Summary

- Care, precision and logic are necessary to thinking and writing.
- Good writing generates reader goodwill.
- Identify your readers and their objectives, and your own objectives, before beginning to write.
- Don't feel that you have to begin at the beginning.
- Confidence grows with the practice of good writing.

Chapter 2

Types of Technical Writing

- Emails
- Letters
- Business cases
- Reports
- Inspection reports
- Specifications and instructions
- Dissertations

Emails

Emails are one of the most common means of communication, used within families, between friends and colleagues, within companies and to clients and customers worldwide. They have enormous advantages, in that they can be sent and received at a time convenient to sender and recipient (much more convenient in this way than the telephone); they can be used on the screen, forwarded to other readers, or printed out and used as documents; they travel quickly round the world; they can be long or short and can include attachments; they can be sent to individuals or groups as required. It is important, however, to remember that, legally, emails are seen as written documents and may be used in court; however carelessly or rapidly they are written, they cannot be undone once they have been sent.

Style and tone

There are rules and conventions in writing a business letter which have developed over centuries (see pp. 11–13), but few conventions exist in an email. One of the most common problems is that writers tend to regard an email as a form of speech: they can be informal, humorous, aggressive or chatty as if they were talking to the recipient, and the speed at which the email travels increases this illusion. The words on the screen, however, are not supported by facial expression or tone of voice: they are simply written words, and that is how the reader sees

them. Any attempt to reproduce the habits of speech is likely to fail or be misinterpreted; for instance, capital letters used for emphasis may seem aggressive to the reader.

There is a further problem with emails in the context of work. A friendly, informal email between colleagues can be passed on or even printed out and circulated as a document, and what was intended as a casual exchange of information has become a formal written statement, seen by other people perhaps not known to the originator. If an email is used at work, it must be sufficiently formal to remain appropriate for different readers; in other words, slang, chattiness or a too-casual spoken language are not appropriate. The abbreviated language often used in text messages ('u' for 'you', for example) must be avoided for the same reason. Writers must always be aware that an email is not necessarily one-to-one communication, even if it starts out with this intention; it can easily be passed on and read by many other people.

Nevertheless, emails are generally less formal than business letters, and, provided the warning in the previous paragraph is kept in mind, this seems acceptable. Abbreviations such as 'don't' or 'can't' are freely used and the style tends to be friendly in tone rather than stiff and formal. However, if an email is sent to a group of people, its style must be appropriate for all of them, even if some are known to the writer and others are not, some senior in the organisation and others not. Emails may be passed on again and again, and so can reach people whom the writer was not aware of when writing the message.

> Emails are not limited to the intended reader; they can be passed on without the writer's knowledge.

Sending an email is an extremely rapid and irreversible process. If the writer is angry or upset, the tone of the message may show this all too clearly; if the sender is extremely angry with the recipient, the email may be violent and offensive, and the reader may well respond, equally rapidly, in the same way. Working relationships can be permanently damaged. If the people concerned had seen one another, they might have retained some human sympathy or willingness to compromise; if they had had to dictate a letter, someone else might have counselled different words; if they had had to take the time to walk to the post office or even the post room, they might have calmed down. Instant communication without the benefit of human contact can allow an unpleasant situation to escalate at high speed. The moral is: if you feel emotional when you start to write an email, do something else first and allow yourself time to think rationally about the consequences of what you want to say. And then don't say it.

We all, at times, have to write difficult emails, when the subject is contentious or we are nervous about the reader's reaction. In such cases, it's a good idea to complete the address at the top as the last stage, so that there is no danger that the message will be sent before we are ready, that is, before the message has been carefully considered and checked.

Greeting the reader

There have been, in the past, strict conventions about how to address the reader of a business letter (see pp. 11–12), but there is nothing so prescriptive for emails. There should almost always be some form of signing on and signing off: an initial message with neither a greeting nor a signature may be seen as discourteous, although if the exchange of emails becomes a conversation, greetings may be omitted and just the first name used as signature. If the recipient is not known to the writer, 'Dear ...' can be used, although it feels oddly old-fashioned. It is also acceptable to start just with the recipient's first name on a line by itself before the message begins. The use of first names is almost universal among British engineers, although Mr or Ms with the surname can be used if the writer is addressing a senior person in another organisation. If the writer knows the reader well, 'Good morning' or 'Hello' and the name can be used; 'Hi' is not uncommon, but beware of the difficulty discussed above, that, if the email is passed on, this may look too casual. There is one major warning needed here: we said 'among British engineers' above, and this casual use of first names may be unacceptable in a different culture. Even if the language is English, it would not be appropriate to write to a French or German engineer using the first name, unless the recipient is also a personal friend.

Many emails end with 'Regards', which is pleasant and neither particularly formal nor informal. 'Best wishes' or 'Thank you' might serve when they are appropriate. The writer's name, usually nowadays just the first name, should follow, as a courtesy, though full name and contact details such as a phone number are often printed at the foot of the writer's emails and should always be made available.

Content

Emails can have as much or as little technical content as the situation requires; they can include diagrams or a full report, and so are highly flexible. However, the text can lose its format in transmission, and so it is wise to send any formatted material as a pdf attachment rather than in the body of the email, always with a brief covering message. It may be that the attachment is more formal than the message itself, if it will probably be more widely circulated. If the email is likely to

be long, or has several attachments, it is worth giving a brief contents list at the start, to alert readers to all that follows.

Emails can become long because they have turned into conversations, each reader adding a message or comment, not necessarily at the end of the whole but sometimes partway through. This can become irritating and even difficult to understand; a reader might actually miss the last stages of the information because it is not obvious on the screen that there is more to come. At some point, a brave writer needs to start again and divide the whole exchange of messages into two.

Organisations have complex security systems for their electronic communication, using codes, passwords and other tools to make sure that their confidential material is seen only by the intended reader. Even so, emails can be tampered with, or, more frequently, passed on inadvertently (or otherwise!) to a third party, and every engineering writer needs to be particularly careful in transmitting confidential material through this medium.

This warning applies also to emails that refer to third parties, and it is courteous to send a copy to anyone whose name appears in the message. Even when this is omitted, it is worth at least imagining that the person or people mentioned are going to receive the email: how would they react? Using 'reply all' without considering the consequences is unwise. How many people are going to receive an email in which they find that they are unexpectedly named, or, worse, in which they are spoken of in a less than friendly or courteous way?

There is an additional problem. Many managers are irritated by the dozens, perhaps even hundreds, of emails they receive every working day; a common complaint is that the actual work is held up because of the time spent reading emails. If some of these are 'reply all' messages which are not relevant to the manager's work, the irritation is magnified; an unfortunate consequence can be that the manager doesn't bother to read emails from that source in the future.

Don't 'reply all' unless everybody really has to be informed.

Check that your message is appropriate for all your readers.

Checking emails

It is easy to forget to check an email. Engineers and others, who would not dream of sending a report or business letter without checking it carefully for accuracy of material and typing, will send off an email without even looking through it. Mistakes will give the wrong information and undermine the credibility of the

writer just as much in an email as in a more traditional form of communication. If the information is long and/or complex, check from a printout, not just on the screen. Grammar, punctuation and spelling have the same impact at the receiving end as they would have on the printed page, which is where, in any case, the text may end up.

