PART I

Setting your project's foundation

CHAPTER 2

Choosing a project and writing a proposal

Aims
To introduce techniques for choosing an appropriate project, and to introduce the basics of writing a satisfactory project proposal.

Learning objectives
When you have completed this chapter, you should be able to:

- choose an appropriate project;
- write a project proposal;
- make effective decisions when choosing your project supervisor.

2.1 Introduction

Because the field of computing is extremely diverse, covering a vast range of topic areas, from sociological and management issues to highly technical hardware and software developments, it is not always easy to decide on a suitable project for your degree course. The types of projects that are accepted in different university departments also vary. Some departments may be happy for you to pursue highly technical programming projects (provided they include satisfactory design and implementation), while others require more academic content which emerges from critical evaluation, analyses and literature surveys. Chapter 1 introduced the categories in which computing projects tend to fall: *research based*, *development projects*, *evaluation projects*, *industry based* and *problem solving*. This chapter introduces the skills you will need and some tips for choosing an appropriate computing project for your course. It then discusses ways in which you can present an acceptable proposal for your chosen project and provides some advice on choosing an appropriate supervisor, if this is possible within your institution.

2.2 Choosing a project

This can often be the most difficult stage of all. Just as an artist ponders over a

blank canvas, you have to decide on the type of project you would like to pursue over the following six to twelve months. When choosing your project, it is important that:

- You feel you are capable of doing the proposed project in the time available. You must ensure that your project is not overly ambitious and that you have all the relevant skills that are needed. You may like to consider developing new skills or enhancing some existing skills as part of your project but remember to allow time for this.
- You choose a project that interests you. Remember that you will be working on your project for probably six months or more and it is important that you do not become bored and lose motivation during this time.
- Your project has a serious purpose – it has a clear outcome that will be of benefit to someone.
- Your project has a clear outcome (in terms of deliverables) that focuses your work and direction. Without a clear target to aim for you may lose your motivation as your project progresses and may lose your way.
- Your project links in suitably with your degree course. For example, you would not pursue a highly technical electronics-type development on an information systems course or perform a detailed systems analysis project on an artificial intelligence course.
- Your project is of sufficient scope and quality to fit the requirements of your course.
- It is not a personal issue; that is, you may have a subjective view about a topic that might cloud your perspective and influence your results.

There are various techniques and information sources at your disposal to help you choose a suitable project. These can be summarised as:

- *Lecturers'/departmental lists*: sometimes the only source of acceptable project ideas. These project ideas may have been proposed by academic staff in your department, they may be projects proposed by other departments in the university, or they may be small projects that have been requested by local industry.
- *Past projects*: usually your department or university library will hold copies of previous projects. These can provide you with ideas (for example, how you may develop the work further), and they will give you an idea of the scope and amount of work that is expected from you.
- *Talking with colleagues*: your peers can often provide you with a different perspective on ideas you might have. They may highlight shortcomings with your intended project and may suggest alternatives.
- *Reading around subject areas*: if you read books, journals and articles on a topic that interests you, you can often discover areas that authors have identified as requiring further research and development. As you

improve your understanding of the topic area you may identify a gap in the field that you wish to investigate further. Whatever happens, reading around your intended subject area does no harm and it helps you to prepare a solid understanding of the subject on which you will 'build' your project.

- *Clustering*: you might wish to pursue a project in a particular field but are unsure exactly which aspects of the topic upon which to focus. Clustering can help you to identify aspects within a topic area that link together and are worthy of further investigation. Clustering is performed in two stages. First, you should list keywords related to your chosen topic area. Second, once you have exhausted all the words and phrases you can think of, you cluster them together into related groups and patterns. By doing this you will identify specific topics that interest you and form the basis of your intended project.

