

BUSINESS INFORMATION SYSTEMS

SIXTH EDITION

Technology, development and
management for the modern business



PAUL BOCIJ
ANDREW GREASLEY
SIMON HICKIE



Business Information Systems



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Business Information Systems

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PAUL BOCIJ, ANDREW GREASLEY AND SIMON HICKIE



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To my wife, Mik.

From Paul



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Supporting resources

Visit www.pearsoned.co.uk/bis to find online resources for instructors



Preface

Introduction

With the prominence of the concept of e-business and the increased use of business information systems (BIS) within organisations, the need for all working professionals to have a good knowledge of ICT and IS has also increased. With the vast, rapidly changing choice of IS available, important business skills are understanding and assessing the range of options available, and then choosing the solution best suited to the business problem or opportunity. This is, essentially, our aim in writing this book: to provide a source of knowledge that will explain how the right systems can be chosen by a business, then developed appropriately and managed effectively.

Despite the rising expenditure on IS, surveys also show that the potential of IS is often not delivered, often due to problems in the management, analysis, design or implementation of the system. The intention in this book is to acknowledge that there are great difficulties with developing and using IS and to explain the measures that can be taken to try to minimise these difficulties in order to make the systems successful.

IS form an integral part of modern organisations and businesses. Computer-based IS are now used to support all aspects of an organisation's normal functions and activities. New technology creates new opportunities for forward-thinking companies. Higher levels of automation, high-speed communications and improved access to information can all provide significant benefits to a modern business organisation. However, the benefits of new and emerging technologies can only be realised once they have been harnessed and directed towards an organisation's goals.

Aims

This book is intended to provide a comprehensive, yet accessible, guide to choosing the right systems for an organisation, developing them appropriately and managing them effectively. The book was conceived as a single source book that undergraduate business students would refer to throughout their course, without the need to purchase a separate book for different topics such as ICT, information management, systems analysis and design, and strategy development. It covers, in detail, the software and hardware technologies which form IS, the activities involved in acquiring and building new IS, and the elements of strategy required to manage IS effectively.

Key skills necessary to participate in the implementation of ICT in businesses are developed, and these skills, which form the main themes of the book, are:

- an understanding of the terms used to describe the components of BIS to assist in the selection of systems and suppliers;
- assessing how BIS applications can support different areas of an organisation;
- managing IS development projects;
- systems analysis and design;
- developing an IS or e-business strategy and managing its implementation.

The book assumes no prior knowledge of IS or ICT. New concepts and terms are defined as simply as possible, with clear definitions given in the margins of the book. It explains the importance of information in developing a company's business strategy and assisting decision making. The uses

of relevant hardware and software components of computer systems are defined and explained in the context of a range of business applications. The book also explains the benefit of innovations such as big data and analytics.

After using the book as part of IS modules on their course, students will be able to:

- evaluate and select ICT solutions for deployment within different functional parts of a business to achieve benefits for the business;
- participate actively in ICT projects, applying skills such as selection of suppliers, procurement of hardware and software, systems analysis and design, and project management;
- communicate effectively with ICT specialists when collaborating on a task or project;
- use ICT to access a wide range of information sources for research and acquisition of knowledge.

Changes for the sixth edition

The logical structure of the fifth edition has been retained, but many changes have been incorporated based on lecturer and student feedback. The main changes are as follows:

- New developments in areas such as the Internet of Things (IoT), big data, analytics, cloud computing and Industry 4.0 are now covered.
- Numerous new case studies with questions have been included in this edition.

The structure of this book

The book is divided into three parts, each covering a different aspect of how BIS are used within organisations to help achieve competitive advantage:

- *Part 1* focuses on the hardware and software technologies, known collectively as ICT, which make up IS. It is intended for introductory courses in ICT and BIS.
- *Part 2* explains how IS are acquired and developed by considering the activities involved with each of the stages of developing IS. This part is intended for more advanced courses in systems analysis and design.
- *Part 3* describes how IS need to be managed, and a strategy developed, to ensure they effectively support the mission of the business. This part is appropriate for courses which consider the strategic management of IS.

Each part is self-contained and is the equivalent of what might be covered in a single module, or course, in a programme of study.