There is an extra level of checking in an email: making sure that the right people receive the information. If an email is sent to a group, the writer must check that every individual in the group *should* (because of eligibility and the nature of the content) receive the message. It has been known for a complaint about a colleague to travel to the person concerned simply because he or she was on the circulation list. In a lengthy exchange of emails, the message itself gets longer and longer, and material at the beginning may be forgotten by the writers; incidentally, if the exchange is received by a third party, they may assume that it has been completed before it has, simply because what they see on the screen is signed off and looks like the end of the communication.

Reduce the length of 'continuous' emails, or the last stages may be missed.

There is, unfortunately, no way of ensuring that the recipient actually reads an email. A common complaint is that emails disappear into the ether and appear never to arrive – or that they are ignored when they do arrive.

Activity 2.1 Email

The following material was written by a tutor to engineering student 'project managers', and sent to the group as an email attachment. The essential information is included, but it is not easy to follow or use. It needs to be organised and written in a consistent and appropriate style.

Subject: Year 1 projects: safety

I need to know the hazards which are associated with your project, remembering that if you take apparatus away from supervised areas special precautions are necessary. Let me know the steps you propose to deal with them. Watch out for: electric shock and insulation and protection, fire risks and where you intend to keep fire extinguishers and other fire-fighting equipment; if pressurised or other highly stressed components are involved they must be protected against; moving components must be guarded, such as rotating shafts, gears, belts, pulleys; you may also be injured by falling or tripping especially if there are sharp projections or objects are dropped. The first time hazardous apparatus is used, your project supervisor must be present and if it is very hazardous, every time. If you have problems with safety, I will assist you. Jane Edwards, Tutor

Activity 2.2 Emails that have gone wrong

Example 1: this is not a bad email, but a little reorganisation would improve it.

Hi, Samiya

I thought yesterday's meeting went really well, and I was so pleased that you and two of your colleagues could be there. Everyone contributed and I was enormously encouraged by the comments on our progress and the promise of further collaboration. Do let me know how you felt, and let's think about a date for our next get-together. I think we should look at meeting again in the next few weeks. You said, by the way, that you had the figures available from your last experiment – please send them as I'd be very keen to see them.

All the best
Louise

Example 2: identify the many problems with this email and improve it.

To All staff

Subject update on discussions

Over the last few months, we have been meeting and talking to all our staff and their union representatives about the issue of flexible hours. It has been a challenging issue and many of you understandably have strong views, and we have as usual been ready and willing to listen to your points of view. As you may or may not know, the issue has been brought to our attention recently by the retirement of some of our key staff, and we are of course very sorry to lose them, as they have given stalwart service to our company over many years. As you will all realise, we have an excellent record of keeping our staff, probably one of the best records in the area. However, given the challenges we now face, and the country's current precarious financial situation we have had to give serious consideration to cutting back on the flexibility of working hours. We therefore have to inform you that, in line with our agreement with your union representatives, we shall end the flexibility of working hours in two months' time. Details of your individual hours will be discussed with you in due course.

Philip Banks
General Manager

Checklist to persuade readers to read their emails

- Decide whether an email is appropriate; sometimes walking to the next office and talking in person is more effective!
- Does the email contain useful information for its readers, or is it an exercise in self-protection?
- Ask the recipient to record receipt by clicking on the appropriate message.
- Make the purpose of the email clear in the title; vague headings such as 'update' or 'next meeting' suggest that the message is unimportant.

- Think about the bigger picture: be aware of the context of the message and help readers to see the relevance of what is written.
- Start a new email rather than add to an already lengthy one.
- If the point of an email is to ask a question or request information, put this at the start of the message so that it is clear at once what you are asking for.
- Avoid chatter in an email – keep to the point.

Letters

There are, in spite of technical advances in the means of communication, a few occasions which still demand a letter. Contact with individual staff, such as appointment, promotion, changes in working conditions or formal disciplinary action, is in letter form. Engineers may have to write to members of the general public or influential groups, for instance to ask for permissions. Generally speaking, particular legal requirements make a letter necessary, while email has become the everyday means of written communication. Legal letters are among the few documents, possibly in addition to highly complex technical diagrams, where a fax is still a common means of transmission.

In preparing to write any such letters, the engineer needs to assemble useful information: technical data, previous communication on the same subject and up-to-date or revised details which must be included. It is helpful to look at any previous letters on the subject received from the organisation to which the present letter is addressed, not only to make sure that all relevant topics are covered in the reply, but also to check the tone used. If the reader's company uses a formal style and formal names, it is generally wise to follow suit and vice versa; it would suggest disagreement and perhaps hostility to write 'Dear Mr Twigg' when he signed his letter 'Alex'. However, since most letters today are on legal issues, a formal style is more common.

Forms of address

The use of first names is a tricky subject. Business letters once began 'Dear Sir' or 'Dear Sirs' as a matter of course. Although this is still not uncommon, surnames are now more widely used ('Dear Mr Twigg') and first names ('Dear Alex') are also common, even among people who have not actually met, or even had any previous connection. There is still need for caution. Alex, whom you know well, may be away from the office and your letter may instead be dealt with by Sue, whom you do not know. Worse, Alex may, no doubt by oversight, have failed to pay his bills, and it is difficult to write a stiff letter threatening legal action if you begin it, as usual, with 'Dear Alex'. Discretion is needed, and previous correspondence is a useful guide to what is appropriate. Company policy, of course, may be the overriding factor.

Engineers may be men or women. This seemingly obvious fact is sometimes overlooked by letter writers, and too many letters still start with 'Dear Sir', when a little research would have shown that 'Sir' is female. People are often unsure about the correct form of address to a woman, and indeed the situation is changing and the conventions are not entirely clear. 'Dear Madam' is as appropriate as 'Dear Sir', although, oddly, it sounds rather more formal; 'Mr' and 'Ms' are now standard. A full-name signature, as opposed to initial and surname, at least prevents the 'Dear Mr Twigg' response to a woman. In passing, it is worth noting that an increasing number of women use their maiden names for professional purposes, thus adding to the confusion. It is worth taking trouble to find out the first name or initial and job title of the recipient.

Style

Most organisations have templates for letters, and these should obviously be used. The language in which a letter is written should be as simple as possible, unambiguous and courteous. If it is a reply, it is sensible to begin, 'Thank you for your letter of 6 July.' This is much better than 'I have received your letter of 6 July' (how else could you be replying to it?) or 'I am writing in reply to your letter' (obviously you're writing!), and more grammatical than 'With reference to your letter of 6 July.', which is not a sentence. The recommended version also avoids 'I' as the first word of the letter, which can sound a bit self-important; whenever possible, start with 'you' rather than 'I'. For example:

I know that you are anxious that the completion date is as early as possible ...

would be better as

You are naturally anxious that ...