  Clustering can be used to develop *Research Territory Maps* (RTMs), *Relevance Trees* and *Spider Diagrams*. An RTM, sometimes called an *affinity diagram*, shows how topics relate to one another within your chosen field or fields of study. RTMs provide you with your own conceptual model of your research area. They can be enhanced with thicker and thinner connecting lines to emphasise the strength of relationships between subjects. Figure 2.1 provides an example of an

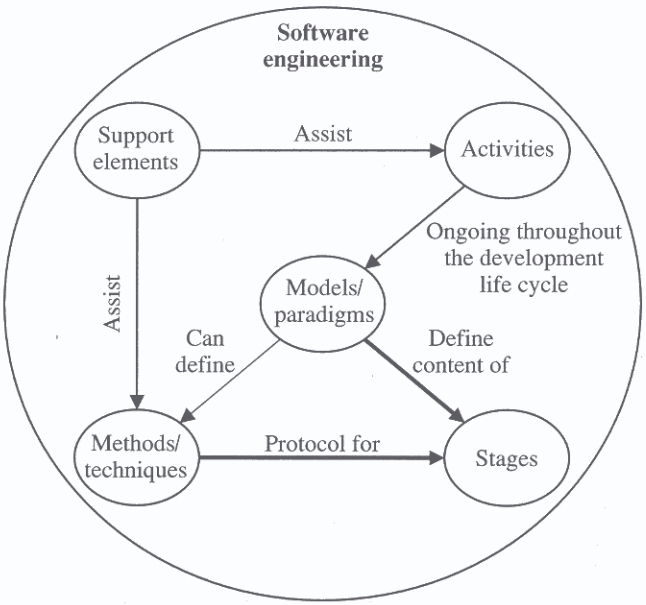

Figure 2.1 A high-level RTM for the field of software engineering

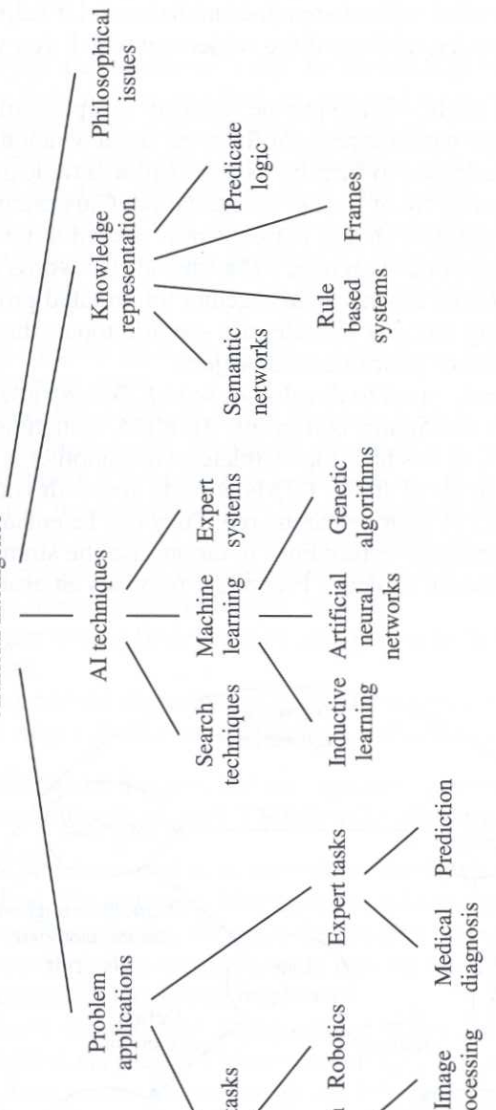

Figure 2.2 *An example relevance tree for the field of artificial intelligence*

RTM – in this case a high-level conceptual map of the field of *software engineering*. These maps help to identify links between related topics and help you to classify and sort any research material that you obtain in your chosen field. RTMs will identify specific topics you might wish to focus on within larger subject areas or, for broader studies, interrelated subjects that are dependent and require investigation.

Relevance trees, discussed in more detail by Sharp and Howard (1996: 33) and Saunders *et al.* (1997: 50), are similar to RTMs in that they try to model your field of study. Where relevance trees differ from RTMs is in their hierarchical structure. While RTMs identify related topics and the links between them, relevance trees break down a particular subject or research question into lower and lower levels of detail, identifying how a subject is composed or identifying the factors affecting a research question posed. RTMs provide a holistic interpretation of the field of study while relevance trees provide a hierarchy of topics that constitute that field of study. An example of a relevance tree for *artificial intelligence* is shown in Figure 2.2.