Part 1: Introduction to business information systems

Part 1 introduces the basic concepts of BIS. Its main focus is the technology that forms BIS, but it starts by reviewing the importance of information and what makes good-quality information. Many people who work in the ICT industry tend to believe it is the technology part of ICT that is important, whereas most business people will tell you it is the information part of ICT that is crucial to business performance. To enable a business user to communicate effectively with his or her suppliers of ICT, a knowledge of the often bewildering terminology used to describe the components of IS and a basic idea of how these components interact are important. To aid understanding, basic concepts and characteristics of IS are reviewed in Chapter 2. Hardware, software, communications and networking technologies are then described in subsequent chapters.

The different aspects of ICT are introduced as follows:

- *Chapter 1: Basic concepts – understanding information* provides an introduction to how information is used within a business.

- *Chapter 2: Basic concepts: an introduction to business information systems* introduces the different types of BIS, including the concept of e-business, and how they can be used to gain strategic advantage.
- *Chapter 3: Hardware and software* describes the issues in the selection of different hardware components of IS which are used to capture, process, store and output information. It also reviews the selection and use of general-purpose applications software such as word processors, spreadsheets and databases, which are often referred to as ‘productivity software’. Internet software is also covered.
- *Chapter 4: Databases and analytics* explains the role of databases in the storage and sharing of information and the use of analytics to provide information for decision making.
- *Chapter 5: Networks, telecommunications and the Internet* explains how BIS are linked using telecommunications links which form networks within and between businesses.
- *Chapter 6: Enterprise and functional BIS* considers how BIS can be implemented as enterprise or functional business systems. The chapter also covers departmental applications of BIS.

Part 2: Business information systems development

Part 2 focuses on how BIS are acquired and built. A basic understanding of this is necessary to every business user of BIS so that they can appreciate the context of their use of the system and which is of particular importance when they are involved in testing or using a new system since they will need to understand the reason for introducing new systems as well as their limitations. A more detailed understanding of building BIS is important to users and managers who are responsible for, or are involved in, a systems development project. In this case they will need to know the different stages of systems development to help plan the project or work with the developers of the system. They will also need to be aware of the different alternatives for sourcing IS, such as buying pre-written ‘off-the-shelf’ systems or specially written ‘bespoke’ systems, to decide which is best for their company or department.

This book provides a reference framework known as the ‘systems development lifecycle’ which puts all the activities involved with building a system into a business context. Chapters give guidelines on how best to approach systems development, giving examples of activities that need to occur in order to avoid any pitfalls and enabling a quality system to be produced which meets the needs of the users and the business. The chapters in Part 2 are sequenced in the order in which activities occur in the systems development lifecycle:

- *Chapter 7: An introduction to acquiring and developing BIS* gives an introduction to alternatives for acquiring new systems. It also introduces the software development lifecycle which acts as a framework for the next chapters.
- *Chapter 8: Initiating systems development* covers the initiation phase of system development when the need for the new system and the feasibility of different development methods are assessed.
- *Chapter 9: BIS project management* describes how project management can be used to ensure the new system is built within the time and budget constraints, while also providing the features and quality required by the business and end-users.
- *Chapter 10: Systems analysis* details systems analysis techniques including methods of capturing the requirements for the system and summarising them. Different diagramming techniques are also covered.
- *Chapter 11: Systems design* reviews different aspects of the design of IS from overall architectural or systems design to aspects of detailed design, such as database and user interface design.
- *Chapter 12: System build, implementation and maintenance: change management* describes the final stages of a systems development project when the system is released to end-users, following programming, testing and installation, and is then maintained. The area of change management at the levels of software, IS and the organisation is also considered.

Part 3: Business information systems management

Part 3 considers issues involved with the management of IS within an organisation. Of these, probably the most important is ensuring that the strategy defined is consistent with the mission and objectives of the business. Techniques for achieving this are reviewed, together with trends in IS strategy, such as location of IS within a large company and outsourcing IS management to third-party companies. Key issues in implementing the strategy are detailed in the areas of ensuring IS are secure; managing end-user facilities such as desktop PCs, development tools and the help desk; and ensuring the company is acting within moral, ethical and legal guidelines.

The chapters are structured as follows:

- *Chapter 13: Information systems strategy* considers tools for developing IS strategy, including the integration of the IS and business strategy.
- *Chapter 14: Information systems management* explores the management of IS investments and the location of IS resources.
- *Chapter 15: Managing information security* describes how information and systems can be protected through controls from threats such as destruction, failure or loss as part of business continuity planning.
- *Chapter 16: End-user computing – providing end-user services* explains why managing use of systems and, in particular, development by end-users is a significant trend in IS.
- *Chapter 17: Ethical, legal and moral constraints on information systems* discusses the importance of protecting personal data and other ethical, moral and legal requirements which must be met by the IS manager.