Companies vary in their policy about 'I', 'we' or the impersonal form ('It is agreed that ...'). Such policy should, of course, be followed. When a choice is available, it is worth noting that 'we' (that is, the writer on behalf of the organisation) is easier to use than the impersonal; it is more concise and sounds more cooperative. 'We agree that' gives a sense of personal concern which is missing from 'It is agreed that'. 'I' may be allowed, but should be reserved for personal involvement; when the writer means '*I* will be at the next meeting of the institution and will be able to discuss the matter with you then', the use of 'we' would be silly.

The last section of a letter, the 'courtesy close' sentence, can cause the most hesitation. It must be a grammatical sentence, which rules out 'Looking forward to receiving your comments' or the awful 'Thanking you in anticipation', neither of which contains a main verb (see p. 84). The nature of the letter will dictate

what is appropriate, but 'Thank you for your help', 'I look forward to meeting you' or 'If I can be of further assistance, please contact me' are all acceptable.

Letter writers are oddly unwilling to refer to themselves directly as 'me', and manage to sound pompous in avoiding it. 'The undersigned', 'the present writer' or even 'myself' distance writer from reader; if writers mean 'please contact me', they should say so.

Above all, letters should be helpful. They go as ambassadors of the writer's company, and if they are overformal, ambiguous in content, wordy or chilling in tone, goodwill is strained. The writer should always be aware of the need to give clear information, offer assistance, sound concerned or offer apologies, as required, and check that the document says exactly what it was meant to say.

> Letters are nowadays formal documents, often legal in content, which represent the company that sends them.

Writing a business case

A business case presents the basis for a decision about a new project, product or development. It answers the question of whether the outlay, financial and otherwise, is justified, by considering the options, the cost and benefits of the recommended scheme, and its place in the organisation's overall strategy.

Obviously, such a document is complex and takes time to prepare; it will probably be considered at a high level of management and may potentially affect the future of at least part of the organisation concerned. In itself, it may involve a considerable investment of time and skill, and so, before starting to write, an engineer given the task of preparing a business case should be sure that it is really needed.

The first stage of preparation is therefore to look again at the situation that has led to the request for a business plan, to make sure that it is understood and that the need for the new development seems at this stage to be a strong one. It is sensible to consider the kind of investment that might be involved, in terms of finance and personnel. What sort of deadlines are likely to be needed?

Research may be necessary to collect the material for the business plan. Where will the appropriate data come from? Will the writer need to liaise with bodies outside the organisation, for example to discover whether skilled staff would be readily available or whether local authority involvement might be needed, for instance in obtaining planning permissions?

It would be useful to have another view of these considerations, and if it is possible, the engineer responsible for the business case should discuss the

implications with a few carefully-chosen colleagues, not least to assess the level of support that might be forthcoming for the final decision.

> Check whether a business case is needed, and if it is likely to receive some support.

Once there is a consensus that a full business plan is needed, work can proceed. At this early stage, it is useful to plan the structure of the final document, so that each section will receive appropriate attention and the overall balance will be right for the issue.

The sections of a business case that might be needed are described below. Many organisations have their own recognised formats, and of course these must be followed. There are different names for different sections, for instance the analysis of other possibilities might be called Options or Justification, but the basic pattern is likely to be as discussed here.

The first section of the completed document will be the **Executive Summary**, which gives an overall view of the whole document in condensed form. It will include the current situation and the need for change, the resources needed for the new project, some idea of cost–benefit analysis and the conclusions and recommendations. The summary will be placed at the beginning of the final, written business case and it will be the most influential part, as it may be read by high-level executives who will read nothing more: their decisions may be made on this evidence alone. For this reason, although the Executive Summary is at the beginning, it must be written at the end of the process of making the case, when the writer is sure that all available considerations have been taken into account.

> The Executive Summary is the most influential part of the business case, and should be written last but placed first.

The **Current Situation** (Issues, Problem) follows. This is an analysis of the situation that the proposed project is to influence (develop, improve, correct, solve). The need may have become apparent because of financial considerations, staffing levels, research opportunities, and so on. Whatever its origins, the current requirement for the project has to be presented in a balanced, impersonal way, so that readers are as far as possible in the picture before they are presented with possible solutions. This section may include the potential outcome if the current situation is allowed to continue.

The **Options** are now considered, in sufficient detail for readers to understand them and to realise why they have been accepted or rejected. Each should be discussed objectively, with their strengths and weaknesses analysed. It is important

that the writer is seen to have considered them seriously and without prejudice. Generally, one option is to do nothing, and this must also be included.

Among the options, presumably, is the one the writer is recommending, and the reasons for this choice must be made clear, with sufficient backup data to convince readers. Senior staff will be reassured to see a detailed discussion of the possibilities and a helpful analysis of why the recommendation has been made.

> The Options should be presented clearly and objectively, with the appropriate backup data.

Risks, financial and otherwise, may be given as a separate section. These should be considered honestly, with an assessment of how they might be avoided or their effects mitigated.

A **Cost–Benefit Analysis** of the chosen solution follows. (If there is a great deal of information at this point, it might be an advantage to separate Costs and Benefits into different sections.) Benefits should be presented as fully as possible, with adequate justification, and data from similar projects or case studies might be included. Charts and graphs may be the best way of showing costs in detail, and they should be either included at this stage or presented in an appendix.

Resource Requirements and **Timescale** may in a long business case be separate sections. The resources needed may be internal, such as staffing, or external, for instance consultancy or hire of equipment, or both. Initial investment and running costs will both be considered. The timescale of the undertaking should be assessed as far as possible, stage by stage if appropriate and overall. Particular milestones at which the progress of the project can be reviewed should be included.

Conclusions (Evaluation) can now be drawn. The writer has the opportunity to stress the main considerations which have suggested the choice of a particular scheme, how the cost–benefit analysis has shown its advantages, and why the recommendation is good value for money and fits well into the overall strategy of the organisation.

This leads naturally into the **Recommendation**, which is the writer's final opportunity to show how the choice has been made and why it will prove advantageous in the long term.

> In a business case, the Recommendation shows how and why the choice has been made and its advantages.

When all this has been completed, the Executive Summary can be written, making its case clearly, logically and effectively.

Activity 2.3 Business case writing

Choose one of the following scenarios, and outline the kind of information that might be included in a business case for your own organisation.

(a) You have seen a piece of equipment in use elsewhere, and feel that it would be of great value to your organisation, although it would be expensive to buy. What would you include in a business case for the purchase of this equipment?
(b) You feel that, as your workload has expanded a great deal in the past year, it would be a good idea for you to have an assistant, perhaps on a part-time basis. What kind of information would you include in order to make your case?

The final stage is, of course, checking. This should be undertaken by the author but also by at least one other person, preferably not closely involved in the preparation of the material: a fresh pair of eyes can see errors that someone who knows exactly what should be written can read over and not notice.

The whole document will have the writer's name and the date, and also probably its distribution list and amendment history, with the dates of any significant changes.

Technical notes

Technical notes are short articles generally designed to convey new information, such as the results of research, to a specialised readership. They may be published in technical journals (see Chapter 7, Writing for Publication) or internally within the organisation to which writer and readers belong. In either case, there is usually a strict format to be followed, and as a result this section will look at particular aspects of technical notes rather than present a suggested format.