Another way of structuring your thoughts and identifying how subjects break down is through the use of spider diagrams. These diagrams are similar to RTMs in that they show how topics within a subject area relate together. They are also similar to relevance trees in that they show how topics break down from a central idea, subject or research question. In spider diagrams a central node is used to represent the topic of interest and lines emanating from this node identify how the topic can be organised into its constituent parts. Colours are often used to group ideas and topics together. Figure 2.3 provides a spider diagram interpretation of the field of software engineering. This diagram is adapted from the RTM in Figure 2.1.

Remember that relevance trees, RTMs and spider diagrams are structured by you to represent your *own* interpretation of your chosen subject area. Other people may decompose your subject area into an alternative structure or use different terminology for the same things. You must be aware of these differences so that you are not confused by what appears to be contradictory information which you gather from your literature search. For example, in Figure 2.2, some authors may subsume *Knowledge representation* within *AI techniques* or might disregard *Philosophical issues* entirely, while others may include other topics not identified here.

- *Brainstorming*: if you are really struggling for a project idea, brainstorming can provide the answer. Brainstorming involves 'throwing' any and all the ideas you have down on a piece of paper, in any order and as quickly as possible. You should write anything down, even if it sounds completely irrational, as the brainstorming process

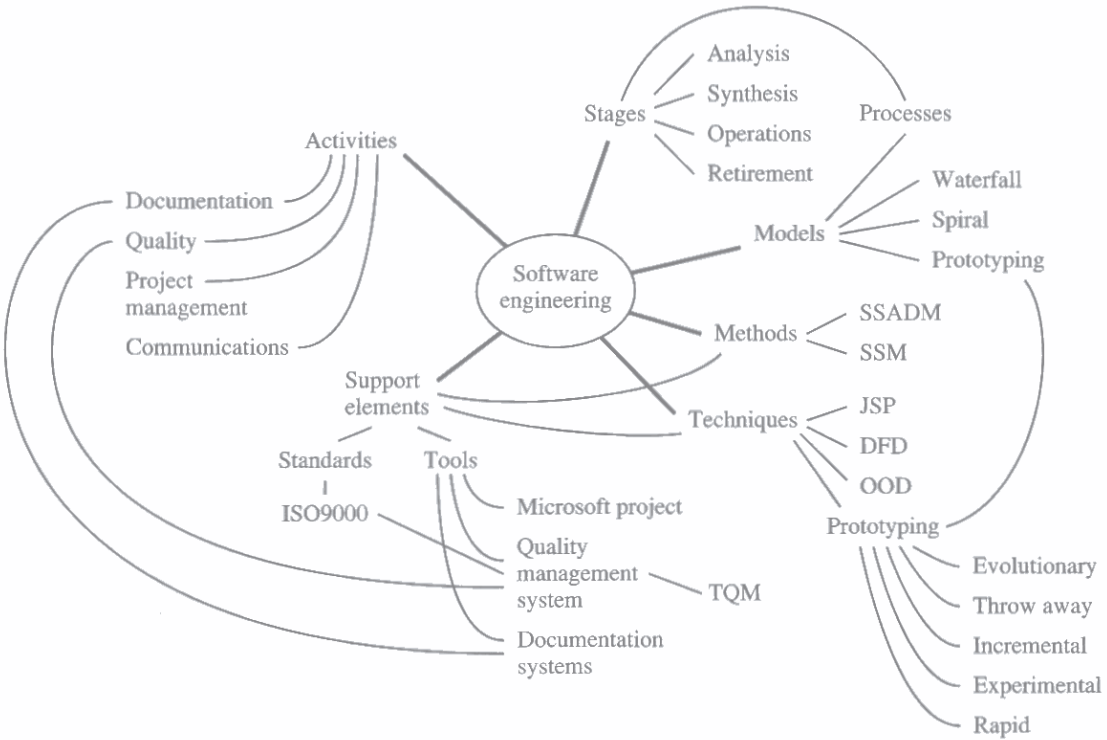

Figure 2.3 *An example spider diagram for the field of software engineering*

should not be stifled. When you have finally exhausted all of your ideas you should look at each one in turn and evaluate and assess it in more depth. What may have sounded ridiculous at first may actually lead to a good project idea; perhaps when viewed from a different angle. You might also like to group your thoughts (using clustering) as this may help to clarify, in your own mind, where your real interests lie. One way to choose between topics is to toss a coin – not to see which way the coin lands but to see how you feel you want the coin to land while it is spinning in the air.