Who should use this book?

The book discusses key aspects of BIS development and management for students who need to understand the application of ICT to assist businesses. It is designed for college students, undergraduate degree and postgraduate students taking courses with modules giving a grounding in the practical ICT skills of selection, implementation, management and use of BIS. The main types of reader will be as follows:

- *Undergraduates taking general business courses* such as Business Administration and Business Studies or *specialised business courses* such as Accounting, Marketing, Tourism and Human Resources Management.
- *Undergraduates on computer science courses* in Business Information Systems or e-commerce which involve the study of business applications of information technology and the management of the development of IS.
- *Students at college aiming for vocational qualifications* such as the HNC/HND in Business Management or Computer Studies.
- *Postgraduate students on MBA, Certificate in Management, Diploma in Management Studies or specialist masters degrees* which involve courses on information management or IS strategy or electives in e-business and e-commerce.

Managers in industry involved in the development and use of IS who will also find the practical sections in this book of use are as follows:

- *Business analysts* working with customers to identify business problems and propose solutions.
- *Systems analysts and software designers* specifying how the solution will be implemented.
- *'Hands-on' managers* responsible for implementing ICT solutions as either a supplier or a client.

What does it offer to lecturers teaching these courses?

The book is intended to be a comprehensive guide to the business applications, development and management of BIS. As such, it can be used across several modules to help integrate different modules. Lecturers will find that the book has a good range of excellent case studies to support their teaching. These include industry case studies of the applications of BIS together with problems encountered and simplified practical exercises for systems analysis and design. Web references are given in the text to important information sources for particular topics.

Student learning features

A range of features have been incorporated into this book to help the reader get the most out of it. They have been designed to assist understanding, reinforce learning and help readers find information easily. These features are described below.

At the start of each chapter:

- *Chapter introductions*: succinct summaries of why the topic is relevant to the management of IS and its content and structure.
- *Learning outcomes*: lists describing what readers should learn through reading the chapters and completing the exercises.
- *Links to other chapters*: a summary of related information in other chapters.

In each chapter:

- *Definitions*: when significant terms are first introduced the main text contains explanations and succinct definitions in the margin for easy reference.
- *Web links*: where appropriate, web addresses are given as reference sources to provide further information on a particular topic. They are provided in the main text where they are directly relevant as well as at the end of the chapter.
- *Case studies*: real-world examples of how technologies are used to support businesses. Case studies are taken from around the world but there is a particular emphasis on the UK and Europe. They are referred to from related material within the text they support. Questions at the end of the case study are intended to highlight the main learning points from each case study.
- *Activities*: exercises in the main text which give the opportunity to practise and apply the concepts and techniques described in the text.
- *'Focus on' sections*: used to consider topical issues of IS in more detail. Such sections may be used to support the essay or discussion-style questions, or may provide areas for further student research, perhaps giving ideas for student dissertations and projects.
- *Chapter summaries*: intended as revision aids which summarise the main learning points from chapters.

At the end of each chapter:

- *Self-assessment exercises*: short questions which will test understanding of terms and concepts described in the chapters.
- *Discussion questions*: require longer essay-style answers discussing themes from the chapters, and can be used for essays or as debate questions in seminars.
- *Essay questions*: conventional essay questions.
- *Examination questions*: typical short-answer questions which would be encountered in an exam and can also be used for revision.

- *References*: these give details of books, articles or papers referred to within the chapter.
- *Further reading*: supplementary text or papers on the main themes of the chapter. Where appropriate a brief commentary is provided on recommended supplementary reading on the main themes of the chapters.
- *Web links*: extensive lists of relevant web sites and particular articles together with a brief description of what information is available.

At the end of the book:

- *Glossary*: a list of all definitions of key terms and phrases used within the main text.
- *Index*: all key words, abbreviations and authors referred to in the main text.