A technical note gives details of a specific development, technique or procedure; it is likely to be shorter than a full technical article (perhaps less than 5000 words), but it will contain appropriate diagrams and references. Guidelines are likely to limit the number of these.

The first section of a technical note is likely to be the Abstract, which is of particular value as it identifies the most important information for potential readers, and may therefore be more widely read than the note itself. It should contain the background, briefly but in sufficient detail to make the situation clear to readers, the most significant findings, the conclusions and any recommendations. Obviously, a good abstract is invaluable but difficult to produce, and writers are advised to keep it in mind throughout the writing process, as it is unwise to try to produce an abstract in a very short time when the deadline is near.

The abstract may be accompanied by a small number of key words to identify the subject coverage of the note. These should be chosen with care, and general words such as 'development' or 'growth' should be avoided.

The Introduction, which follows the Abstract, gives the circumstances which have occasioned the note, and the main text then guides the reader through the information itself, to the Conclusions (including discussion of alternatives if appropriate) and Recommendations if there are any. The format and style will be similar to those of a report (see pp. 17–20).

Technical notes are a very useful way of introducing information of immediate interest and concern to readers; they may subsequently be developed into full-length articles or reports and they may help to establish a readership for the future.

Reports

Reports, like letters, are written for their readers. This obvious fact is overlooked at the report writer's peril. Most reports convey information about a given subject, such as a project, an accident, tests on equipment or a visit. Many reports are also requests: the writer wants more time, more money or more cooperation to sell a product or an idea. Both formal language and logically presented format must work to the benefit of the reader, who is the most important person. They will then also result in the 'right' response from the point of view of the writer.

Objectives

The reader(s) and the objectives must both be clearly identified at the start of the report writing process. There may be one known reader, or several, or the report might be destined for a wide readership, but the writer needs, as far as possible, to identify who these people are, what their level of technical knowledge is and why they need the report. This will help in the choice of the correct language, that is, the appropriate level of technicality, with explanation and backup as required. Far too often reports, like letters, use pompous words ('initiate' rather than 'start') and inexact expressions ('in due course', 'regularly'). As in all technical writing, the English language should be used in a formal but flowing and readable way, and as precisely as possible. Technical language should be chosen for the reader and the subject matter, preferably in that order.

The purpose of the report, its objectives, should also be well defined in the writer's mind. The writer will have his or her own reasons for writing the report, perhaps one that is immediate ('I want them to make this decision') and others that are more long term ('I need their cooperation for future projects, even if they reject my suggestions this time'). The reader will also have objectives, and again they may be both short term ('I need advice about making the right decision') and long term ('I wonder if we could ask this writer to cooperate with our next project?').

Identifying the objectives allows the writer to check that all the information given is relevant to the subject and builds up a clear, uncluttered picture of the situation and what should be done about it. This clarification also helps to make the writing concise; report readers are usually busy people who prefer a short document to a long one. There is a tendency among engineers – they are not alone in this – to ramble, often repeating the same information several times, introducing unnecessary details or wandering away from the point.

> Identifying readers and objectives is the first stage of preparing a report.

Structure

Although some reports are read in order from start to finish, far more are *used*, with the reader picking and choosing sections which are helpful, of particular interest or needed urgently. The structure of the whole document must be apparent from the contents list, although convention is also a useful guide. A report on a technical process might follow a standard format such as the following:

Title page	
Contents page	
Summary	(including, very briefly, the main conclusions and recommendations)
Introduction	(with the reason for the investigation, and any constraints in carrying out the work)
Procedure	(how the investigation was carried out)
Results	(the facts which emerged from the investigation)
Discussion	(the implications of the results)
Conclusions	(what is or is not satisfactory)
Recommendations	(what should be done as a result of the conclusions)

A long advisory report might have even more sections:

Title page	
Acknowledgements	
Summary	(including the main conclusions and recommendations)
Contents list	(section numbers, headings and subheadings, page numbers)
Introduction	(putting the reader in the picture, including any necessary background)
Findings	(what was discovered as a result of the work, in numbered sections)

Conclusions	(the implications of what was discovered)
Recommendations	(what should be done in the future)
References	(books, articles, etc. referred to in the text)
Bibliography	(other related reading)
Appendix (appendices)	(supplementary material)
Annexe (annexes)	(documents bound at the end of the report for the convenience of readers)

The format shown above is complex, much too long for many reports, but the pattern is useful: introduction, factual content, comment or conclusions and, if they are asked for, recommendations. This ordering of information can be followed even if the report is a short one.

Within the given format, reports are closely structured in sections with numbered headings. A short report might need only a small number of headings and in this case there may be no advantage in numbering them. Most reports, and certainly any which are more than a couple of pages in length, have headings numbered for ease of identification and reference. There are various numbering systems, some of them very simple:

1 Background
2 Investigation
3 Comments

Longer reports need a more complex structure, either paragraph numbering or, preferably, decimal notation, in which all headings are numbered, irrespective of the number of paragraphs in the section. This is a clear hierarchical structure, in which sections with major headings can be subdivided into subsections with lesser headings, as follows:

1 MAIN HEADING
1.1 Subordinate Heading
1.1.1 Smaller heading

The pattern is repeated, so that:

- Sections 2, 3, 4, etc. are equal in importance (in the numbering system) to Section 1;
- Sections 1.2, 6.4, 9.5, etc. are equal in importance to Section 1.1;
- Sections 1.1.2, 1.2.6, 8.11.3, etc. are equal in importance to Section 1.1.1.

If the report is very long, a fourth layer, 1.1.1.1 etc., can be added, but the numbering should not usually be extended beyond that.

This numbering system is useful in that it is widely used and recognised, easy to check and logical. Sections can be readily identified: Section 2.4 begins with that number and continues to 2.5, and all material in between is subordinate to the 2.4 heading. In this system, all numbers have headings and vice versa, with one exception. Lists are kept clear of the main decimal notation system. Items are identified by single Arabic numbers in parentheses to the left of the text, as in the example below:

Headings in reports should be:

(1) short, but long enough to be used as an index to the information
(2) as specific as possible
(3) set out in a form appropriate to the numbering hierarchy.

This last point is particularly helpful to readers. If major headings look as if they are major headings (for instance, in bold upper case) and subordinate headings can be identified by their format (for instance, a smaller upper case bold, or lower case bold) as well as by their number, the reader can see the structure of any page of the document immediately. The format of the headings and the numbering system reinforce each other.

> Reports have a logical structure which should be clear to the reader; their language is always formal.

Dates in reports

All reports should be dated, not least to protect the writer, who is responsible for the accuracy of the information at the time of writing but who cannot be expected to foresee economic or legal changes which could invalidate the conclusions. A visit report is likely to have two dates, that of the visit and that of the writing of the report. If a report is updated and reissued, both dates need to be shown. Many company reports have all their textual history, including amendments and updating, shown on the pages immediately after the title page.

Ideally, a report is a document for *use*, planned and written for the convenience of the reader, and structured so that its logic is immediately apparent. Readers should be able to identify and use detailed information without having to work through long paragraphs or pages of text. For this to happen, all the headings must be set out in order on the contents page, together with details of any appendices or annexed material. Readers then have a logical overview of the

structure of the document, and can select any section or subsection which they need, seeing how it fits into the report as a whole.