- *Chapter breakdown*: once you have an idea for your project it is a good idea to identify how your project will break down into a number of chapters for the final report. If you have difficulty identifying a number of specific chapters for your final report it may mean that you are unclear about the detail of your project and do not really understand what it is you hope to achieve. Breaking down your project into chapters will also give you an indication of its scope. If you can only identify two or three chapters then maybe your project is not sufficiently broad. Conversely, if you can identify ten or more chapters you may be trying to do too much.

Some additional considerations that should be made when you feel you have chosen your project are:

- *The 'so what?' test* (Herbert 1990: 7). You have decided on your project but 'so what?'. Is the topic meaningful? If you complete the project successfully will it be of value to anybody? What contribution will it make? These are the kinds of questions you should be asking yourself to ensure that you do not pursue something that has no value or worth. Pursuing a meaningless project can lead to poor motivation as your project progresses and you begin to question what is the point of your work.
- *Justification.* Can you explain your project and justify it (the 'so what?' test) in simple terms to the man or woman in the street. If so, you have a good understanding of the subject area and the topic you want to pursue. Note, however, that your explanation may be too technical or too deep for the man or woman in the street to understand but this still means that *you feel* you can explain it in simple terms because the topic is so clear to you.
- *Numerating your understanding.* Can you put a figure on what you know about your chosen subject; for example, 80%? If you are able to numerate your understanding about a topic it means that you have, at least, a concept of that field of study and an awareness of its magnitude. If you have no idea what your understanding is then you have no idea of your subject area's depth or breadth and to undertake a project in this area would be very risky.

This principle was initially presented by Lord Kelvin, who stated:

> When you can measure what you are speaking about and express it in numbers, you know something about it: when you cannot measure it, cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind. It may be the beginning of knowledge, but you have scarcely in your thought advanced to the stage of science.

This idea is sometimes referred to as *metaknowledge*. This refers to knowledge about knowledge, which means that you have some concept of your own understanding about a particular issue, event or subject. In some ways the wiser people become the more they realise just how little they really know. This is especially true when they place their understanding within the broader context of world knowledge, even though their own expertise in a particular subject may be very deep.

- *Contacts.* Are the contacts you require for your project available, accessible and willing to help; for example, contacts within a local company who have volunteered to help you with a case study? If not, then your project is going to face problems that will need to be dealt with sooner or later.
- *What do you already know?* Orna and Stevens (1995: 29) suggest that another consideration which should be made when identifying your research area is to think about what you already know or have access to that is relevant. This is useful in that it will help you to clarify your strengths and, perhaps, form a foundation for your RTM, relevance tree or spider diagram. In addition, you might also want to identify what you want to *learn* by doing your project – what are your educational objectives? Are there any skills you would like to develop or new techniques you would like to learn? If this is the case, you may like to include a need for these skills within your project to force yourself to learn them.

Using these ideas, sources and approaches will assist you in deciding on your project. However, although you may now have an idea for a project that you feel is of suitable quality and scope for your course, you must now 'sell' it to others with a project proposal.

2.3 Preparing a project proposal

2.3.1 *Introduction*

It is normal, in most institutions, for you to prepare a proposal for your project so that it can be assessed for acceptability. Unless you can present an acceptable proposal your project will never even start. It can serve as a contract

between you, and your department and project supervisor – but don't expect it to be used against you if you achieve more than you actually intended to do! In many cases projects can, and do, change direction as they proceed, as you become more aware of the topic area and the problem you are investigating. This is acceptable provided that the scope and quality of your project do not become 'watered down' and you are not heading so far away from your initial intentions that the project becomes unrecognisable. If this were the case you would need to obtain permission for significant changes and possibly have to submit a new proposal.

When preparing your proposal there are two golden rules:

- Follow any guidelines precisely. Most institutions have specific information they require; for example, project title, project objectives, hardware required etc. Failure to complete these sections may mean your proposal is rejected without even being read; for example, because you failed to get an academic signature, or did not complete an essential section properly.
- Proofread it thoroughly (and get someone else to check it). Any errors and omissions will appear sloppy and put your commitment and proposed project in a bad light.

