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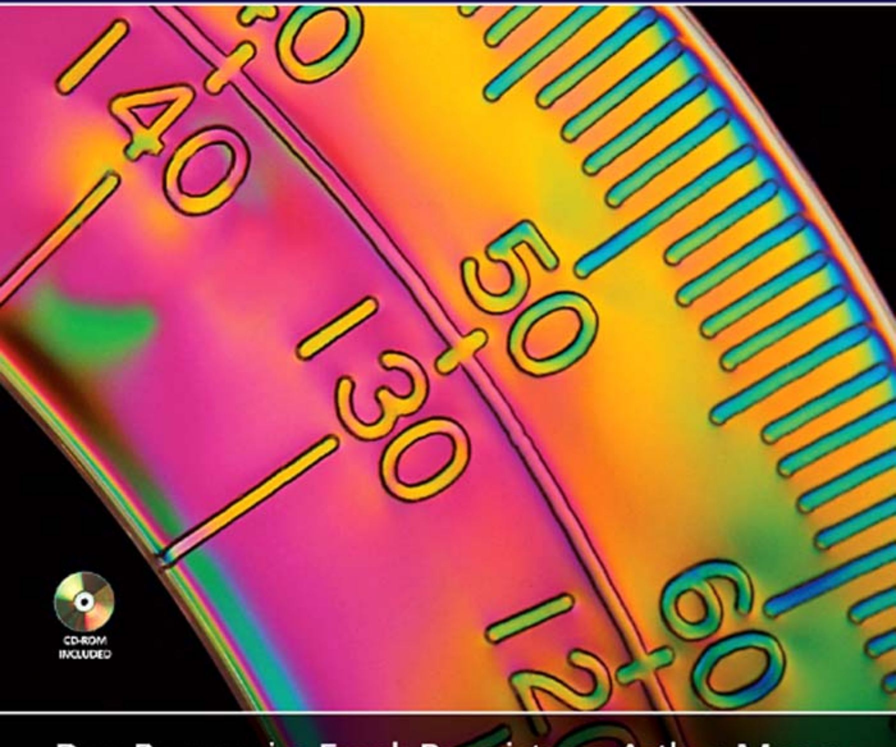
The Effective Measurement and Management of ICT Costs & Benefits

Third edition



Dan Remenyi • Frank Bannister • Arthur Money

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Dan Remenyi
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About the authors

Dan Remenyi is a visiting professor in information systems management at the School of Systems and Data Studies at Trinity College Dublin and a visiting academic fellow at Henley Management College in the United Kingdom. His original academic interests are in the field of information systems management with special emphasis on the evaluation of information and communications technology investment. His major concern in this respect has been to help organizations understand if they have been obtaining value for money from their considerable investment. In this regard he has worked with various applications including technology to support decision making, corporate strategy, knowledge management and e-government. He runs courses and seminars on this topic in a number of countries.

His work has been published in some 30 textbooks and 50 peer refereed papers. Some of his books have been translated into Chinese, Japanese and Romanian. He has consulted with many organizations over the years including banks, manufacturers, distributors, retailers and educational institutions. He holds a B Soc Sc, MBA and PhD.

Frank Bannister is Head of the Department of Statistics at Trinity College Dublin. Prior to becoming an academic in 1995, he worked in both the Irish civil service and for PricewaterhouseCoopers as a management consultant. His research interests include e-government, e-democracy and IT value and evaluation, particularly in the public sector. He has been published extensively in both academic and professional spheres, the latter including a book on the Financial Management of IT. He is editor of the *Electronic Journal of e-Government* as well as being on the editorial boards of several other academic journals. Frank is a member of the Institute of Management Consultants in Ireland, a Fellow of the Irish Computer Society and a chartered engineer. He holds a BA, MSc, CEng and a PhD in IT management.

Arthur Money is an Emeritus Professor with a long history in the design and management of doctorate programmes at Henley Management College. In this respect he works both in the United Kingdom and abroad. Since obtaining his

PhD in 1972 he has assisted several hundred postgraduate students as a supervisor or mentor. He has been published extensively in the field of quantitative methods as well as in the measurement of information systems benefits. He regularly conducts seminars and workshops on research statistics in the UK and abroad. He holds a BSc, MSc and PhD.

How to use this book

This book offers a combination of theory and practice. The theoretical chapters discuss the nature of IT investment and the benefits to be derived from it, while the practical chapters provide guidelines about issues such as business case accounting, ranking and scoring techniques and user information systems surveys.

In general Chapters 1 through 6 can be considered to be theoretical chapters as well as Chapters 13, 14 and 15.

Chapters 8 and 9 address in detail the practical ins and outs of both deterministic and stochastic business case accounting. In Chapter 10 the use of a measuring instrument to assess user satisfaction is described in detail. Chapter 11 addresses the issues of ranking and scoring, with Chapter 12 exploring how this is used specifically in a value for money study.

Chapter 14 takes the user through the practical steps of using evaluation as a project management tool.

Finally, Chapter 15 offers some final thoughts on these complex issues.

All the forms needed for the practical hands-on type sections are provided in the appendices as well as being available in electronic form on the CD which accompanies this book, which also contains video footage of the author team speaking about the changes to the third edition of the book, the way ICT evaluation has been developing and the use and importance of quantitative methods in understanding ICT evaluation.

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Preface to the first edition

So far no comprehensive economics of information has been developed.

By 'economics of information' is meant a systematic series of concepts and theories which explain the role which information plays in assisting the firm in its conception, production and delivery of goods and services in order to create wealth in society. Although much work has been done in the field of cost benefit analysis of information technology as well as user satisfaction with specific systems, little attempt has been made to produce a comprehensive approach to understanding the economics of how information is used to boost either the efficiency or the effectiveness of the firm. Also, the economics of the way information may be focused so that it becomes the basis of a new business strategy, or even how information can itself be used to establish a new enterprise, has not been well addressed.

A definition of information economics is not a trivial matter. A traditional definition of economics states that economics is the science of how wealth is created and managed and how this is achieved through exchange. A non-traditional definition of information would state that it is the presentation of facts and figures in such a way that decisions may be easily and quickly made. Therefore, it may be said that the economics of information is concerned with how facts and figures may be used to create, manage and exchange wealth. This is a very wide subject area, which overlaps with many other aspects of business management.

As will be seen in the first chapter, IT has been used to help manage wealth creation for quite some time. This has been done through the processes referred to as automate and informate. However, the use of IT to create wealth is a relatively new process sometimes referred to as transformate, which has only been understood for a decade or so.

There are probably several reasons why the economics of information has not been properly developed. One of the most important reasons is that the subject of information economics is a very difficult one and most practitioners respond to the challenges it offers either by attempting to ignore it, i.e. just get on with the day-to-day job, or by understating its importance. Unfortunately for IT practitioners and professionals, top management has begun to insist that much more attention be paid to the economic aspects of information systems than ever before and this has led to an increasing demand for a comprehensive and reliable IT metric.