Running headers and footers are also helpful in guiding users through the document. Pagination can be of the '1, 2, 3' variety, or the '1 of 6, 2 of 6, 3 of 6' form, which is particularly useful if the pages are looseleaf rather than bound. Date, classification and, in a long report, section number can be added to the footer, as can the author's name and title, as long as the latter is short enough not to require an extra line of print.

Most useful of all is the inclusion of a summary at the beginning of the text, unless the material of the report makes a summary impossible (for instance, if the purpose of the report is simply to give detailed information to readers, with no suggestion for action).

Summaries in reports

This section is headed 'Summaries' but there are various forms of summary, any of which – one or more than one – may be chosen by the writer or the reader or laid down in company report templates. Whichever form is chosen, it will be placed at the start of the finished document and may be the only part to be read by some readers, such as those whose work is tangential to the subject but who need to be aware of what colleagues are working on. Senior and influential readers may read only the summary and base a decision on it, and so it is in the writer's interest to make this section of the report as clear and informative as possible.

There is no uniformity about the names by which the forms of summary are known, but we have listed widely-used definitions below:

Abstract/Synopsis/Outline: essentially, this attracts readers to the report and encourages them to read. There will be a word limit, perhaps about 300 words, which may be a mixture of narrative and key words (which can usefully be emboldened in the text). **Key words** will identify the topics covered by the report and will help a potential reader to decide whether to read more.

Executive Summary/Gist Summary: this will alert readers to the essential message of the report, and will be used especially by people who have to go to a meeting at which the subject matter will be discussed.

Summary: this, the longest form of summary, will give readers both an introduction to the report and, in brief, its most important information. It will give a résumé of the whole report, emphasising those aspects which are likely to be of most significance to readers, almost always the conclusions and recommendations. In about half to two-thirds of a page (the summary would be longer than this only if the report itself were long,

perhaps more than 30–40 pages), the writer has to give readers an accurate and unbiased picture of the message contained in the report. Readers will go through this first, go back to it as a reminder of the content, study it to help them to understand technically complex information, and, in some cases, read the summary and nothing more. This is true especially of the two categories of readers mentioned above: managers who need a general view of what is happening, and senior staff who are unlikely to give the time to a full reading of the report but who may well be involved in making decisions on the basis of its recommendations. If they read a clear, well-balanced and well-written summary, they are almost inevitably on the side of the writer and will approach the rest of the report in a positive frame of mind. The time needed to produce a good summary should never be underestimated.

The summary is usually the most influential part of a report.

Diagrams

Diagrams will often be included, either in the main body of the report or at the end, as appropriate, although in this, as in all decisions, the convenience of the reader must be considered. Generally, it is easier to follow the flow of information if the diagrams are placed near the words that explain them, unless the diagram is so large or lengthy that it would seriously interrupt the reading or it is of interest to only a minority of readers. Pages of computer code or a table which covers several pages are likely to be too long or too complex for the body of the report, and would almost certainly be better at the end, if they are really needed at all.

A diagram is useful to make an immediate visual impact, often to allow readers to assimilate information that it would be difficult or even impossible to present in words. It must therefore be clear in every detail. This means that it must be large enough for every letter or number to be instantly recognisable (5, 6 and 8, for example, are easily confused if they are printed in too small a font). Space should be used helpfully: in a table, space is often better than grid lines, which can have a dazzling effect; if items on a long vertical axis are grouped in fours or fives with a blank line between groups, the figures will be easier to read than if they are all equally spaced. In producing a great many tabulated figures, the writer should consider how to help different types of reader: sometimes, a graph showing a trend will be appropriate in the body of the report, while detailed figures to several decimal places might be better in an appendix. Knowledge of the reader's needs is, as usual, the best guide.

Within a diagram, all labelling should be placed horizontally as you would read it, whether the illustration itself is presented in portrait or landscape form. If the page has to be rotated to see a diagram in landscape form, it should always be turned in a clockwise direction. Abbreviations, symbols and so on should of course conform to international standards in diagrams as in the text itself.

Clarity is a special consideration in the choice of colour. Generally, dark colours stand out well on white or lightly coloured backgrounds, but if there is writing on top of colour, the contrast must be sufficiently strong for the reader to see the words easily. Black print on a deep red or dark green background will be hard to read, and this is not the only problem presented by these two colours: many men are colour-blind, especially where red and green are concerned, and if these apparently brightly visible colours are used together, for instance to show lines on a graph, many male readers (and an extremely small number of female readers) will be unable to distinguish between them.

It is especially worth checking the clarity of diagrams imported from another source. Definition can sometimes be lost in the transfer, especially if the diagram has to be resized for its new home. Headings in tables can also be moved, so that they no longer clearly belong to the correct column of figures.

Every diagram needs to be identified by a number and a short title. This information is usually placed directly beneath the diagram, along with details of the source or a key if appropriate. The convention for numbering diagrams in reports is that two numbers are used, the first being that of the main section of the report and the second being sequential. Figure 2.2 is therefore the second diagram in Section 2 of the report (only the main section numbers are shown, so that this number would be used even if the diagram appeared in Section 2.4.1 of the document). Readers need to be told when to look at a diagram. In the appropriate place, a reference (see Figure 2.2) indicates that the reader will be helped by the diagram at this point of the text.

Activity 2.4 Report

The information that follows comes from a real-life technical report, but the structure has been removed so that it reads as an essay, with paragraphs but without numbered headings. It is difficult to extract details from so many words and figures, and an engineer attempting to use the information would find it frustrating and no doubt extremely irritating. Organise this material into a well-structured report that could be used easily and accurately.

The effect of acoustic ceiling tiles on noise at the County Swimming Pools, Northeston, February 2015.

After acoustic tiles had been installed in the ceiling of the Learner Pool at the County Swimming Pools, Northeston, Edward Downs, a member of the Parks and Leisure Subcommittee, was asked to liaise with Dr Andrew Poynter, Senior Lecturer in the Department of Mechanical Engineering at the local University of Abimouth, in order to investigate the effect of the tiles on noise levels.

Andrew Poynter had been involved in 2013 in testing noise levels at the Pool, after staff and parents had complained to the Council. At that time, he had recommended that the Council install acoustic tiles manufactured by Fraser and Macfarlane to an area of 114 m². He measured current reverberation times (see Table 1) and also noise levels. These latter were recorded as an average of 92 dBA, with a maximum of 103 dBA and a minimum of 87 dBA.

The Council approved Andrew Poynter's recommendation, especially as both he and the tile manufacturer's representative predicted shorter reverberation times (see Table 1) and lower noise levels if the tiles were fitted. The new acoustic ceiling was therefore installed in November 2014.

Two months later, Dr Poynter was asked to assess the effect of the ceiling, and to give Edward Downs a report on the findings. He agreed to do this. On 1 February 2015, they visited the Learner Pool together when there was the usual weekend attendance of about 35 people, adults and children. This was approximately the same number as in 2013 when the original tests were carried out.