Support material

An Instructor Manual for this book is available for download from www.pearsoned.co.uk/bis

Plan of the book

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| BUSINESS INFORMATION SYSTEMS TECHNOLOGIES | CHAPTER 3 HARDWARE AND SOFTWARE | CHAPTER 4 DATABASES AND ANALYTICS | CHAPTER 5 NETWORKS |
| BUSINESS APPLICATIONS | CHAPTER 6 ENTERPRISE AND FUNCTIONAL BIS | EXAMPLES THROUGHOUT CHAPTERS 1 TO 5 | |

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| ELEMENTS OF BIS STRATEGY AND DEVELOPMENT | CHAPTER 15 PROTECTING BIS | CHAPTER 16 END-USER SERVICES | CHAPTER 17 LEGAL AND ETHICAL ISSUES |



About the authors

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PART
1

Introduction to business information systems

PART 1 INTRODUCTION TO BUSINESS INFORMATION SYSTEMS

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| BUSINESS INFORMATION SYSTEMS TECHNOLOGIES | CHAPTER 3 HARDWARE AND SOFTWARE | CHAPTER 4 DATABASES AND ANALYTICS | CHAPTER 5 NETWORKS |
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Introduction to Part 1

When beginning the study of the use of information systems (IS) in business, it is important to understand a number of concepts drawn from a variety of different fields. In order to create, improve and manage business information systems (BIS), one must combine an understanding of information, systems concepts, business organisations, and information and communications technology (ICT). Part 1 is intended as an introductory section to IS which provides a background supporting further study in Parts 2 and 3. In addition to explaining basic terms and concepts, Part 1 shows, through examples in each chapter, why IS are vital to business today. The role of BIS in transforming organisations through the application of electronic commerce and electronic business is also introduced in Part 1.

Understanding the terms and components that define IS is necessary in order that business users can communicate with the IT suppliers building and maintaining their systems. All systems involve transforming inputs such as data into outputs such as information by a transformation process. The UK Academy for Information Systems defines information systems as follows:

Information systems are the means by which organisations and people, using information technologies, gather, process, store, use and disseminate information.

In simpler terms, BIS can be described as systems that provide the information needed by managers to support their activities in achieving the objectives of a business. Computer-based information systems can be described as IS which use information technology in the form of hardware, software and communications links. The term 'information and communications technology' (ICT) is often used to emphasise the growing importance of communications technology such as local-area networks and the Internet. Throughout this book, the terms 'information technology' and 'information and communications technology' are used interchangeably. Note that IS can be manual or computer-based. For simplicity, computer-based information systems and business information systems are referred to as BIS throughout this book.



LINKS TO OTHER CHAPTERS

Chapter 2 builds upon the concepts described within this chapter and introduces new ideas, such as BIS.

Chapter 6 gives examples of how decision support systems assist decision making.

Chapter 10 describes the techniques used in analysing information flows within an organisation.

Chapter 13 reviews the ways in which information systems can support an organisation's business strategy.

Chapter 15 considers techniques for increasing the security of information.

Basic concepts – understanding information

CHAPTER AT A GLANCE

MAIN TOPICS

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LEARNING OUTCOMES

After reading this chapter, you will be able to:

- distinguish between data, information and knowledge;
- describe and evaluate information quality in terms of its characteristics;
- classify decisions by type and organisational level;
- identify the information needed to support decisions made at different organisational levels;
- identify some of the tools and techniques used to help make decisions.

MANAGEMENT ISSUES

The purpose of business information systems (BIS) is to produce high-quality information that can be used to support the activities of an organisation. In order to gain a good understanding of BIS, managers must first understand the nature of information and how effective decisions are made. From a managerial perspective, this chapter addresses the following areas:

- the importance of managing information and knowledge as a key organisational asset;
- the transformation process from data to information of high quality;
- the process and constraints of decision making;
- the different kinds of decisions that managers make and how these affect the organisation.

INTRODUCTION

The general aim of this chapter is to introduce readers to the basic concepts needed to gain a thorough understanding of business information systems (BIS). However, before looking at BIS themselves, it is important to understand something of the nature of information. For BIS to be effective, the quality of information provided is vital. In this chapter, we look at how we can assess and improve the quality of data and information. The topics covered are intended to give readers an understanding of:

- the nature of data, information and knowledge;
- the value of information;
- the characteristics that can be used to describe information quality;
- information in the context of the e-business environment;
- managerial decision making, including the characteristics of decisions at different organisational levels;
- the information needed to support decision making.