This book provides a basic framework for understanding the main issues concerning the economics of information as well as some suggestions as to how the firm's IT efforts may be appraised. The book discusses a number of different evaluation concepts as well as reviewing several approaches to cost benefit measurement. It takes a management approach to both investment proposals and to post-implementation audits and describes how separate departments may be set up to specifically measure and manage IT benefits. In the final chapters an approach towards a number of IT assessment metrics (ITAM) is proposed which allows firms to measure their progress towards obtaining maximum value from their information technology efforts.

In all, this book provides a significant step towards an economics of information, but cannot be regarded as a definitive work of this enormous subject. It is a potpourri of ideas and approaches which most IT professionals and many business executives will find both stimulating and useful. Perhaps this book might be considered a guide to measuring and managing IT benefits.

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Preface to the second edition

The original work in writing this book began in 1990 when I developed a two-day executive briefing on the subject of how to manage IT benefits. The course turned out to be very popular and was conducted scores of times in a dozen different countries. From that work we developed a measuring instrument to determine the effectiveness of IT investment and this has now been used in a variety of different organizations in various parts of the world.

In addition, this book has already been through three editions – two editions with Blackwell-NCC and one with Butterworth-Heinemann. This is really the fourth edition, and it is today quite a different book to how it started out. The book and all the activities that surround it have been a major learning experience for all of us involved in this field of study and the further we advance generally the more we realize that the subject is almost limitless.

All this work makes me feel that in a certain sense a considerable amount of progress has been made in understanding the issues involved with the effective measuring and management of IT costs and benefits. On the other hand when I talk to those who claim to know about this subject I am often surprised that basic misunderstandings occur time and again. There is clearly still a lot of learning to be done.

I hope that this book will offer some insights to practitioners, academics, consultants and of course students, who are looking to improve their understanding and their ability to effectively measure and manage IT costs and benefits.

Dan Remenyi

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Preface to the third edition

The roots of this book go back to 1990 when it became apparent that the value of ICT investment was being seriously challenged by practitioners, consultants and academics. Initially it appeared that it would not be a major task to develop an appropriate framework or methodology for this purpose. But 17 years later one of the few matters about which it is possible to be reasonably certain is that there is no simple answer to the question of how to evaluate ICT investment or to measure or manage ICT investment.

In fact the challenge of measuring and managing or evaluating ICT investment is in a way well described in Tom Paxton's 1960s song *I can't help but wonder where I'm bound.* The words are:

> It's a long and dusty road, It's a hot and a heavy load
> and the folks I meet ain't always kind.
> Some are bad and some are good.
> Some have done the best they could.
> Some have tried to ease my troublin' mind.
> And I can't help but wonder
> where I'm bound, where I'm bound.
> Can't help but wonder where I'm bound.

These words are especially appropriate to ICT evaluation because they describe some of the challenges offered by the processes involved.

First – *It's a long and dusty road* – ICT evaluation takes time and there are numerous issues which have to be faced.

Second – *It's a hot and a heavy load* – ICT evaluation is difficult.

Third – *The folks I meet ain't always kind* – ICT evaluation has direct corporate political implications and this may cause problems.

Fourth – *Some are bad and some are good* – Because of the potential political nature of the results of evaluation some people will welcome it and some will oppose it and sometimes quite strongly.

Fifth – *Some have done the best they could* – These people are trying hard to be helpful.

Sixth – *Some have tried to ease my troublin' mind* – And of course many people have been helpful in compiling this book.

But we do know where we are bound and that is a better understanding of ICT evaluation. It is not thought that we will be able to answer all the questions related to this topic but it is hoped that this book will be helpful to readers in understanding the challenges involved and to find a solution for their own needs.

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January 2007

Foreword

This book has been in print for 17 years and has thus made an important contribution to the subject of ICT costs and benefits. All three authors are recognized as thought leaders in this field of study and they stand out as people concerned with improving the practice of management in their chosen fields.

In this new edition of the *Effective Measurement and Management of ICT* there are a number of innovative chapters that significantly enhance the book. One of these is a review of the development of ITC benefit thinking over the past few years. This is welcomed as to really understand where we are in this subject it is necessary to know the history of this field of study. Besides this historical review there are new chapters that provide a more comprehensive overview by including topics on evaluation and management instinct, ICT asset evaluation and a major new chapter on costs. This reflects current thinking in the field.

This book will provide useful insights and methods for both practitioners and consultants. The book will no doubt continue to be used by academics and students.

I welcome this new edition. Readers should find the contents of the book of benefit to themselves personally and to their organizations.

Christopher Bones
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Greenlands, Henley-on-Thames
United Kingdom

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Acknowledgements

Over the years during which this book has been in print many people have contributed to our understanding of the complex issues addressed here. There have been other members of faculty, consultants, IS managers and directors and even students. It would not be possible to produce a definitive list of everyone who has shared their knowledge with us.

However, we would like to mention a few individuals. Michael Sherwood-Smith, Terry White, Paul Griffiths, Alan Twite, Shaun Pather, Egon Berghout, Patrick McCabe and Reet Cronk all offered important insights into the ICT evaluation process at some point over the past few years and I would like to acknowledge our debt to them. We hope that we will continue to learn from each other for quite some time to come.

By its very nature this book cannot offer any closure on this subject or field of study and we look forward to our knowledge and understanding of these issues improving over the years ahead.

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The evaluation of ICT investment – a 50 year odyssey

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> *Learning from history is never simply a one way process. To learn about the present in the light of the past means also to learn about the past in the light of the present. The function of history is to promote a profounder understanding of both past and present through the interrelation between them.*
>
> E.H. Carr, What is History?, p. 68, Penguin Books, 1967

1.1 Introduction

Before examining the issues related to the measurement and management of ICT costs and benefits it is worth reviewing some of developments in ICT evaluation over the period of the last 50 years. ICT evaluation is a complex subject and 50 years is a long time. Consequently, this review of approaches to ICT evaluation must necessarily be at a high level of abstraction and be selective in the approaches reviewed.

The principal objective of tracing the evolution of ICT evaluation over this period is to try to develop an understanding of the thinking behind the use of ICT and how decisions have been made about the suitability of its use. As will be seen, the way ICT is evaluated has changed over time. An interesting question is why this has happened and whether the insights built up are cumulative or characterized by discontinuities.

1.2 The nature of evaluation

Evaluation seems to be a fundamental part of the human social behaviour. Humans evaluate and compare everything from football teams to corner shops. They evaluate governments and their policies, organizational performance and national characteristics. This type of evaluation is predominantly subjective, which does nothing to reduce the passion with which it is conducted and with which individuals sometimes argue for their point of view. Furthermore each and every one of us is in turn evaluated. We are evaluated by money lenders for creditworthiness. Professionals are evaluated by their clients; employees by their employers (and in some organizations vice versa). One of the characteristics of this type of evaluation is that some attempt is made to make it objective. Of course objectivity is always difficult and is at best only partially achieved. In the light of the above, *evaluation may be defined as the act of comparing a process, an artefact, a person, an organization or any other situation with other comparable entities and/or with a set of standards which the evaluator regards as appropriate to that situation*. Evaluation may be formal, requiring a detailed study (taking time and resources) or it may be informal, even *ad hoc*.

