8 Developing Information Systems

8.1 The systems development life cycle

The systems development life cycle (SDLC) is the classical approach used to develop information systems (Kroenke, 2007). The SDLC approach recognises that systems are developed in a series of steps or phases and that each phase needs to be completed before the next one commences. Recognition is also given to the fact that the programming activity (part of the build phase) should only commence once user requirements have been determined and the system design produced. We will now summarise the basic steps that most systems development projects follow.

8.1.1 Initiation

Initiation phase is the initiation or startup phase and is the first phase in an information systems development project. Its aims are to establish whether the project is feasible and then prepare to ensure the project is successful. The initiation phase contains the stimulus from which the need to develop a new BIS arises. This stimulus may come about as a result of some external event such as a change in legislation, or it may arise from a desire internally to develop an information system that better supports the business needs of the organisation. The source of this initiation process may be one of the following:

- *Managing director or other senior management*. Systems initiated from this point are likely to have the support necessary for successful development.

- *Information systems department*. A system may be initiated here as part of the organisation's overall IS/IT strategy; to maximise the chances of success the system will still need high-level management support.

- *Functional business area*. A system initiated here will be competing for attention with all other development projects then being undertaken; often an organisation will have a steering committee to decide on development priorities.

8.1.2 Feasibility assessment

Feasibility assessment is the activity that occurs at the start of the project to ensure that the project is a viable business proposition. The feasibility report analyses the need for and impact of the system and considers different alternatives for acquiring software. The feasibility assessment can be considered to be part of the *initiation phase*. It will establish whether a computer-based information system fits certain feasibility criteria. Three criteria are usually cited:

- It must be established whether the information system is technically feasible. To be technically feasible, either the technology exists or it can be created to support the required system.

- To be economically feasible, an information system must generate more in the way of benefits than the cost needed to produce it. One of the problems here is that benefits are often difficult to quantify in monetary terms, while costs are far easier to estimate.

- Assuming that a proposed information system is both technically and economically feasible, an assessment must be made of whether the project is operationally and organisationally feasible. By operationally feasible, we mean that the system must be capable of performing within the required speed, volume, usability and reliability parameters. Also, to be feasible for the organisation, the proposed information system must either be capable of running alongside work patterns or existing work patterns must be capable of being adapted or re-engineered to run alongside the new information system. Organisational feasibility will involve a review of how the potential users' skill sets and attitudes will affect the system.

Part of the feasibility process may be the invitation to tender for some or all of the information system elements. These may include application software, hardware, communications technology or systems software. Different alternatives from different vendors will then be assessed.

The output from this step (and, therefore, the input to the next step of the model) is a stage review and a feasibility report, which will recommend either that the project proceeds or that the project is reassessed in some way.

8.1.3 Systems analysis

Systems analysis is the capture of the business requirements of a system from talking to or observing end-users and using other information sources such as existing system documentation. Once a proposed information system is agreed to be feasible, it is necessary to carry out the detailed work of assessing the precise requirements that the intended users have for the new system. Note that the systems analysis step is sometimes referred to as the 'requirements determination' step or the 'systems study' step. There are three main tasks within this phase.

First, it is necessary to gain an understanding of how the current information system (computerised or paper-based) works. Second, a diagrammatic model of the current system workings is produced to ensure that IT professionals and system users are in agreement. Finally, a set of requirements for the new information system is produced. The requirements specification will define:

- the features that the new system is required to contain (e.g. the ability for end-users to be able to design their own reports);
- the scope of the system under consideration (for example, is the system intended for just one functional area of the business or is it to embrace all business activities?);
- the intended users of the new system;
- system performance standards, including response times, batch processing times (if required) and reliability needs;
- environment requirements such as physical working environment, operating system and hardware on which the system will run. In this last task, it may be desirable to produce another diagrammatic model, this time of the required information system.

If at any point it is discovered that the requirements of the system as articulated by the prospective users appear to be unfeasible in some way, it will be necessary to revisit the feasibility step and perform an additional analysis of the possible options. The output from this step in the model will be a user requirements analysis document which details what the proposed system must do.