There are no universal standards for project proposals although there are particular pieces of information that all proposals should include. This content emerges from your proposal's *implicit content* and *explicit sections*, which are discussed below.

2.3.2 *Implicit content*

In general, there are four areas that your proposal should address. These areas may not be identified explicitly in the structure of your proposal but they should be addressed implicitly within the proposal's content. They are:

1. Introduction to the subject area. This will provide the reader with an understanding of the field in which your project lies and an idea of where and how your project fits into this field. This aspect will set your project into an overall *context* and will show that it is bound within a recognised field – not an idea that you've had that makes no sense and has no recognisable foundation.
2. Current research in the field. This will emphasise that your project is not based in a field that is out-of-date and that you are aware of current issues within that field of study. It will also imply that you have done some preliminary research into the topic area and are not approaching your project with little background or motivation.
3. Identify a gap. You should be able to identify some aspect of the field that requires further investigation or study. There is no point in

repeating the work of others (unless you are evaluating their approaches) and this component emphasises that the field is not exhausted and is worthy of further investigation.

4. Identify how your work fills the gap. Having identified a gap in the field your proposal should show how your project intends to fill this gap or at least go some way to investigating it further. This will emphasise the *contribution* that your project will make.

2.3.3 **Explicit sections**

Detailed below are the most common sections that project proposals should include. If you are given no guidance as to the content of your project proposal you should include the following three sections as an absolute minimum.

1. Title. This should be clear and concise. Try to avoid using acronyms if possible. Examples of clear and concise titles are:

- 'Evaluation of soft systems methods as analysis tools in small software houses'
- 'Artificial neural networks for software development cost estimation'
- 'Development of process models for graphical software tools'

2. Aims and objectives. Aims identify at the highest level what it is you hope to achieve with your project – what you intend to achieve overall. An aim is a broad statement of intent that identifies your project's purpose. Objectives, on the other hand, identify specific, measurable achievements you hope to make that build towards the ultimate aim of your project. They are more precise than aims as they are 'quantitative and qualitative measures by which completion of the project will be judged' (Turner 1993: 108). They represent major components of your project that direct your work activity (Weiss and Wysocki 1992: 13).

Identifying aims and objectives clarifies, in your own mind and that of the reader, what you specifically hope to achieve with your project. They are also used to assess your project at the end. For example, did you really achieve all that you set out to do? Because of this they should be clear and unambiguous. Chapter 3 discusses aims and objectives further.

An example of aim and objectives is:

Aim:

- To evaluate artificial intelligence techniques for modelling weather patterns.

Objectives:

- To identify and evaluate existing weather pattern modelling techniques;

- To identify artificial intelligence approaches suitable for modelling weather patterns;
- To develop an artificially intelligent system for modelling weather patterns;
- To design and develop an artificial neural network for modelling weather patterns;
- To compare an artificial neural network approach with other artificial intelligence techniques identified and existing approaches to modelling weather patterns.

3. Expected outcomes/deliverables. This section will identify precisely what you intend to submit at the end of the project. It may well identify a written report that covers particular points and makes certain recommendations. A chapter breakdown may be included where appropriate. It can include programs and user documentation and it might include models and algorithms that will be developed to address specific problems. You might also be delivering a functional specification for a piece of software, a prototype or a test plan.

The sections introduced above represent a minimum set that your project proposal should include. Additional sections that proposals can contain, and you might wish to consider including, are:

4. Keywords. Keywords are used to identify the topic areas that your project draws on. They are used by people to see at a glance what subjects your project relates to, which might not be clear from your project's title alone. Libraries and databases also use keywords to help classify material. You might be limited on the number of keywords you can use, for example four or five. Remember that keywords are not necessarily individual words but can be linked words or simple phrases as well; for example, artificial intelligence.

5. Introduction/background/overview. This section would provide an overview of your project and introduce the background work to it. In this section you might wish to include reasons why you feel you are a suitable candidate for performing the project (why you feel you can do it, what skills are required and how you fulfil these requirements), why the topic interests you specifically, and why you chose the project in the first place. This section might also include an introduction to the industry/organisation that is being investigated/evaluated. Overall this section will set the scene of the project for the reader.