1.3 Evaluation in business performance

Many people and most organizations continually evaluate their *own* performance. People monitor their business success, often in terms of their bank balance. They monitor the body mass index and their fitness by attending a gym regularly. Organizations monitor their success for a variety of reasons not the least of which is the impact that their performance will have on the probability of their survival. While commercial companies have long done this, a more recent phenomenon has been the application of this type of evaluation to public sector and not-for-profit organizations. However, the evaluation methods commonly used in commercial organizations do not always travel well when applied to the public sector. Concepts such as return on investment can be difficult to apply. Other approaches such as cost benefit analysis and value for money may be more meaningful. As will be shown later, analogous problems occur in the evaluation of ICT. It would be wrong to push this analogy too far, but the challenge of performance evaluation in the public sector provides interesting parallels to the challenge of evaluating ICT.

Prior to the 1930s, commercial investments were made on the expectation of making profits. The type of evaluation techniques used today were as yet unknown. The entrepreneurs who built the first railways and canals or who built the first chemical plants or commissioned the great ocean liners of the early 20th century did not do so on the basis of blind hope. But neither did they employ teams of financial analysts and specialist bankers to build sophisticated financial models of their projects. As a result, some became extremely wealthy, others went broke. In fact the concept of formal interest in investment appraisal arose well after the industrial revolution and can be traced back to the work of Fisher (1930) in his book, *The Theory of Interest*. Another early writer on this subject was John Maynard Keynes (1936) in his world changing book *The General Theory of Employment, Interest and Money.* These works discuss the idea that, under normal circumstances, an investment needs to earn a yield or a return on the money spent and this became the cornerstone of traditional investment appraisal.

Having pointed out that Keynes was one of the early writers on the subject of investment yields it is only fair to say that he was cognisant of the difficulty which often beset attempts to perform such calculation. One of Keynes' (1936, p. 149) more famous comments is that:

> Our knowledge of the factors which will govern the yield of an investment some years hence is usually very slight and often negligible. If we speak frankly, we have to admit that our basis of knowledge for estimating the yield ten years hence of a railway, a copper mine, a textile factory, the goodwill of a patent medicine, an Atlantic liner, a building in the City of London amounts to little and sometimes to nothing; even five years hence.

Of course Keynes was more interested in the macroeconomic effects of investment than its impact on an individual enterprise. But his comments about the challenge of estimating the values needed to evaluate an investment are equally applicable to building a railway or buying a small computer. It is also remarkable that Keynes' 1936 thoughts remain so relevant in the 21st century.

From the preceding discussion it is clear that investment appraisal is not trivial. If business computers had been in existence in 1936 it is probable that Keynes would have included them together with patent medicines, Atlantic liners and buildings in the City of London as difficult investment decisions. Nonetheless, despite these limitations, for a number of sound reasons, including those to do with probity and good corporate governance, modern organizations feel compelled to perform detailed and complex investment evaluation exercises. These calculations are normally performed before the investment, which is referred to as *ex-ante* although some are undertaken after the investment has been working for some time and are called *ex-post*. Perhaps fortunately, the calculation of yields is only one small part of the evaluation of ICT investment.

1.4 ICT evaluation

If general business investment evaluation is challenging then ICT evaluation may be regarded at least in some respects as *super challenging*. The reasons for this will be explored in some detail later in this chapter, but for the moment it should be pointed out that it is no trivial matter to estimate the benefit flows or the cost implications of an ICT investment. To complicate things further, the economic life of such an investment is usually difficult to estimate. It is interesting to note that the early attempts at evaluation relied on techniques related to investment yield such as cost benefit analysis in the form of cost displacement or cost avoidance models. However, it was soon realized that there were a number of other ways of looking at the problem.

1.5 The first era in business computing

Business computing began in the UK[1] in the early 1950s. The first functional commercial computer was Lyons Electronic Office (LEO[2]), developed by the Lyons Tea Company (Ferry 2004). These early systems played a valuable role in business in that they demonstrated the ability of computers to perform large-scale clerical tasks such as payroll processing, invoicing and inventory recording. More important, they established the role of computers in areas beyond the military and radically changed the landscape of computing.[3]

Where investment evaluation was performed, these early computer systems were usually justified on a cost displacement basis which compared the cost of labour saved against the cost of the computers and associated activities or expenses. Thus the question asked was: Is a computer system costing £*y* to purchase and £*x* to run per annum justified if it produces savings of £*x* + £*n*? If *n* was big enough,[4] then the investment brought value to the organization.

A variation of cost displacement calculations is cost avoidance. In this case the advantage of acquiring a computer system is compared to notional costs which are believed to have been (or which are expected to be) avoided as a result of acquiring the computer. In both these cases relatively unsophisticated calculations were normally performed such as those required to establish payback[5] or a return on investment (ROI[6]). Some organizations would have used the more sophisticated net present value (NPV[7]) or internal rate of return (IRR[8]) approach.

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[1] In the USA in 1951/2 the first commercially successful electronic computer, UNIVAC, was also the first general purpose computer – designed to handle both numeric and textual information. Designed by J. Presper Eckert and John Mauchly, whose corporation subsequently passed to Remington Rand. The implementation of this machine marked the real beginning of the computer era. Remington Rand delivered the first UNIVAC machine to the US Bureau of Census. This machine used magnetic tape for input. http://en.wikipedia.org/wiki/Timeline_of_computing_1950-1979

[2] It is interesting to note that although 3000 miles apart the LEO and the US Bureau of Census were commissioned at virtually the same time.

[3] Thomas Watson, then chairman of IBM, famously said in 1945 that he thought there was a world market for maybe five computers. He was not alone in this type of thinking.

[4] The size of *n* would have to exceed the opportunity cost of using £*y* plus £*x* per annum elsewhere in the organization.

[5] The payback of an investment is the time period required to recover the investment cost.

[6] ROI is normally calculated by dividing the annual net profit or net cash flow derived from the investment by the total cost of the investment. There are a number of variations on this.

[7] The NPV of an investment is the sum of the discounted net cash flows arising in the investment.

[8] The IRR is the discount rate which yields a net present value of zero.

One of the earliest contributions to the ICT evaluation literature is Boyd and Carson (1963).

1.6 The second era in business computing

The second era may be thought of as starting in the mid-1970s with the arrival of the affordable minicomputer. The first minicomputers were developed at the end of the 1960s, but it was only in the mid-1970s with the Digital PDP/11, the IBM System 34 and similar machines that smaller organizations could afford their own computers as opposed to buying time on other people's.[9] The explosion in available business software that followed this was one of the factors that drew attention to the idea of information as a management resource. In this period it was realized that computers not only automated dreary tasks, they could also deliver information using which, more informed management decisions could be made. Nonetheless during this period cost displacement and cost avoidance remained the central plank of ICT evaluation and measures such as payback, ROI, NPV and IRR continued to be regarded as the most important metrics to use. This position started to change as computing evolved with increasing rapidity during the early 1980s. By the mid-1980s following highly influential work by Porter and Miller, it had become common to discuss how ICT could be a facilitator of business success via competitive advantage and the concept of strategic information systems planning became fashionable. American Airlines and American Hospital Supply became urban legends in the world of corporate computing.

