination of conversion techniques to be used.

IMPLEMENTING TRAINING FOR PARTICIPANTS AND USERS

Successful training requires motivated learners. Even the best trainers, using fantastic training techniques and materials will fail if the learners are simply not motivated. For example, nearly all of us complete subjects at school that we are not really enthused about. As a consequence learning in these subjects is an effort. In contrast, even the most unmotivated student is able to learn incredible amounts of information about their favourite hobby or sport. When people are motivated about a subject they actively seek out information often without prompting. This is not to say that the training methods used are insignificant, rather the point is that motivated learners are vital if the training methods are to be a success.

GROUP TASK Discussion
Choose a subject where some of the class is motivated to learn whilst others are not. Identify reasons for each individual's level of motivation. (Don't choose IPT, as no doubt everyone is highly motivated!)

In regard to new information systems, the learners are the participants and the users. These people are likely to be motivated learners when they:

- are open to change.
- understand how the new system will meet their needs.
- have provided input that has been acted upon during the development of the system.
- have an overall view of the larger system and how their particular tasks will assist in achieving the system's purpose.

These characteristics are achieved through continuous two-way communication throughout the SDLC. For example, if a user has provided an idea during the development process then they should receive feedback regardless of whether the idea has been implemented or not. Indeed feedback on ideas that have not been included is particularly important. Most people will accept rejection if they can see their ideas were considered and that there is a logical reason their ideas were not included.

Let us assume the participants and users are on the whole motivated. We still need to implement some formal training to enable them to commence operating the new system. Some possible training techniques include:

- **Traditional group training sessions**

The trainer can be a member of the system development team or an outsourced specialist trainer. If the software has been purchased with little modification then an outsourced training specialist is likely to provide a better service due to their intimate knowledge of the software. If the software has been customised then a member of the development team is perhaps a better choice. In either case the training can be performed onsite or at a separate premises. Onsite group training can often lead to problems as apparently urgent, but unrelated matters, often interrupt the sessions. Off site training allows participants to focus more fully on the training.

- **Peer training**

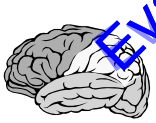
One or more users undergo intensive training in regard to the operation and skills needed by the new system. These users are also trained in regard to how to train others to use the system. The trained users are then used to train their peers. Peer training is often a one-to-one process. The trained user is essentially an onsite expert who works alongside and assists other users as they learn the skills to operate the new system. This technique allows users to learn skills as they are required over time.

- **Online training such as tutorials and help systems**

Online tutorials and help systems allow users to learn new skills at their own pace and as they are needed. It is common for larger systems to be provided with a complete tutorial system. Such systems include sample files and databases that can be manipulated and changed without fear of altering or deleting the real data. Many help systems are now context sensitive. This means they display information relevant to the task being completed.

- **Operation manuals**

Printed operation manuals contain procedural information similar to many online tutorial and help systems. However, operation manuals describe step-by-step instructions specific to the new system. For instance, detailed instructions on how to perform backups, how to add a new customer account or what to do if a product is returned. Such processes likely include both manual and computer-based tasks that differ according to the policies of the organisation. We discuss operation manuals in more detail in the Testing, evaluating and maintaining section later in this chapter.



Consider Pet Buddies Pty. Ltd.

Pet Buddies new system is about to be implemented. Fred, Iris and Tom are discussing the most appropriate method of conversion. The following comments are made during their conversation:

Fred *The speech recognition and faxing software is still not complete. The software developer needs another 3 weeks to complete her work. I think we can go ahead regardless.*

Iris *Some of the experts are over 60 years old. I think it will take them some time to feel comfortable talking to a computer. Also, some customers have expressed their concern in regard to the security of the new system.*

Tom *Do we really need to collect all the activity reports using the new system straight away? We can easily continue using the manual system and just mark reports as done on the computer system.*

Fred *You're going to lose two of your voice telephone lines, so you can't have too many experts continuing to use the old system for long. Also it will be difficult to inform customers. Some will dial the old number and others will need to call the new voicemail number.*

Tom *Iris and I are still unclear about why we need the new RAID device. Our existing server is secure, we're not sure why we can't simply added extra storage.*

Fred *It's about fault tolerance and performance. Each hardware system operates independently. If one fails then the other can continue. Furthermore the amount of audio data stored is enormous compared to your existing database. There is no need for the audio data to be totally secure, it will not contain any personal customer information.*

Iris *I'm nervous about understanding how to use the voicemail software. I'd like someone from Telesound to come out and do some intensive training with us.*

Fred *A technician is coming out to configure the voicemail software a few days before the system goes live. They have requested we all be present to answer any questions they may have. In the afternoon the technician will provide us with a hands-on training session. We can always book further training, if needed.*

Tom *We'll have to inform our customers of the changes. We'll create a brochure that includes a step-by-step explanation of the voicemail operation. The experts can give out the brochure when they're doing each quotation. In this way customers can ask questions face-to-face.*

GROUP TASK Discussion
Recommend a suitable method for converting form Pet Buddies old system to their new system. Use evidence from the above conversation to justify your recommendation.