Andrew Poynter found that an area of 180 m² had in fact been treated with the acoustic tiles, but he did not consider that this invalidated his original predictions, although of course the figures were no longer precise.

The backing of the tiles was fibreglass in film bags, which was also different from that used in the earlier tests. This backing could have been responsible for the beneficial results that were obtained.

The reverberation times were measured and compared with the times predicted by Andrew Poynter and by the representative of Fraser and Macfarlane. They were found to be much shorter (see Table 1). Noise levels were also tested, with the average now 77 dBA, the maximum being 87 dBA and the minimum 71 dBA. This was a pleasing decrease over the earlier level.

Dr Poynter also talked to the staff at the Learner Pool. The instructors and the pool attendants all agreed that the general noise level had gone down, which made their working conditions more pleasant. They also felt that the intelligibility of speech had been greatly improved, so that they could now both hear more clearly and identify who was making a particular noise. This was obviously good from a safety point of view, and made the training of youngsters easier. They declared themselves to be delighted with the new ceiling.

After he had completed his assessment, Andrew Poynter reported that he was so pleased with the results that he felt the Council should extend the acoustic ceiling. The general noise level had clearly fallen and the reverberation times were much shorter, probably as a result of the backing of the tiles. The same kind of tiles should obviously be used in the future. The staff felt that their work had become easier and the safety level had improved, which must be good for everyone.

Andrew Poynter prepared his report along these lines and presented it to Edward Downs for consideration by the Council.

Table 1 below shows the measurements of reverberation times.

Table 1 Reverberation times in the Learner Pool (curtain open)

Frequency (Hz)	2013 measurements (seconds)	Poynter's recommendation (seconds)	Fraser & Mcfarlane's prediction* (seconds)	2015 measurements (seconds)
125	1.75	–	2.8	0.7
250	2.2	–	2.0	0.4
500	2.4	1.5	1.3	0.55
1000	3.8	1.65	1.5	0.8
2000	3.6	1.65	1.7	0.85
4000	3.0	1.5	1.6	0.9
8000	–	–	–	0.55

* Fraser & Macfarlane's prediction was based upon 114 m² of treatment whereas the actual area installed was 180 m².

Inspection reports

Inspection reports are almost always presented on a template which is standard in the organisation concerned. This has great advantages: it helps the writer by providing headings, it ensures that all the appropriate sections are completed, and it makes quick reading much simpler, as the recipient knows where to look for particular information.

The writer's responsibility is to provide accurate and complete data. An inspection report must be objective, all details being completed without bias and as clearly and fully as possible. They must also be easy to understand. The use of a template has the disadvantage that the space available may encourage the writer to abbreviate too much or leave out what seem to be 'unnecessary' words, and the effect can be confusing; an inspection report should never need interpretation or, worse, guesswork in order to make sense. (See pp. 68–9 for an example of over-abbreviated writing.)

Nevertheless, it may be necessary for the engineer who has carried out the inspection and verified all the data to add information that has no place in the template. This might, for example, be the evidence of a witness to the incident that caused the inspection to be carried out. This must be quoted exactly, using quotation marks, with the witness's name included and the time at which the observation took place.

Perhaps the most important aspect of the writing stage is that words are chosen with great care. Nothing must be exaggerated or appear affected by the writer's bias, and language should be kept as simple and easy to read as possible; sentences and paragraphs should be short.

While the facts must be set out for readers in a way that can be read and assimilated quickly, the writer may be asked to make some comment about the cause or long-term effects of any problems which have been identified. This should be in a separate section from the rest of the data, and clearly headed Comments or Conclusions so that there is no doubt that this is an assessment rather than part of the evidence.

An inspection report should give a clear and complete picture of what has been inspected, so that the reader can take the appropriate action with confidence.

Inspection reports should show the evidence fully and objectively.

Specifications and instructions

Specifications are perhaps halfway between reports and procedures: they present the standard expected or against which the work can be tested, and for this reason often incorporate or are closely linked to British or international standards. Specifications may show, for example, how machinery is to be manufactured or maintained, or how a system is to be designed or operated, and the language in which they are written must conform to specific rules. Procedures are of two sorts: *general* procedures, which indicate that the work should be done in a particular way, and *specific* procedures, which give precise instructions for carrying it out. Instructions themselves simply tell the user what to do, often with little elaboration, although explanatory notes or diagrams are sometimes included.

Style and language

In all these forms of instruction writing, a major source of difficulty is the use of a group of words which are often confused: *can/could, may/might, should/would, will/shall/must*. They are defined as follows:

- *Can/could* are used to show ability:

  The car can reach 110 mph.
  It could travel even faster in different road conditions.

- *May/might* show permission or possibility:

  The car may (is allowed to) travel at 70 mph on the motorway.

The lorry might arrive (there is the possibility that it will) before dark if it is not held up by a traffic jam.

- *Might* can also be used negatively:

  The lorry might have arrived if the road had not been flooded.

- *Able* means skilled or equipped to perform a specified job; it has no suggestion of willingness or intention:

  The engineer is able to repair the damage. (He or she is capable of repairing the damage.)

- *Should/would* are nowadays used interchangeably, and their force is often ambiguous, as in the following examples:

  I wonder if I should drive so fast. ('should' implies hesitation, whether I ought to or not)
  I should go as quickly as possible. ('should' implies moral imperative, under an obligation to)
  He would go if conditions were right. ('would' implies unlikely possibility, conditions are not right)
  He would go in spite of our warnings. ('would' implies determination, he insisted on going)

As a result of this confusion, the choice between 'should' and 'would' is often one of sound, as at the beginning of emails:

I should be grateful if you would kindly supply the following.

'Will' is also ambiguous in writing, although in speech it is often made clear by emphasis, as in the following examples:

I will mend the car tomorrow. ('will' implies future action, intention)
I *will* mend the car tomorrow in spite of my other commitments. ('will' implies determination)
The garage owners will be responsible for those repairs that are covered by the guarantee. ('will' implies future obligation)

All the above examples suggest the difficulty of using 'should', 'would', or 'will' casually in technical writing. However, there is one very strong convention: 'shall' is generally used to express obligation, and is now so forceful that, particularly in specifications, it has become an instruction word:

The company shall be liable for the cost of maintaining the equipment. The engineer shall carry out the repairs as agreed.

In the writing of **specifications**, 'shall' should be used as the normal word to represent obligation: the company is deemed to be liable, the engineer will have to carry out the repairs. In other contexts, there is not the same degree of uniformity, and the writer should remember that 'shall' can be interpreted as a simple future:

I shall go to enquire about the order tomorrow or the following day.

It must therefore be made clear in such documents if the word is used to convey an obligation; in a specification, this would be taken for granted.

The other word which is available to writers of specifications is *must*, which allows no option, and which carries an extra layer of meaning: it tells the user that the obligation is not simply that of the current document. The action is mandatory because of 'higher' authority, for instance because the law demands it. This distinction between 'shall' and 'must' is a useful one, and should be maintained, not least because it is widely recognised.

For this reason, it is better in specification writing to avoid less precise expressions such as 'is to'/'has to'. In everyday life, we use them to suggest obligation ('the engineer has to carry out the procedure'), but in a technical document they can cause uncertainty, and it is better to use 'shall' or 'must'.