The term strategic information systems (SIS) was coined to describe these iconic systems. At the same time it became apparent that these types of information systems did not lend themselves to the established forms of investment analysis based on cost displacement and cost avoidance. Meanwhile, in another part of the forest, the proliferation of personal computers, often with useful commercial lifespans of less than two years, was raising other evaluation questions. Traditional forms of cost control were stretched by these new, low cost, items and the realization that the costs of a PC did not stop when you paid the invoice began to percolate into corporate consciousness. Terms such as 'lifetime cost' and 'total cost of ownership' were yet to appear, but the concepts were beginning to evolve. Even during this period there were dissenting voices. Disquiet in what computers were actually

[9] Buying time on other people's computers was quite popular well into the 1980s. Organizations who sold time were generally referred to as computer bureaus. This type of business has been transformed with the largest computer bureaus becoming facility managers or outsourcers.

achieving was first voiced by Russell Ackoff in his classic paper, 'Management misinformation systems' (Ackoff 1967), which challenged some of the assumptions made about MIS. Ackoff was the first in a long tradition of doubting voices.

Although the term decision support systems had been around for quite some time (Keen 1991 and Scott Morton 1991) it was only towards the end of the 1980s that a new word was coined to describe the computerized information element referred to in making decisions. Shoshana Zuboff is normally attributed with first coining the word *infomate* which described the ability of ICT to deliver relevant information to the right managers at the right time for them to make appropriate decisions. Another word also came into the ICT vocabulary to describe certain types of SIS and that was *transformate.* It was now said that information systems could *automate* (make routine systems faster and more fault or error free), *informate* (deliver the right information to management at the right time and place) or *transformate* (make the organization more competitive). And, it was argued, each of these types of system needed a different approach to their evaluation.

This period also saw the publication of Paul Strassmann's (1985) first book in which he convincingly argued that a correlation cannot be found between ICT corporate expenditure and improvements in ROI or return on equity (ROE[10]). This marks the beginning of attempts by academics, consultants and practitioners to find other more sophisticated ways of evaluating ICT investments. Strassmann advocated the use of a metric which he called Return on Management (ROM[11]). But this did not gain any real currency. Strassmann did make one insightful comment which was to the effect that if an ineffective organization computerizes it will become more ineffective. This of course would apply to the application of most technologies in such organizations.

One group of pioneers in developing a new approach to ICT evaluation were Parker *et al.* (1988) who developed what they called Information Economics. Information Economics was an innovative approach – at least in the world of ICT evaluation. The Parker *et al.* (1988) book is a tutorial. It is easy to read and their argument unfolds logically. It addresses both the theory and the practice of ICT evaluation and it made a contribution to widening the ICT communities' vision of this complex subject. They do not dismiss normal financial type measures. They point out the

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[10] The ROE is the return on equity and is calculated by dividing the net profit after tax by the total of the organization's equity.

[11] ROM is a ratio of the net after tax profit divided by the organization's cost of management. This was a manipulation of accounting data which Strassmann claimed would reveal the real impact of ICT on the management of the organization.

limitations of simple ROI and they attempt to overcome these by incorporating business domain values and risks and technology domain values and risks into the evaluation process. Understanding corporate culture and its underlying corporate values are also part of their system. This is a complex approach which uses a variant of weighted ranking to help managers assess the value of information systems. The authors claim that Information Economics helps the planning of MIS so that maximum value may be derived from the system. This work is an important example of the efforts made to try to take ICT evaluation beyond the arena of the purely financial techniques which underlie the payback, ROI, NPV and IRR approaches. Information Economics did not receive the acclaim which it perhaps deserved, possibly because the technique required a considerable amount of subjective judgement to be mixed with the hard financial numbers. But Parker *et al.* made a valuable contribution to broadening the thinking in ICT evaluation.

1.7 The third era in business computing

The third era in business computing could be said to have begun with the publication of the results of the Massachusetts Institute of Technology report which is referred to as MIT 90.[12] MIT 90 was led by Michael Scott-Morton and was the largest business ICT research project of its time. Its budget was of the order of $15 million. It was funded by about ten of the largest business houses in the USA and the UK. Based at such a distinguished institution as the Massachusetts Institute of Technology its finding attracted much attention. This research did not address the problems of ICT evaluation as such. What it did was to strengthen the belief that ICT could transform organizations and, if this was the case, it followed that there would be a need for a different sort of metric to evaluate this activity. MIT 90 addressed the problem that it was difficult to see the effect of the use of ICT and it suggested that there may be a lag effect. The authors pointed out that despite the fact that the electric motor was patented in 1837 it did not come into common use until the 1920s, i.e. the roaring twenties (roaring being the noise of the machine powered by electric motors).[13] In that this study discussed both Business Network Redesign and Business Scope Redefinition, it laid the basis for the intellectual underpinning of the Internet and web-based businesses which were to follow ten years later.

[12] MIT 90 is an abbreviation for Management In The 1990s.

[13] See http://www.tecsoc.org/pubs/history/2002/feb25.htm for a brief history of the patenting of the electric motor.

The study was published in several different forms, one of which was the Oxford University Press book, *The Corporation of the 90s*. In this book the notion of evolutionary and revolutionary information systems was introduced to the wider world. Local exploitation of computer power and efforts to integrate information systems were regarded as *evolutionary* applications. Business process re-engineering (BPR), business network reconfiguration and business scope redefinition are all discussed as examples of *revolutionary* information systems. It is probably only by about this time that ICT began to be seen not as something in its own right but as a major facilitator of changing business processes. Concurrently with the MIT 90 book, two American consultants, Hammer and Champy (1991) wrote a paper in the *Harvard Business Review* and also published a book on BPR. This also helped reposition ICT as a major facilitator for transforming organizations.

During this period, Strassmann's was not a lone dissenting voice. From the mid-1980s an increasing number of authors were expressing doubts about the returns on ICT investments. Various articles questioning the value of IT started to appear and the issue was aired in leading business journals such as *Fortune Magazine* (Bowen 1986) and the *Financial Times* (Griffith 1997). Dier (1992) cites a litany of reports expressing, in one way or another, concern about the lack of return from IT investment.

Meanwhile, a significant amount of energy was being devoted to try to find methods of evaluating the impact of ICT as a transformer of organizational performance. A group at the Massachusetts Institute of Technology, using macroeconomic data, declared that they could not find evidence of increased productivity resulting from the use of computers. This was clearly articulated by the Dean of MIT and Nobel Laureate Robert Solow who (reportedly) said:

> You can see the computer age everywhere but in the productivity statistics.

Following on from this, researchers from MIT such as Erik Brynjolfsson (1993) declared that there was *a productivity paradox*, i.e. the productivity paradox referred to the fact that record sums were being invested in ICT, but there was no apparent increase in the national productivity statistics. Another way of seeing this paradox is that there was a *gap* between corporate computerization expenditure and corporate output or productivity improvements.

In 1996, along with Lorin Hitt, Eric Brynjolfsson published a paper entitled 'Paradox lost: firm level evidence to high returns to IS spending'. The reaction to this recantation of the previous productivity paradox did not produce much excitement.