DATA AND INFORMATION

As will be shown a little later, much of a manager's work involves using information to make decisions and ensuring that information flows through the organisation as efficiently as possible. Increasingly, technology is used to capture, store and share information throughout the organisation and with business partners. Many organisations are keenly aware that using information – and information technology – effectively can have an impact on every aspect of their operations, from reducing running costs to dealing with competition in the marketplace. In his best-selling book *Business at the Speed of Thought*, Bill Gates (2001) says, 'Information technology and business are becoming inextricably interwoven. I don't think anybody can talk meaningfully about one without talking about the other.' In this chapter we present an insight into the natures of data, information and knowledge to provide a foundation for learning about BIS.

Russell Ackoff's 'DIKW' model (Rowley, 2007: 176) provides a good framework for helping to understand the relationships between data, information, knowledge and wisdom. As can be seen in Figure 1.1, these concepts can be shown as a hierarchy. The hierarchy suggests three important ideas. The first is that data become information, information becomes knowledge and knowledge ultimately becomes wisdom. In other words, there is a progression from one level to the next. The second idea is that knowledge and wisdom are somehow more valuable, desirable or important than data and information. This is because wisdom and knowledge sit at the top of the triangle. In turn, this leads to the third idea, that data are relatively common while knowledge and wisdom are less so.

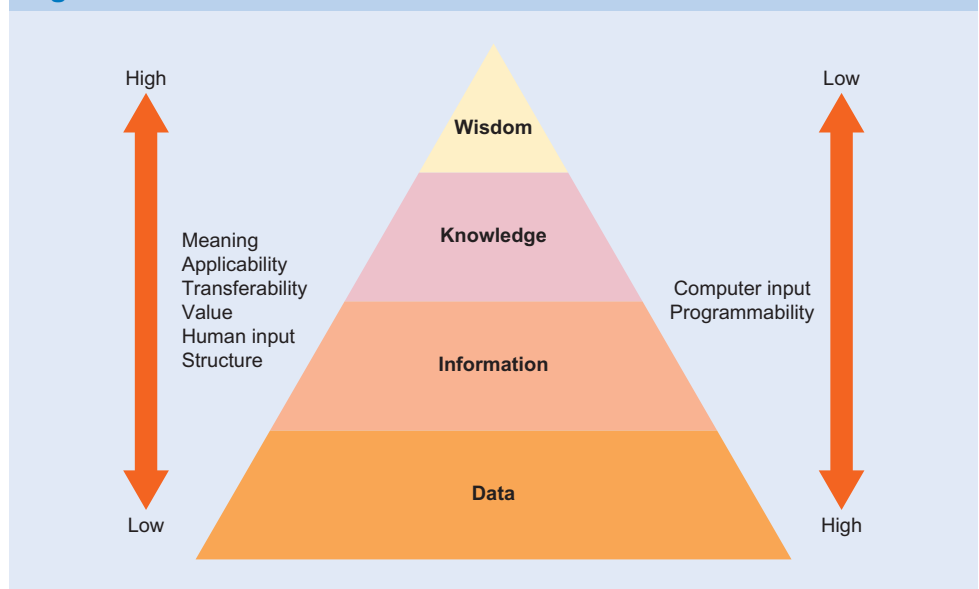
We will look at each of the levels in the hierarchy in detail throughout the rest of this chapter, starting with data in the next section.

What is meant by data?

Data

A collection of non-random facts recorded by observation or research.

Data are raw facts or observations that are considered to have little or no value until they have been processed and transformed into information. A single piece of data is called a datum. Unrelated items of data are considered to be essentially without meaning and are often described as 'noise'. It is only when data have been placed in some form of context that they become meaningful to a manager.

Figure 1.1 The 'DIKW' model

There are several definitions for data that are in common use:

- a series of non-random symbols, numbers, values or words;
- a series of facts obtained by observation or research and recorded;
- a collection of non-random facts.

Examples of data include:

- today's date;
- measurements taken on a production line;
- records of a business transaction, such as a single visit to a web site.

Data can exist naturally or can be created artificially. Naturally occurring data need only to be recorded. In business, organisations often establish procedures to make sure data are recorded properly. When a customer makes a telephone enquiry, for example, staff may be instructed to ask for up-to-date contact details and make sure they are recorded in the company's database.

Artificial data are often produced as a by-product of a business process. Processing an organisation's accounts, for example, might produce the number of sales made in a particular month.

What is information?

As with the concept of data, there are several definitions of **information** that are in common use:

- data that have been processed so that they are meaningful;
- data that have been processed for a purpose;
- data that have been interpreted and understood by the recipient.

Information

Data that have been processed so that they are meaningful.