In specifications and instructions, use the appropriate words to show obligation.

A good writing style is always appreciated by readers, but in the case of specifications it must, if necessary, be sacrificed to accuracy. Many sentences will sound repetitive, especially in the constant use of 'shall', but this is in the nature of specifications and cannot be avoided. A 'literary', flowing style is almost impossible to achieve in any kind of instructional writing: sentences within a passage tend to be too often of the same length and structure.

Specification writers sometimes fall into the trap of using pseudo-legal language such as 'aforesaid' or 'always provided that'; this sounds pompous and should be avoided, as should a combination of words that mean the same, such as 'orders, instructions and directions'. Words need always to be chosen carefully, with the needs of the specification user in mind. Terms such as 'regularly' or 'workmanlike' sound helpful, but how regular is regular? Once every century? 'Workmanlike' implies that all workmen operate in the same way and to the same standard, which is not, alas, the case.

Most companies nowadays have written **procedures** which are regularly appraised and updated, and here too there is a recognised terminology.

A general procedure describes how actions should be taken (it does not give instructions) and the word 'should' is used, exactly as it was earlier in this sentence. Specific procedures, however, are much more like **work instructions**,

and may be written either in specification terms ('shall' and 'must') or in the usual language of direct instructions, using the imperative form of the verb. This is the 'command' form, 'do this', as in the following examples:

Check the machine and sign the form.
Inform the safety officer immediately if the machine is to be moved. Replace the guard on the machine immediately after maintenance.

In these sentences, 'check', 'sign', 'inform' and 'replace' have the force of a command; there is no possibility of misunderstanding the intention.

The engineer, in preparing **instructions**, is not in the business of asking, suggesting, recommending or preferring. Orders have to be carried out exactly, and the only safe way of writing is to make each step sound like an order. We are not asked if we would mind turning the engine off as we take petrol at the service station: the results could be too awful if we decided not to comply. Nevertheless, it is sensible to give a reason for the order unless it is equally obvious. 'No unauthorised entry', for instance, might be followed by the familiar radioactivity symbol to warn us of the hazard.

British and International Standards combine to make many hazard warnings international in use, and the colour codes (red for prohibition, yellow for caution, blue for mandatory actions and green for safe conditions) should, of course, be adhered to. Words and symbols are both used in warning notices, and a combination is often sensible so that people with poor knowledge of the language still understand the message.

Instructions which are also warnings should be written in a positive rather than a negative form if at all possible:

Do not leave equipment switched on.

is better as:

Switch off equipment.

Some instructions, however, are negative in themselves, even doubly negative, as in:

Unauthorised persons may not change grinding wheels.

If possible, this should be made positive, as in:

Grinding wheels should be changed ONLY by authorised persons.

Both style and layout are important considerations in the preparation of instructions, as they are in any technical writing. It is easy to see why. Instructions have to be carried out; they must be unambiguous or the wrong action will be taken, and they must be well set out or actions may be omitted or performed in the wrong order.

The correct choice of words is essential throughout the document. The writer must select words not only for their accuracy but also for the reader's understanding. Instructions are usually written for people junior to the writer in status, knowledge and experience: the difficulty is to think oneself back into the position of the reader and write accordingly.

Imagination is needed to recreate the reader's lack of knowledge and also to envisage the reader's physical position. Words such as *left, right, back* and *front* depend on point of view. Similarly, words such as *near, far, close, beside, behind,* and even *big* and *small,* are subjective. Precise information is needed. Other words create problems: *appropriate, relative, substantial* and *suitable* all depend on the reader's perception, and should be clarified or avoided.

Structure and layout

All types of instructional writing have their conventions. In the case of **specifications,** the format is usually rather like that of a report, although there are a few differences that need to be highlighted. Some organisations have their own format for specifications, which must be followed, but a common pattern for a specification is as follows:

Title page	
Contents list	
Introduction	(the first numbered section)
Scope	(range and depth of coverage; limitations if appropriate)
References	(normative and informative – see below)
Definitions	(of specified terms – see below)
Glossary	(abbreviations, etc.)
Main text	(of the specification, in appropriate sections)
Appendices	(additional information for particular readers)

Two of these sections need extra comment. Specifications contain two types of reference: normative and informative. Normative references cross-refer to other specifications which are to be used alongside the one in which the reference appears. It may be necessary to show which has priority, for instance, by adding 'in case of conflict, this specification takes precedence over BS ...'. Informative references are similar to those found in reports, giving details of other publications which have been quoted or are useful for further guidance.

Some names or terms have a specific meaning throughout the document, and by convention these have initial capital letters. So the word 'Client' may have a capital C to show that the word stands for the particular Client for whom the document is being prepared. 'Works' or 'Contractor' may similarly have the initial capital. In writing the specification, it is obviously essential to be consistent: 'client' with a small 'c' will be interpreted as any client other than the one for whom the document is intended.

The main body of a specification, like that of a report, will have numbered sections, as in:

2 MATERIALS
2.1 Cement
2.2 Aggregates
2.3 Admixtures

and so on; there are likely to be far more divisions than in a report, and the specifier might need five or six decimal places and perhaps even a, b and c after that.

The organisation and layout of **instructions** are also important. The most important rule is: one step at a time in a logical order. Each step should be numbered, and sequential Arabic numbers are the easiest to follow. Numbering identifies clearly the individual stages to be completed, and is a useful reference tool if the process is interrupted (each step can be ticked off as it is finished).

The writer is also aided by a numbered sequence as it helps in checking that all stages have been included in the correct order, that is, the order in which the reader will carry them out. Never backtrack in instruction writing: imagine being told that the battery must be checked after all naked flames have been extinguished. The *first* action (extinguishing all naked flames) must come before the *second* action (checking the battery), and the layout must make the sequence clear.

Space is an important tool, to limit the amount of information which the reader has to take in at one time. Space should be left between heading(s) and instructions, and each instruction should begin on a new line. General comments, such as 'This procedure should be carried out weekly', should be either at the beginning or at the end, but clearly separated from the instructions themselves. If additional information is needed within the text, it should be distinguished either by position (for instance in a margin to the right of the instructions) or by font (for instance by being in italics). Warnings must be especially clear, and if possible placed both at the beginning and at the appropriate stage of the instructions. Attention should be drawn to them, by the use of red and (not least because colour blindness is common) capital letters or some other identifying mark.

Sometimes instructions can be grouped, with extra space at the end of each sequence and appropriate headings. Whatever form is chosen, the pattern of instructions should be clear to users, to increase their efficiency and give them confidence that they are doing the job correctly.

> Instructions must be appropriate in content and language, and set out in a way which helps the user.

Activity 2.5 Instructions

The following set of instructions for the design of a state machine is written in a rambling and imprecise way. Reorganise and rewrite it to make it easier to use.

First of all, you should make a statement defining the state machine in terms of a state diagram and then after the number of required state variables has been determined and the state representations chosen, you can determine both the next-state functions of the present state and inputs and the output functions of the present state and inputs.