It is worth pausing at this point to note that, by this stage, three distinct strands had emerged within the ICT evaluation literature. The first was the one that had dominated discussion of the benefits and value literature of which the 'hard numbers' school of thought, which used tradition financial and/or economic metrics, was an important subset. Solow and Brynjolfsson were (and are) part of this latter tradition. Their research focused on economic type measures. Unfortunately, these approaches have exhibited similar types of problems to those generated by accounting measures, albeit in this case compounded by a serious lack of good and relevant data. Within a few years Brynjolfsson (Brynjolfsson and Hitt 1996; Hitt and Brynjolfsson 1996) had admitted errors in his approach and was then claiming that ICT offered exceptionally large (arguably ludicrously large) ROIs. By this time, some scholars were becoming sceptical of such econometric methods, not least because of the questionable nature of the data underlying them. There were, however, two other strands to which they could turn. These are the methodological literature and the cost focused literature and it was out of the first of these that many new ideas now started to emerge.

1.8 Some non-accounting approaches

The early 1990s began to see other approaches being explored, in particular in the United Kingdom at the National Computing Centre (NCC) in Manchester. There they attempted to develop a single metric by which ICT could be evaluated. This led to a ranking system which employed a dozen dimensions and the results of which were reported using a spider chart. A variation of this was a method which was developed by the Prudential Insurance Company (Coleman and Jamieson 1994). Much like Information Economics which had been developed about five years earlier the NCC approach did not make a big impression on academe, consultants or practitioners, again possibly because it was too complicated and not easy to understand. However, a few consultants picked up some of the ideas of the NCC[14] and started to offer value for money studies which addressed many of the dimensions suggested by the NCC.

At around the same time Kim (1990) presented a paper at the International Conference of Information Systems (ICIS) on the use of gaps to conceptualize IS user satisfaction. This technique was then adapted for ICT. It was originally developed by Parasuraman *et al.* (1985) and called ServQual. ServQual was

[14] The NCC work conducted in the UK was referred to as Health Check Reviews (HCRs). An HCR gave a high-level comment on how the ICT operation was being managed.

designed for the measurement of service quality in the marketing arena. Kim argued that Parasuraman's ServQual could be used as a surrogate measure for IS effectiveness. This was a major step forward in the non-monetary measurement of ICT systems' success. Unfortunately this type of analysis which is sometimes referred to as User Information Satisfaction (UIS) analysis can only be used in an *ex-post* situation. It does not provide a means of assessing the viability of an ICT investment before it is initiated. Kim (1990) certainly moved the evaluation debate forward. While Kim's approach was an important development, it was only of value in as far as one could accept that user satisfaction was a suitable proxy for ICT effectiveness. (A variety of sophisticated mathematical techniques may be used on the data created by one of these studies which can give it the feeling of a genuinely scientific approach.)

The idea that there was a need for a wider view continued to gain support in the early 1990s. The pioneering work in this was, as noted above, done by Parker *et al.* Symons (1990, 1994), for example, argued the case for multiple perspectives. In 1993, Barbara Farbey, Frank Land and David Targett published their findings from five years of research which emphasized that the only way of understanding ICT evaluation is through the business processes it facilitated. They argued that context was of paramount importance in ICT evaluation. They also pointed out that it was important to focus on who was asking the question about success of the ICT investment and they made the point that evaluation is a political act. As part of their work, they proposed that different methods of evaluation should be used in different contexts and provided a map of which methods were appropriate where.

In 1992 Remenyi, Money and Twite published a comprehensive review of most of the different approaches to ICT evaluation. This work encompassed accounting techniques, ranking and scoring techniques and value for money studies. It also featured the beginnings of a multi-dimensional approach to the problem. However, it remained for Kaplan and Norton (1992) to take the next step in this thinking and to publish both in the *Harvard Business Review* and in a textbook the multi-dimensional approach that they called the balanced scorecard. Although Kaplan and Norton designed the balanced scorecard as a method of assessing business performance, it was a potentially powerful tool for ICT evaluation and consequently was a further important step forward in ICT evaluation thinking. Meanwhile, the Remenyi, Money and Twite book emphasized that the value from ICT does not materialize without effort, and thus management needs to have a benefit realization programme in place.

Another approach which for a while appeared to have great potential was the Options Pricing Model for ICT evaluation. The limitations of traditional financial models such as discounted cash flow (DCF) for ICT evaluation have led researchers to explore alternative methods that allow for incorporating risk analysis and the value of deferral options in information technology investments. One of these alternatives has been to borrow Option Pricing Methods (OPM) from financial markets analysis and apply it to information technology investments. Although this technique is at an early stage and further research needs to be done before it can be used by practitioners, its capability for managing asymmetric returns and deferral options looks promising.

In cases where the firm has a deferral option (delay deployment), the OPM method has significant advantages over the traditional discounted cash flow (DCF) method. The most basic advantage is that, unless an attempt is made to explicitly model asymmetric returns, NPV will always undervalue; another more operational one is that OPM takes into account the fact that changes in revenue will occur as time passes and no parameter adjustments (e.g. discount rate or expected value of revenues) are needed. Examples of how OPM can be adopted in ICT evaluation are the following:

- Organizations that adopt an enabling view of information technology infrastructure often make ICT investments without any immediate expectation of payback. They do this to create the opportunity for later operational ICT projects that support a specific business process which yields measurable revenue (e.g. intranet and multi-media user interface technologies, portal technology, etc.). This is handled in OPM by considering that this opportunity is the option's underlying asset.
- Application design prototyping investments also provide significant option value. With prototyping, the firm aims to maximize the value of an application development project whose value will ultimately be determined by how well its functionality can remain in synch with the needs of a changing business process. Clearly, when there is considerable uncertainty in an organization about whether an application will be able to perform when it is delivered, efforts to break down such projects into phases, and monitor their payback over time, are an appropriate approach. From this perspective, much of the value of a prototype project will be in the options that it offers the firm in the future.

The main criticism made to the application of OPM to ICT is that ICT investments are not tradable, which is one of the underlying assumptions of OPM. However, the finance literature offers several strong arguments in support of the case for using the Black–Scholes version of OPM to price ICT investment options. An intuitive argument is that, in capital budgeting, irrespective of whether a project is traded, the aim is to determine what the project cash flows would be worth if they were traded (i.e. the contribution to the firm's market value).

By the middle of the 1990s e-commerce or e-business was well on its way to be coming a new phenomenon in business. The wave of enthusiasm that followed resulted in a much greater interest in ICT among business and the general public than there had ever been before. But the scramble to create web facilitated businesses did not lead to any improvements in ICT evaluation. On the contrary it could be argued that this rush led to a deterioration of the ICT evaluation practice as preposterous 'new business models' were proclaimed and an army of false prophets foretold the death of traditional business values. Between approximately 1995 and 2000 a whole range of potential businesses, some with very little prospect of success, were launched. Little or no evaluation was performed and most of these businesses failed losing substantial sums of money for their sponsors and shareholders.