Three important points can be drawn from these definitions. First, there is a clear and logical process that is used to produce information. This process involves collecting data and then subjecting them to a transformation process in order to create information. The concept of a transformation process will be discussed in more detail in the next section. Secondly, information involves placing data in some form of meaningful context, so that they can be understood and acted upon. Thirdly, information is produced for a purpose, to serve an **information need** of some kind. The concept of an information need is described in more detail later on.

Information need

Information is produced to meet a specific purpose or requirement.

Some examples of information include:

- a bank statement;
- a sales forecast;
- a telephone directory;
- graphs of trends in visitor numbers to a web site.

A somewhat different view of information can be examined by introducing an additional definition:

Information acts to reduce uncertainty about a situation or event.

Although uncertainty can never be eliminated entirely, it can be *reduced* significantly. Information can help to eliminate some possibilities or make others seem more likely. Managerial decision making can be improved by using information to reduce uncertainty. Information is said to influence *decision behaviour*, the way in which people make decisions. Managerial decision making is dealt with in more detail in a later section.

To summarise the key points made in the preceding section, information:

- involves transforming data using a defined process;
- involves placing data in some form of meaningful context;
- is produced in response to an information need and therefore serves a specific purpose;
- helps to reduce uncertainty, thereby improving decision behaviour.

At this point it is also worth considering the question of whether or not data has any value. One view suggests that, since data are effectively meaningless until processed further, they have no real value. However, it can be argued that the costs associated with capturing and storing data impart some value and importance to them. Ownership of data may also add value since data can be seen as an exclusive resource that can be exploited in many ways. The idea of value is discussed again a little later on.

CREATING INFORMATION

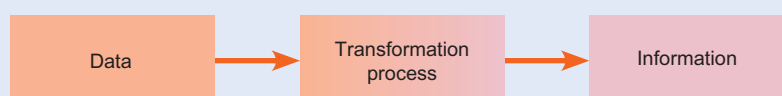
Transformation process

A process used to convert data into information. Examples include summarising, classifying and sorting.

Processing data is necessary to place them into a meaningful context so that they can be easily understood by the recipient. Figure 1.2 illustrates the conversion of data into information.

A number of different **transformation processes** can be used to transform data into information. Transformation processes are sometimes also known as ‘data processes’. The next section describes a range of common transformation processes.

Figure 1.2 Transforming data into information using a data process



Transformation processes

Some examples of transformation processes include the following:

- *Classification.* This involves placing data into categories, for example categorising an expense as either a fixed or a variable cost.
- *Rearranging/sorting.* This involves organising data so that items are grouped together or placed into a particular order. Employee data, for example, might be sorted according to surname or payroll number.
- *Aggregating.* This involves summarising data, for example by calculating averages, totals or subtotals.
- *Performing calculations.* An example might be calculating an employee's gross pay by multiplying the number of hours worked by the hourly rate of pay.
- *Selection.* This involves choosing or discarding items of data based on a set of selection criteria. A sales organisation, for example, might create a list of potential customers by selecting those with incomes above a certain level.

It is worth noting that any action that serves to place data into a meaningful context can be considered a valid transformation process. In addition, several processes may be used in combination to produce information.

Activity 1.1

Data v. information

From the point of view of a student at university, which of the following might be examples of information? Which might be examples of data?

- (a) the date;
- (b) a bank statement;
- (c) the number 1355.76;
- (d) a National Insurance number;
- (e) a balance sheet;
- (f) a bus timetable;
- (g) a car registration plate.

Value of information

While it may be debatable whether data have value, there is a general consensus that information has value and that it is often possible to measure that value directly. The **tangible value** of information is often measured in terms of financial value. An example might be the use of inventory information to improve stock control procedures. A simple calculation can be used to determine the value of a given item or collection of information:

$$\text{Value of information} - \text{Cost of gathering information}$$

However, in many cases, it is not possible to calculate the value of information directly. Although it is certain that the information is of benefit to the owner, it is difficult – or even impossible – to quantify its value. In such cases, the information is said to have **intangible value**. A good example might involve attempting to measure the extent to which information can improve decision behaviour. Such a calculation might appear as shown below:

$$\text{Improvements in decision behaviour} - \text{Cost of gathering information}$$

Tangible value

A value or benefit that can be measured directly, usually in monetary terms.

Intangible value

A value or benefit that is difficult or impossible to quantify.