6. Related research. This section is used to identify other work, publications and research related to the topic of interest. It will demonstrate that your project is not placed in an academic vacuum but relates to research topics and fields that are currently of interest. Related research can also help to demonstrate your understanding of your topic area to the reader, showing that you are

aware of what is currently happening in the field and are conversant with other topics that impinge upon it.

7. Type of project. You might wish to identify the type of project you are undertaking; for example, research based, development project, evaluation project etc. However, make sure that these terms are recognised and provide more detail if appropriate.

8. Research questions and hypotheses. Your project proposal may also include a research question you intend to investigate and, hopefully, answer to some extent within your project. Computing projects do not necessarily set out to answer particular questions but for some projects a statement of your research question is essential. Examples of research questions are:

- Does the size of an organisation affect its commitment to software quality standards?
- What is the relationship, if any, between software maintainability and coding structure standards?
- Is there an optimum solution to the prediction of software development costs?
- How do large organisations maintain quality standards in the development of internal software?

While research questions on their own are 'open-ended opportunities to satisfy your curiosity' (Rudestam and Newton 1992: 56), they are often linked closely with one or more hypotheses. A hypothesis is 'a tentative proposition which is subject to verification through subsequent investigation' (Verma and Beard 1981: 184, cited by Bell 1993: 18). Although you do not have to define hypotheses alongside a research question, they do present potential 'answers' to the question(s) you have posed and provide definitive statements that will focus your research. Examples of hypotheses that might be investigated, based on the fourth research question posed in the list presented above, are:

> Hypothesis 1: Large organisations invariably employ recognised standards to maintain internal software quality.

> Hypothesis 2: Large organisations generally have internal quality departments which oversee the implementation of procedures that ensure the quality of internal software.

It is also worth mentioning here the importance of maintaining research *symmetry* with respect to research questions and hypotheses. Research symmetry implies that your 'results will be of similar value whatever you find out' (Gill and Johnson 1991, cited by Saunders *et al.* 1997: 13). With this in mind it is important to realise the implications of the hypotheses you have stated. If they are true you must ask yourself 'so what – was that really worth proving?'. Thus, each hypothesis that you state should have a similar value if proved.

9. Methods. This section will identify the research methods and project methods you will be employing to perform your project. This section should not identify methods that you might be investigating as part of your project, but those methods you are actually using. It might include development methods (for example, SSADM) that you are using as part of a systems development, survey methods for a case study evaluation, and evaluation methods that are used to compare two or more systems. Research methods would include those introduced in Chapter 1, such as action research, case study, survey and experiment.

10. Resource requirements. You might need to identify any resource requirements for your project such as hardware, software and access to particular computers. It may be that you already have access to particular resources and this should be pointed out within this section. Quite clearly, if the resources for your project are not available in your department, or are too expensive to obtain, your project will be unacceptable. However, if you know you need a particular piece of software or hardware you must find out its cost and include this information within this section. A proposal that omits this information may be rejected because the assessor does not know the price or availability of the item, and might assume that it is beyond your project's budget.

Within this section, or under a separate heading, you might include a list of literature material that you will need to perform your project – for example, specific journals, company reports, books etc. Once again, if these materials are unavailable then realistically your project may be unsuitable and you may need to change its focus or direction. Access to particular companies for performing case studies might also be identified here. Without this access your project might flounder so it is important to show that you have contacts that can be utilised.

11. Project plan. It is very useful to present a project plan as part of your proposal. This emphasises that the project is 'doable' in the time allowed, it shows that you have some idea of the work involved, and you have a clear pathway to follow in order to complete that work. The best way to present a project plan is by using a visual representation such as a *Gantt chart*. These figures are described in the next chapter but it is worth emphasising here that presentation of these charts is important and you should limit them to a single page. Spreading these plans over several pages makes them difficult to read, and for a proposal a general overview is all that is required.

2.3.4 Reviewing your proposal

The second golden rule for preparing a project proposal states that you should proofread your complete proposal thoroughly.