1.9 The turn of the millennium

It took until the e-bubble burst in 2000 to prove that this gung-ho approach was not sound. Hundreds of billions of dollars were lost during this period. The George Soros Quantum Fund alone lost $2.5 billion. This period was also marked by the Y2K problem. There were many computer systems which were written in the 1970s, 1980s and 1990s which used a date format of two digits. With the ending of the century and the millennium on 1 January 2000 these elderly pieces of software were suspect and could easily have crashed with catastrophic consequences. This potential problem inspired many organizations to have their old systems, generally referred to as legacy systems, redeveloped or replaced. Much of this work was seen as obligatory and was not subjected to the type of scrutiny which it might have otherwise deserved. There was a general feeling in many circles that the ICT community exaggerated the potential disruptions of the Y2K situation to benefit at the expense of business and society in general. In summary this period was not a vintage one for ICT evaluation as a general euphoria temporarily swept the doubters aside.

In the relative calm that followed the dot.com storm, ICT evaluation has been evolving slowly. The large sums that are being spent on this technology are in themselves a form of confirmation that ICT is producing organizational value (Bannister *et al.* 2003). Furthermore the issue of the challenges involved in producing reliable ICT cost estimates has been raised (Bannister and Remenyi 2000). The idea of the balanced scorecard, which incorporates financial figures with non-financial metrics, or similar multi-dimensional perspectives, is increasingly accepted as a respectable approach. However, as the world emerged from the financial debris of the dot.com crash, the stage was set for a more cold blooded and negative approach to ICT investment. The years from 2000 to date have seen both a more reflective attitude towards ICT evaluation and something of a 'back to basics' backlash. A renewed emphasis on things like value for money and ROI has accompanied the greater acceptance of the principle of using multiple lenses. There has also been the realization that ICT should not be evaluated by specialist evaluators, but rather by those who use the technology themselves (Keen 1991; Remenyi 2005). The one noticeable exception to this has been the HBR paper by Nicholas Carr (2003). In this paper and a book that followed Carr (2004) argued that ICT had lost its capacity to offer competitive advantage. The argument was that ICT, like many other revolutionary technologies that preceded it, was getting closer to its phase of advanced build-out and becoming an infrastructure. It has thus become a cost of doing business that must be paid by all, but provides distinction to none. From an evaluation point of view, if this is the case then it would seem that it is hardly worth spending effort on evaluation at all.

1.10 Some other ICT evaluation issues

As part of the search for a robust method of evaluating ICT several important issues emerged which offered additional understanding of the problems and challenges faced by those who would evaluate their ICT investment. The first of these was the process nature of any evaluation, especially ICT evaluation. The second was the fact that any evaluation is quintessentially a political act.

The process nature of ICT evaluation was addressed in the Remenyi, Sherwood-Smith and White book *Achieving Maximum Value from Information Systems: A Process Approach*, in 1997. One of the contributions made by this book was to argue that ICT evaluation was not short of tools. It was perhaps even hampered by the proliferation of different approaches. What ICT evaluation required was to be placed in the context of a management process and before this could be done it was necessary to position evaluation in terms of some basic attitudes to evaluation itself. Thus the terms summative[15] and formative evaluation were introduced. In general evaluation, especially *ex-post* evaluation, could not be competently performed without it being part of a greater process of ICT management.

[15] The concepts of summative and formative evaluation are discussed in *Achieving Maximum Value from Information Systems – A process approach*, Wiley, Chichester, UK, 1997 by D. Remenyi, M. Sherwood-Smith, with T. White.

The fact that ICT evaluation has a political dimension was also discussed in this book. The process of appraising new investment is always a political process in so far as it touches on the diverse interests of many people and stakeholder groups. Farbey *et al.* (1993) stated that:

> The process of appraising new investment is always a political process in so far as it touches on the diverse interests of many people and groups.

This thought brings home the fact that an ICT investment may well have a wide range of stakeholders some of which may be friends and others enemies and that the attitudes of the different stakeholders need to be taken into account when an evaluation of the investment is made.

The book by Remenyi *et al.* (1992) emphasizes the need to explore the context of the ICT investment before it can be evaluated. In stating that evaluation was a political act, Farbey *et al.* (1999) made us aware of the need to examine the motives for evaluation. Remenyi *et al.* (1992) discuss the multi-dimensional or multi-perspective approach to ICT evaluation without giving it the name balanced scorecard. That was to remain incomplete until Kaplan and Norton arrived and created a whole industry out of this concept.

1.11 Examining the timeline in more detail

Examining the past 50 years of ICT evaluation it can be seen that it is characterized by a number of waves of thinking which have to be understood in terms of their times and the maturity of the use of the technology. Table 1.1 shows the different waves and the uses of the technology together with other evaluation issues. One of the important issues which has arisen is that an ICT evaluation study is actually a research study and it needs to be thought of as such. There are several implications resulting from this way of looking at ICT evaluation which will now be discussed.

The early applications were thought of as primarily being direct interventions into the cost structures of organizations and the ICT community at that time saw the cause and effect relationship between costs and benefits as being the primary issue. The relationship between ICT investment and corporate costs were seen through a positivist[16] lens. This assumed that ICT investment costs could be accurately measured and the effects could be identified and also measured. This was to change when it was realized that the cause and effect relationship was more subtle and complicated than had been thought heretofore.

[16] The term positivist is used here to denote a purely quantitative view of evaluation which would rely exclusively on physical measurements including money measurements.

Table 1.1 A timeline-based view of ICT evaluation thinking

Date	Primary applications	Approach to evaluation	Metrics	Who should be the evaluator
1950 to mid-1970s	Labour saving devices	Simple cost reduction or cost avoidance	Payback ROI	Accountants or auditors
Late 1970s–1980s	More sophisticated applications including automate and informate applications	Still a strong emphasis on Accounting-based approaches Strassmann suggests a new metric	Payback ROI but also NPV, IRR and other discounted measures Return on management	Mostly accountants or auditors
1990s	The concept of infomate is strengthened and transformate becomes an issue BPR becomes a fact in how ICT investment is viewed	Although cost reduction or cost avoidance are still used they are now in a more sophisticated arena The search for other metrics is heated up with work being done on both sides of the Atlantic	An increasing wide range of metrics which are then combined into a multi-perspective format the best known of which is the balanced scorecard	A combination of organizational officers including accountants and auditors but also IS staff and consultants
Late 1990s experiences the e-bubble and the Y2K effect	Evaluation takes a back seat	The idea of the new economy gains currency	Metrics are underplayed	Little evaluation done

(*Continued*/)

Table 1.1 (/Continued)

Date	Primary applications	Approach to evaluation	Metrics	Who should be the evaluator
2000	e-bubble bursts		Calculation of money lost	Stock market evaluates the range of investments made during the e-rush to invest Senior corporate executives complain that there was an overspend on Y2K Entrepreneurs and investors bemoan their losses on the stock exchanges
Since 2000	Increasingly wide range of applications	Some form of multi-dimensional perspective with emphasis on the strategic impact of ICT	A series of balanced scorecard type metrics	Managers who are using the technology
	Realization of the importance of management instinct in ICT evaluation	More appreciation of the life time costs of ICT		Senior and top management
	Realization of the challenges inherent in producing relevant cost data			

In understanding how the ICT evaluation lens changed, it is important to remember that ICT evaluation theory and practice has been, and still is, a moving target with a continuous stream of new ideas emerging.[17] This is why this field of study is sometimes referred to as eclectic. The wide range of approaches is indicative of the fact that there is little consensus in this field of study and practice. Sometimes regarded as evolving, ICT evaluation may also be thought of as somewhat chaotic, there being so little consensus and so many different views. The evolution in this field of study is triggered by new minds coming to this subject and bringing to it fresh outlooks, often being borrowed from other fields of study which have a different research paradigm. Despite this, the one constant has been the crucial significance of a financial dimension.