GROUP TASK Discussion
Explain how Iris and Tom, the experts and Pet Buddies' customers can best be trained to use the new system.

TESTING, EVALUATING AND MAINTAINING

Testing, evaluating and maintaining is the fifth and final stage of the software development lifecycle (SDLC). Unlike the previous stages of the SDLC, aspects of this final stage continue throughout the life of the system.

Tasks included in the testing, evaluating and maintaining stage include:

- testing to ensure the system meets requirements,
- trialling and using the operation manual,
- ongoing evaluation to monitor performance,
- ongoing evaluation to review the effect on users, participants and people within the environment,
- maintaining the system to ensure it continues to meet requirements, and
- modifying parts of the system where problems are identified.

GROUP TASK Discussion
Testing and evaluation occurs throughout all stages of the SDLC. Identify examples of testing and evaluation used during each preceding stage.

TESTING TO ENSURE THE SYSTEM MEETS REQUIREMENTS

The testing, evaluating and maintaining stage commences with formal testing of the operational system to ensure it meets the requirements specified in the Requirements Report – this is known as acceptance testing. Once the tests confirm the requirements have been met the system is signed off as complete. The client and the system developers usually agree to use the results of the acceptance tests as the basis for determining completion of the new system. If the tests are successful then the client makes their final payment and the development team's job is complete.

Acceptance Tests
Formal tests conducted to verify whether or not a system meets its requirements. Acceptance testing enables the client to determine whether or not to accept the new system.

For large-scale information systems acceptance testing is best performed by an outside specialist testing organisation. Even for smaller systems it is preferable for acceptance tests to be performed by people who were not involved in the system's development. People involved in the system development process are likely to be biased. They have designed and implemented the new system, so clearly they will feel the requirements have been met. Furthermore they will, unsurprisingly, view their particular solution as superior to other possibilities.

Although using outside testers are preferable, it is not unusual for the client to perform their own acceptance tests prior to finally accepting and signing off the new system. This is understandable, given that all systems are ultimately developed to meet the needs of clients. Unfortunately disagreement between the clients view of an acceptable system can differ from the views of the developers. It is preferable to agree on the precise nature of the testing and who will perform the tests early in the SDLC – in terms of the traditional development approach this should occur during the creation of the Requirements Report. This can easily become a significant problem with less structured development approaches.

The system is tested and evaluated using a variety of different tests and test data including volume data, simulated data and live data. Such tests ensure the system will meet all system requirements when operational.

Pages 91 to 100

Not included in this Evaluation Copy

Suggested Solution

(a) There are five inputs into the system, namely:
- Satellite photos – bitmap images that are of sufficiently high resolution that areas of less than 1 square metre can be analysed with accuracy.
- Rainfall data – dates and rainfall for each day.
- Temperature data – dates and temperature readings for each day.
- GPS coordinates – numeric data specifying the current location of the tractor.
- Sensor data – numeric data describing the soil chemistry at the tractor's current location.

(b) The tractor contains the following information technology:
- A GPS transmitter/receiver to determine its current location.
- Sensors that are able to detect differences in soil chemistry.
- Actuators to adjust the rate of each treatment applied.
- An on board computer and software to perform both the Apply treatments process and the Determine and store chemistry data process.
- A hard disk or other secondary storage device that holds both the Application times and rates data store and the Soil chemistry data store.

(c) The soil chemistry data is collected at a completely different time to when it is used to generate the environmental conditions. This means it must be stored during the intervening period of time. Also the Soil Chemistry data is collected during the operation of the tractor, hence a data store is needed so that the data is maintained for later copying to the farmer's computer. The Application times and rates data is generated by the farmer's computer, but is used during the tractor's operation. Using a file means that the system can halt whilst the data is transferred to the tractor.

(d) A two stage phased strategy for conversion could be used. Firstly the parts of the system that do not require the tractor could be implemented. These processes are software based and hence the cost would be minimal compared to the large capital required to purchase the specialised tractor hardware. A sample of the application times and rates output from the system can then be analysed on site by the farmer using his experience and a hand held GPS device. If the farmer agrees with the data then the final more expensive phase can be implemented.

Comments
- In an HSC or Trial HSC examination each part would likely attract 3 or 4 marks. Hence this would be a significant question worth a total of 12 to 16 marks.
- In part (a) the inputs to the system are all data flows commencing from an external entity.
- In part (b) and also in part (c) it is possible to assume a wireless link exists between the tractor and another computer. If this were true then the data stores would be on the other computer and the tractor would require wireless communication devices and related software. This would also be reflected in answers to part (c).
- In part (d) a number of different conversion methods could be proposed and justified. For instance direct conversion could be used, with justification based on the fact that the system has already been implemented on other farms. Parallel conversion could also be argued whereby the farmer uses the new system on some paddocks and his old system for others. This would allow him to assess the advantages of the new system for his particular property. Marks would be awarded for a logically justified conversion strategy.