You should check your proposal for spelling mistakes, omissions and grammatical errors. Have you included all the sections you were supposed to and

have you completed those sections in sufficient depth? Is the proposal well presented (typed rather than handwritten, for example)? Do the sections flow logically together?

The following are two examples of undergraduate, final year information systems project proposals. Both proposals represent the same project and have been kept short for clarity.

Title:
Software migration.
Project type:

Aims and objectives:
Migrate a series of software applications from a mainframe to a client/server systam within a local company.
Outcomes and deliverables:
- Connectivity to the mainframe for approx 1000 PCs;
- Full integration into a client server environment;
- Education of users;
- Coding and testing complted.

Research methodology:
PRINCE.
Hardware and software requirements:
All available at local compnay.

This proposal is quite poor. Its *Title* is rather vague and only represents the type of project that is being proposed. The section identifying *Project type* has been left blank and the *Aims and objectives* represent a basic, technical, industry-type project with no academic content or justification. Expected *Outcomes and deliverables* emphasise this point and merely identify the technical outcomes of the project. The *Research methodology* section identifies the method that will be evaluated, rather than the research methods that will be employed. The proposal also includes a number of spelling mistakes and abbreviations. Overall, although this project may be acceptable within industry, it lacks any academic quality or rigour and is poorly presented.

Let's look at this project proposal from a new angle:

Title:
Project management issues of software migration.
Project type:
Evaluation project, industry based.

Aims and objectives:

Aim: To evaluate the use of the PRINCE method as a means to manage the migration of software from a mainframe to a client/server system.

Objectives: An evaluation of tools and methods to assist the technical aspects of the migration and organisational management aspects.

Evaluation of similar companies performing migration for comparative purposes.

The migration of a series of applications at a local company (to which access has been obtained) will be used as a vehicle for critically evaluating the PRINCE method in particular.

Outcomes and deliverables:

A report detailing the following:

- an explanation of the perceived benefits of such a migration;
- an analysis of the difficulties experienced;
- a critical evaluation of the PRINCE methodology and its application;
- an outline methodology for future migration projects;
- a discussion and evaluation of alternative tools and methods for software migration.

Research methodology:

Case study, action research.

Hardware and software requirements:

All available at a local company.

This proposal is a far better representation of an academic project than the first. Although the project is based on the same software migration, it identifies, far more clearly, the academic side of the project and the critical evaluation required by such projects. All sections are now completed correctly; for example, *Research methodology* identifies those methods actually employed and *Project type* has now been identified. The proposal reads well and has been checked for errors and omissions.

2.4 Choosing your supervisor

If you are lucky enough to be able to choose your own project supervisor there are a number of considerations you should contemplate when making your choice. Sharp and Howard (1996: 28–29) identify five questions that students should ask of potential supervisors:

1. What are their records in terms of student completions?
2. What are their views on the management of student research – and, in particular, the supervisor's role in it?

3. How eminent are they in their specialisms?
4. In addition to being knowledgeable about their subjects have they high competence in research methodology?
5. How accessible are they likely to be?

The fifth point noted here can relate not only to a supervisor's general availability, but to their approachability as well. It is all very well being able to see your supervisor regularly, but if you do not trust them, or get along with them, this time is wasted.

Supervisors come in various shapes and sizes but, to emphasise, the main points you should be looking for are accessibility (in terms of availability and approachability) and expertise (in terms of the subject area *and* supervisory skills). Chapter 5 looks in more detail at the student/supervisor relationship and discusses how to manage the time you spend with your supervisor effectively.

2.5 Summary

- Choosing the right project is probably the most important stage of any project.
- A number of techniques have been presented that you can use to assist you with choosing a suitable project.
- When preparing a proposal there are two golden rules: follow any guidelines precisely and proofread it thoroughly.
- A project proposal should include, at least implicitly, background, related research, identification of a gap, and how your project fills that gap.
- Project proposals should include, at the very least, the following sections: project title, aims and objectives, and expected outcomes/deliverables.
- Questions have been presented that you should ask yourself before you choose your project supervisor – if this is possible within your own institution.

2.6 Exercises

1. Try to build an RTM, relevance tree and/or spider diagram for your own computing project.
2. Can you improve the project proposal presented in Section 2.3.4.?
3. Put together a proposal for your own project using ideas and skills you have learnt.