Examining Table 1.1 it is not difficult to see just how important financial analysis has always been and still is in the evaluation of ICT investments. This is despite the fact that cost benefit analysis is seldom if ever accurate, though cost benefit calculations may be accurate enough to give adequate insight into the investment decision and to be able to subsequently comment on its success. It is also worth pointing out that the financial approach is the only one that has been available from the earliest days in the 1950s. Such methods continued to be used despite the fact that during this period high levels of inflation were experienced in many countries and this damaged the credibility of the accounting systems and methods.[18]

One of the main reasons why financial-based evaluation systems have persisted is that they are easy to understand and that they are the common currency of managers, even non-financial managers. The variables required for their use are clearly defined and, while there are technical arguments about nuance, there is little disagreement among exponents as to how to use them or interpret them. The problem which arises is that it may be exceedingly difficult to estimate the necessary input values. It has been previously believed that the benefits of ICT were difficult to measure but that the costs were not. In their 2001 paper Bannister *et al.* demonstrated that ICT costs can be quite difficult to measure.

Research today tends to look at issues to do with the implementation of different techniques of evaluation and observes their impact on organizations and the individuals involved.

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[17] It is now suggested by some that the flow of new ideas has slowed down and this may be the case. On the other hand it is likely that new ideas will still emerge to help understand how ICT costs and benefits may be controlled.

[18] For more on inflation see http://en.wikipedia.org/wiki/Inflation

1.12 Lessons learnt

A striking, and perhaps disappointing, fact is that over the past 50 years, no core or overarching theory of ICT evaluation has emerged despite an exceptional effort to find one. It is clear that ICT has a substantial impact on organizations and that this impact is generally for the better (Bannister and Remenyi 2000). There was probably a brief moment in the late 1980s or early 1990s when some members of the ICT community thought that a single ICT evaluation metric and supporting theory would be developed. This is no longer the case. It is now understood that there are many metrics which are capable of reporting the success or otherwise of ICT investment. In addition new metrics are likely to be developed as the ICT community continues to struggle with the challenges of evaluation, although the emergence of genuinely novel ideas is becoming increasingly rare. It was noted above that the context of the evaluation and the motives of the evaluators are important. Thus it is important to bear in mind why the ICT is to be evaluated and then to select the appropriate metrics. This, in essence, is the approach recommended by Farbey *et al.* in 1999. The choice would appear to boil down to two poles: look at the context and choose the best method; or apply a number of methods and combine these in some way. In so doing there is always the danger of relying on numbers as a crutch (Bannister and Remenyi 2000; Boyle 2001). It is important to note that there are many different ways of using ICT evaluation metrics and these will produce different results. This is what is meant by the eclectic nature of ICT evaluation.

So is the search for a definitive theory of ICT evaluation, like the quest for the Holy Grail, a vain pursuit? If one is to believe Carr, the answer is yes. His view may be summarized as organizations should make modest, follow-the-leader, low risk investments in ICT and not worry too much about returns on investment or improved competitive advantage. However looked at from a wider perspective, the answer is a definite no and for at least two reasons.

The first of these reasons is that there is still a great deal that we do not understand about how and what humans value. Furthermore human values change, not only over time but also from one situation to another.

Consider return on investment. First, this metric simply looks at an investment from the perspective (or the values) of one group of stakeholders and ignores the potential interest (or the values) of others. Just because an investment profits one group does not necessarily mean that it will be valued by other stakeholders. Second, there are new challenges continually coming down the pipe. Developments in ICT, particularly in areas like artificial intelligence and robotics, pose entirely new problems and questions for evaluators and may change the locus of some questions entirely. So the struggle is far from over. On the other hand, an overarching theory, like a definitive theory of the universe, may prove elusive. In the paper referenced above, Ackoff famously concluded that 'the business of managers is managing messes'. ICT evaluation is just such a mess and like all management problems, while it can be frustrating, it always offers opportunities for fresh thinking and thus fresh insights.

But whatever novel insights are developed it is most likely that they will be part of a multi-dimensional framework of which the balanced scorecard is but one.

From another perspective lesson learnt regarding decision-making quality is that there is a difference between the (perceived) success of an evaluation and the effect of an evaluation (Nijland 2004). Evaluation methods have a major effect on decision making, even though the evaluation activity, as such, might be perceived as unsuccessful. This continuous interaction between evaluation and organization also implies that evaluation continuously needs to be adopted to the changing organizational setting (among others, caused by evaluation itself). Understanding the complex phenomenon of evaluation requires notions from social, economical, political, cultural and historical perspectives.

The lesson learnt regarding the economic perspective is that successful (upfront) ICT evaluation requires a lifecycle approach (Berghout and Nijland 2002). We assume that a major problem in cost benefit management is the relative isolation in which the various lifecycle evaluations take place. Investment appraisal is treated separately from system development, which is again dealt with separately from operations. Most cost and all benefits, however, occur during operations. A professional and learning organization is required to build up the knowledge base to link existing cost and benefits to future investment evaluations.

1.13 Summary

In the past 50 years the evaluation of ICT has attracted a great amount of research, comment and debate. Although this work has not led to a single evaluation method or generally agreed approach to ICT evaluation, it has led to a much greater understanding of the issues involved and this research has pointed out many interesting attributes of the use of ICT in organizations. Furthermore this research has led to a less naïve approach to ICT investment and to a greater understanding of the behaviour of ICT costs and benefits.

However, the research activity in ICT evaluation is by no means finished. Academics, consultants and practitioners are still active in this arena and there does not seem to be any converging of the findings of this work. There is little doubt that there are more insights to be found and a more complete understanding to be achieved in this difficult field of study as was pointed out by Checkland (1986, p. xii):

> *Obviously the work is not finished, and can never be finished. There are no absolute positions to be reached in the attempt by men to understand the world in which they find themselves: new experience may in the future refute present conjectures. So the work itself must be regarded as an on-going system of a particular kind: A learning system which will continue to develop ideas, to test them out in practice, and to learn from the experience gained.*

2

The elusive nature of ICT benefits

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Nowadays people know the price of everything and the value of nothing.

Oscar Wilde, *The Picture of Dorian Gray* (1891)

2.1 Introduction

The appropriate level of corporate expenditure on ICT investment has always been controversial. For many years it has been thought by some executives that too much has been spent and not enough return has been obtained from ICT expenditure. As mentioned in Chapter 1, the Nobel Prize winning economist Robert Solow (1987) has suggested that in business one could see computers everywhere but in the productivity statistics. Brynjolfsson (1993) pointed out that there was a productivity paradox, which meant that computers were not delivering the value promised. *The Economist* in 1991, claimed the return on ICT was so poor that organizations:

> would have done better . . . to have invested that same capital in almost any other part of their businesses.