Dissertations

Student engineers, towards the end of their course, may face writing either a project report or a dissertation. Reports are discussed elsewhere in this book (pp. 17–26), but dissertations may seem more daunting: reports have been produced at regular intervals during the course, but a dissertation is long (maybe between 10,000 and 20,000 words); it will have sections or chapters demanding a logical progression of thought; it will have to read well and show independence, if not originality, of material. Above all, it must be accurate in both the information it contains and the way it is presented.

Perhaps we should now add that panic is never conducive to clear thinking, and in any case is not needed now. There are stages in producing a successful dissertation, and if they are followed sensibly, the process can be both challenging and, best of all, interesting.

First of all, look at the guidelines produced by your department or faculty. There will be a suggested number of words, possibly both a maximum and a minimum, and the acceptable leeway, perhaps 10%, and a note of any sections not included in this total, references for example. There will also probably be guidance about the structure of the dissertation and the way in which it should be presented, for instance font size, layout of mathematical material, and the form in which it is to be submitted, online or as a bound hard copy. Highlight all the details that seem to apply to your specific dissertation and keep them in mind throughout the process.

Follow dissertation guidelines exactly and refer to them regularly.

Preparing a dissertation is a process, rather than just writing. Planning and preparation will come before the actual writing, although if you have a sudden inspiration about part of the dissertation and feel the urge to write it, do so, and mark it up as a section to be checked and revised later. Look beyond the title: the subject that has been agreed by your supervisor will itself suggest questions. For

instance, if you are investigating road surfaces and the friction needed by traffic, questions might include the following:

How does friction affect the stopping distances of cars?
How do different surfaces affect stopping distances?
What is the impact of rain or ice on surface friction?

Some of the questions might later be disregarded, but the fact of asking them will help to clarify the way in which the subject will be developed.

Ask questions about the topic of your dissertation in order to clarify the subject.

Sometimes an interesting thought will occur at an inopportune moment, for instance during a lecture or at a party with friends. Having your mobile phone or a small notebook and pencil always available in a pocket means that, even when you are apart from your computer, ideas will not get lost. At an early stage, plan the time that can sensibly be given to the dissertation, given the final date and other commitments, not forgetting time for rest and relaxation.

Planning the structure of the dissertation itself is crucial. In a long work, it might be good to have a major overall plan and also smaller plans for each chapter or section. In planning, think how many words might be needed to cover each aspect: this will help you to identify the need to narrow the subject matter or indeed to enlarge it, and to identify the sections which will be most important in developing the argument. As an appropriate structure becomes clear, it is helpful to discuss it with a supervisor or tutor and reassuring when it is agreed.

Planning is a critical stage of preparing a dissertation, and time well spent.

In planning, make sure that you are clear about whether you are expected to include a literature review, and what percentage of the dissertation might be taken up with this. In some cases, the literature review might be expected to take up a considerable amount of the space; in others, it will be small. It is easy to think of your dissertation as simply a set of essays strung together in one structure, and this would be a serious mistake. Although the use of headings and perhaps chapters might tempt you to see it in that way, it needs to be a coherent whole: a work that you have planned and written as one entity.

A dissertation is one coherent piece of work and should be planned as a whole.

It might seem that the actual writing of the dissertation is being put off for too long, but the more the structure is planned and developed, the easier the writing will be. A most important message in the production of any document, especially a long one, is: you don't have to begin writing at the beginning. If there is a section, however short, about which you feel you have all the right information and you can see how it fits into the whole, then feel free to start by writing that part first. It might need revision later, but it will help with that most daunting of tasks, facing an empty screen and knowing that a start has to be made and that there are a great many words to fill it with.

> Start writing with an easy section, wherever it fits into the whole.

The writing process needs to be controlled, and this depends on the preference of the writer. Some people like to make a detailed timetable, showing what part of each day is to be spent on the dissertation; others may set a word limit for each day's writing. In any case, allow for the occasional break, when boredom sets in, or writer's block, or some emergency makes fulfilling that day's quota impossible. The programme should not be so detailed that these things become additional worries, and it should not take you up to the very last minute so that there is no time for checking and putting together the complete document.

In other parts of this book, useful information will help at each stage, especially as follows:

- writing style, especially Chapters 4 and 5
- mathematical material, Chapter 3, pp. 44–6
- checking and presentation, Chapter 6.

Checking takes time, for the writer and for any friend who has agreed to proofread the final version. This is particularly useful, as it is always hard for writers to see their own mistakes, and some errors are extremely difficult to see, such as *form* for *from*, or *casual* for *causal*. The most troubling of all is perhaps *not* for *now*, or vice versa, which can change the meaning completely. So a second, even a third, pair of eyes is invaluable. At the same time, the writer needs to know when to stop. The urge to improve by adding a few words or an extra diagram can be hard to resist, and it should certainly be questioned: if it was not there in the first place, will it really be of use now or is it just an unhelpful afterthought?

> Checking is the writer's responsibility, but helped by a second reader.

An examiner looking at a dissertation actually looks before reading, and that first sight is influential. Small errors can loom large, such as omitting the label for a diagram, changing font in mid-page, presenting an inadequate contents page, crowding the page so that it is not easy to read ... Any of these or similar mistakes will put off the reader before a word has been read. Worst of all is a mistake on the title page, which often gets forgotten in the checking process. Such an error will remain with the reader all the way through the examining process.

> Check that the appearance of the dissertation is attractive and easy to read.

The finished dissertation may be submitted online or in hard copy; check what you are told in your guidelines. If it is to be submitted online, use a pdf rather than a Word document so that the assessor sees exactly what you intended. Whatever its form, when the dissertation is completed, it should be a document that the writer can be proud of. Its value will be not just in getting a degree, but possibly in a job interview or even as an introduction to further research in the future. If its continuing use seems likely, it may be sensible to produce a bound hard copy for your own records.

Summary

- Emails are not limited to the intended reader; they can be passed on without the writer's knowledge.
- Don't 'reply all' unless everybody really has to be informed.
- Check that your message is appropriate for all your readers.
- Reduce the length of 'continuous' emails, or the last stages may be missed.
- Letters are nowadays formal documents, often legal in content, which represent the company that sends them.
- Check whether a business case is needed, and if it is likely to receive some support.
- The Executive Summary is the most influential part of the business case, and should be written last but placed first.
- The Options should be presented clearly and objectively, with the appropriate backup data.
- In a business case, the Recommendation shows how and why the choice has been made and its advantages.
- Identifying readers and objectives is the first stage of preparing a report.

- Reports have a logical structure which should be clear to the reader; their language is always formal.
- The summary is often the most influential part of a report.
- Inspection reports should show the evidence fully and objectively.
- In specifications and instructions, use the appropriate words to show obligation.
- Instructions must be appropriate in content and language, and set out in a way which helps the user.
- Follow dissertation guidelines exactly and refer to them regularly.
- Ask questions about the topic of your dissertation in order to clarify the subject.
- Planning is a critical stage of preparing a dissertation, and time well spent.
- A dissertation is one coherent piece of work and should be planned as a whole.
- Start writing with an easy section, wherever it fits into the whole.
- Checking is the writer's responsibility, but helped by a second reader.
- Check that the appearance of the dissertation is attractive and easy to read.