8.1.4 Systems design

The systems design phase defines how the system will work in key areas of user interface, program modules, security and database transactions. The input to this stage is a breakdown of the requirements that the proposed information system is to deliver. The task of the systems design stage is to convert those requirements into a number of design alternatives from which the best will be selected. The design step therefore deals with how the proposed information system will deliver what is required. Systems design deals with such matters as:

- choosing an appropriate database management system;
- establishing general systems security standards;
- deciding on methods of system navigation (e.g. menu systems and graphical user interfaces);
- general standards for printed report production;
- screen design standards for input and output;

- data capture requirements;
- data storage requirements.

Detailed design, on the other hand, will result in a blueprint for individual system modules which will be used in the systems build phase that follows. Detailed design will further define some of the aspects of system design referred to above. If at any point during the design step it becomes obvious that the requirements as presented in the analysis step do not have a design solution (e.g. because of conflicting or incomplete requirements), it will be necessary to revisit the analysis step and determine more precisely what the new information system is to do in those particular respects.

8.1.5 System build

System build is the creation of software by programmers. It involves writing the software code (programming), building release versions of the software, constructing and populating the database and testing by programmers and end-users. Writing of documentation and training may also occur at this stage. The term 'build' is one that we shall be using in addition to the more usual and ambiguous term 'implementation' which is found in many texts and methodologies. This step embraces three substeps: physical database construction, programming and testing.

Physical database construction involves the conversion of the database design from the previous step into the required tables and indexes of a relational database. The programming substep involves the construction of computer code that will handle data capture, storage, processing and output. In addition, it will be necessary to program various other operational attributes of the required system (e.g. those that stem from control design). Alongside and subsequent to the programming substep, various forms of testing will take place. The output from the build stage will be an information system that has been tested and is available for final data conversion or take-on and live operation. If during the build phase it appears from testing that the system does not meet the original requirements as determined during the analysis step, then it will be necessary to revisit the design step to see whether any errors were made in interpreting the systems requirements. If the design brief was correctly interpreted but the system still contains errors in the delivery of the perceived requirements, it will be necessary to revisit the analysis to determine the systems requirements more precisely.

8.1.6 System implementation and changeover

System implementation covers practical issues such as making sure the hardware and network infrastructure for a new system are in place; testing of the system; and also human issues of how best to educate and train staff who will be using or affected by the new system. Implementation also involves the transition or changeover from the old system to the new. This step in the waterfall model deals with preparing for and making the change from old to new information systems. As one might expect, the systems implementation step is fraught with difficulties. Here, it will be discovered whether all the previous steps have combined to deliver an information system that does what the users actually want and that also works properly. Data will be converted from old information systems or directly entered into the new database. Finally, the new system will become operational straight away, or in phases, or after a period of parallel running. If errors are encountered at the live running stage it may be possible for the system to continue in operation while the errors are corrected. Alternatively, it may be necessary to suspend the operation of the new system while the most significant errors are fixed. Such error correction may require any of the previous steps to be revisited, depending on the nature and severity of the error(s). It will be clear from this short discussion that the later in the systems development process errors are discovered, the higher is the cost of putting them right. The worst-case scenario is probably for a system to have reached the live running stage only for it to be discovered that the required system was never really feasible in the first place.

8.1.7 Review and maintenance

Once an information system is operating under live running conditions, it will be inevitable that changes will be required over time. The maintenance phase involves two different types of maintenance. The first, known as 'unproductive maintenance', stems from errors or oversights in the original systems development which, while not preventing the system operating to an acceptable level, are still necessary to correct for it to conform with the original specification. The second form of maintenance involves the addition of new features and facilities that extend the scope and functionality of the information system. In the early days, these may take the form of 'nice-to-haves' or 'bells and whistles' which were not deemed to be essential to the system at changeover time. Over the longer term, the system will be adapted and modified to meet changing business requirements. An activity known as the post-implementation review should also be undertaken. This should take place about six months after the system changeover and should review what was planned for the information system against what actually happened. Lessons learned from this exercise will be extremely valuable when the next system is developed.