SET 1E

1. Which document details training, testing and conversion of the existing system and data to the new system?
   (A) Project plan.
   (B) Implementation plan.
   (C) Requirements report
   (D) Operation manual

2. Both old and new systems operate together for some time when which method of conversion is used?
   (A) Parallel
   (B) Direct
   (C) Phased
   (D) Pilot

3. Parts of a new system are introduced over time when which method of conversion is used?
   (A) Parallel
   (B) Direct
   (C) Phased
   (D) Pilot

4. Training participants to use the new system should occur during which stage of the system development lifecycle?
   (A) Planning
   (B) Design
   (C) Implementation.
   (D) Testing, evaluating and maintaining

5. Which of the following best describes "acceptance testing"?
   (A) Tests conducted to ensure the system meets requirements so the client will accept the new system as complete.
   (B) Formal tests to ensure the new system interfaces correctly with other existing systems.
   (C) A series of predetermined tests that are formally undertaken to monitor the ongoing performance of the system.
   (D) Ongoing evaluation to monitor the financial benefits of a new system.

6. Testing to verify that the system meets requirements when subjected large amounts of data is known as:
   (A) acceptance testing.
   (B) volume testing.
   (C) simulated testing.
   (D) live testing.

7. Which of the following best describes the use of sample files as participants learn to perform the new system's processes?
   (A) Peer training
   (B) Context sensitive help
   (C) Online tutorial
   (D) Procedural help

8. Testing to ensure the system performs when many different processes are occurring together is best achieved using:
   (A) volume tests
   (B) simulated tests
   (C) live tests
   (D) acceptance tests

9. Which document describes participant procedures for completing tasks specific to the new information system?
   (A) System models
   (B) Implementation plan
   (C) Requirements report
   (D) Operation manual

10. Which term describes the ongoing assessment of a system to monitor the extent to which it continues to meet requirements?
    (A) Maintenance
    (B) Testing
    (C) Evaluation
    (D) Ergonomics

11. Describe the typical content of each of the following documents.
    (a) Implementation plan
    (b) Operation manual

12. Distinguish between volume data, simulated data and live data.

13. Describe each of the following methods of conversion and provide an example situation where each would be suitable.
    (a) Parallel conversion
    (b) Direct conversion
    (c) Phased conversion
    (d) Pilot conversion

14. Describe different techniques for training participants to use a new system.

15. Research and develop procedural documentation suitable for inclusion in an operation manual for each of the following tasks.
    (a) The steps performed when a new student enrols at your school.
    (b) The steps performed by a user as they list their first item on eBay.

CHAPTER 1 REVIEW

1. Management of projects is documented using:
   (A) Requirements reports
   (B) Operation manuals
   (C) Implementation plans
   (D) Project management tools

2. The benefits, risks and costs of possible solutions are assessed when:
   (A) analysing the existing system.
   (B) conducting a feasibility study.
   (C) creating system models.
   (D) interviewing and/or surveying users and participants.

3. A team can best be described as:
   (A) a group of people who work together
   (B) people with a similar set of skills and training who all work on a project
   (C) a mixture of skills, personality and behaviour types.
   (D) people with complimentary personality and behaviours who are committed to a common goal.

4. According to Tuckman's four stages of team development, when is conflict most likely to occur?
   (A) Forming
   (B) Storming
   (C) Norming
   (D) Performing

5. Which of the following development methods iteratively produces regular operational systems with progressively more functionality?
   (A) Agile methods
   (B) Traditional methods
   (C) Prototyping methods
   (D) Customisation

6. Where would team members document details of development tasks as they are completed?
   (A) Journal
   (B) Operation manual
   (C) Gantt chart
   (D) Communication management plan.

7. All context diagrams must contain which of the following?
   (A) A single external entity and one or more processes.
   (B) A single process and one or more external entities.
   (C) One or more external entities and one or more processes.
   (D) A single external entity and a single process.

8. Responding with words related to the speaker's message is an essential part of:
   (A) conflict resolution.
   (B) active listening.
   (C) negotiation.
   (D) project management.

9. Which is the most significant deliverable from the designing stage?
   (A) Requirements report
   (B) Gantt chart
   (C) System models
   (D) The new system

10. Details with regard to the operation of the existing system are most likely to be obtained from:
    (A) end-users
    (B) participants
    (C) the project manager
    (D) the development team

11. Describe the content of each of the following documents:
    (a) Funding management plan
    (b) Communication management plan
    (c) Feasibility study report
    (d) Requirements Report
    (e) Implementation plan

12. Describe the communication skills required to successfully manage the development of new information systems, including:
    (a) active listening skills
    (b) conflict resolution skills
    (c) negotiation skills
    (d) interview skills
    (e) team building skills

13. Summarise the essential features of each of the following system development approaches.
    (a) Traditional approach
    (b) Outsourcing
    (c) Prototyping
    (d) Customisation
    (e) Participant development
    (f) Agile methods

14. Recount the sequence of activities occurring during each of the following stages of the SDLC as a system is developed using the traditional system development approach.
    (a) Understanding the problem
    (b) Planning
    (c) Designing
    (d) Implementing
    (e) Testing, evaluating and maintaining

15. Create summaries describing points relevant to the production of each of the following system design tools.
    (a) Context diagrams
    (b) Data flow diagrams
    (c) Decision trees
    (d) Decision tables
    (e) Data dictionaries
    (f) Storyboards