But was the performance of the investment made in ICT really so terrible? We think not and we will address this issue in Chapter 3.

The business community would like to be able to see the benefits of ICT in the same way as one sees a big colourful brass band coming down the street. They want their ICT benefits 'right up in their faces', as the modern idiom would say. However, it is not clear why the business community should have expected ICT benefits to be so glaringly obvious. Maybe this expectation was just unreasonable and unrealistic. There are many aspects of business investment where the benefits are really rather subtle, but are no less real for that. Examples are investment in management education, quality improvements, corporate head offices, prestige motorcars for executives to mention but a few. Maybe, such is the case with ICT investment?

In addition to this, the business community traditionally demanded that ICT benefits should always be expressed in terms of financial values, i.e. how much money was saved or how much extra money was made as a result of the ICT investment. But many ICT investment benefits cannot be satisfactorily stated in monetary terms. Nonetheless they yield real business benefits. These 'intangible' or 'soft' benefits need to be taken into account in any development of the investment evaluation equation for ICT or other assets.

2.2 Economics of information

The measurement and management of ICT benefits is a difficult business, a challenge that has plagued the ICT industry, ICT professionals, consultants and academics for many years. The main reason for this is that despite the considerable amount of research conducted by academics and consultants, so far no comprehensive or rigorous economics of information has been developed.

This term needs some explanation. By economics of information[1] is meant a systematic series of concepts and theories that explain the role which information and information systems play in assisting individuals or organizations in their conception, production and delivery of goods and services in both the private and public sectors. There are probably several reasons why an economics of information has not been developed. One of the most important reasons is that the subject of the economics of information is a difficult one both from a theoretical and a practical point of view and most practitioners respond to the challenges it offers by either attempting to ignore it, i.e. just get on with the day-to-day highly pressurized job, or by understating its importance. The view which practitioners often tried to assert was that, relatively speaking, ICT expenditure was low by comparison with other operating costs and investment and should therefore be seen as an 'act of faith' (Lincoln 1990). If this view was a reasonable one in the past, it is certainly no longer so, as ICT investment has become an increasingly significant component of corporate expenditure. It has been estimated that in some organizations, ICT investment constitutes as much as 50% of total investment.

Fortunately top managers have begun to insist that much more attention be paid to the economic aspects of information systems than ever before and this has led to an increasing demand for a comprehensive and reliable ICT performance evaluation.

2.3 The problems with ICT benefit measurement and management

Four major areas have contributed to the problems with ICT benefit measurement and management. These are:

1. Benefits and identifiable performance improvements
2. The issue of information systems reach

[1] The term economics of information should not be confused with information economics, which is a specific concept derived by Parker and Benson (1987, 1989).

3. Tangible and intangible benefits
4. Benefit evolution

2.3.1 Benefits and identifiable performance improvements

For an information systems project to be judged a success, potential benefits need to be identified as early as possible in the systems development cycle. In fact, in an ideal world benefits would be identified and quantified before the project began. This does happen for some projects, and when it does it is referred to as an *ex-ante* statement. However, it is seldom possible to produce a definitive statement of all the benefits that an information systems development project will deliver. In fact it is often quite difficult to identify benefits fully and accurately in advance. This situation may be complicated when attempts are made to use special ICT benefit metrics. In practice, no special metrics are required. General business performance metrics are perfectly adequate for the identification of ICT benefits.

2.3.2 The issue of information systems reach

Information systems, even when they are simple and stand-alone, often, if not usually, play an important integrating type role in organizations. If one thinks of information as the glue that holds together the structure of an organization, then information systems may be seen as, *inter alia*, the conduit of that glue or the tracks over which the glue is laid and business activities or processes flow. This integrating role brings together a number of different corporate issues, problems and resources. Even for the most straightforward information systems applications, it is never simple to understand exactly what will result from bringing together information about different aspects of a business. There will nearly always be knock-on effects associated with the introduction of any substantial information system especially when such a system has the effect of integrating business processes, providing managers with new and/or wider information or even simply integrating diverse reports about business processes or performance.

Consider, for example, a payroll system where the primary objective is to automate a series of routine and simple clerical type tasks. Such systems will frequently be used as interfaces to human resource management applications which in turn could include details of salary benchmarks, bonus levels, succession planning, training, etc. A payroll system may also be linked to, say, the production costing system and thus be indirectly used to compute actual and/or standard costs, drawing on the amounts paid to staff each week or month. A payroll system may also be interfaced with staff loans accounting or a clock card system. Of course a payroll system will need to be able to transfer data to the corporate general ledgers and to the bank account from which the payments will be made. So a relatively simple system such as a payroll can have tentacles that penetrate and link into several different processes within the organization. Clearly it is a challenge to visualize all the different identifiable performance improvements and knock-on effects that such a system might have.

When more complex business applications are considered such as sales order processing, production planning or control or vehicle scheduling it becomes even more difficult to identify all the possible benefits of a system.[2] In short, information is at the heart of any business and the ability to build useful information systems directly affects the way the business itself is or may be operated and how it performs.

The importance of information is well described by Evans and Wurster when they said:

> When managers talk about the value of customer relationships, for example, what they really mean is the proprietary information which they have about their customers and what their customers have about the company and its products. Brands, after all, are nothing but the information – real or imaginary, intellectual or emotional – that consumers have in their heads about a product. And the tools used to build brands – advertising, promotion, and even shelf space – are themselves information or ways of delivering information. (Evans and Wurster 1999)

When seen in this light, the problem of being able to identify all the benefits in advance becomes an almost insurmountable challenge. Often the impact of an information system is just too complicated to track and thus to assess accurately.

2.3.3 Tangible and intangible benefits

Some aspects of an information system may produce hard or tangible benefits[3] which will visibly and directly improve the performance of the firm, such as

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[2] When it comes to really complex systems such as Enterprise Resource Planning (ERP) then this problem becomes even trickier and benefits have to be, in a sense, discovered as the implementation progresses.

[3] There are several different definitions of tangible and intangible benefits. For the purposes of this chapter a tangible benefit is one that directly affects the organization's bottom line and an intangible benefit does not. An intangible benefit has an indirect impact on the organization's productivity and performance.

reducing costs, and will therefore be seen in the accounts of the organization as an improvement in profit and perhaps in return on investment (ROI). These benefits are, of course, relatively easy to identify and to quantify both in physical terms, i.e. the number of people employed or the number of widgets used, and in financial terms, the number of pounds or dollars saved or earned. But other aspects of an information system may only generate soft or intangible benefits, which while they might improve the general circumstances of the staff and thus make life easier in the organization, may not directly lead to identifiable performance improvements and as such will not be easily discernible in the company accounts.

Although it is difficult to be precise about their actual value, especially in financial terms, intangible benefits can make a critical contribution to the success of an organization. Intangible benefits may often be quantified by using measuring instruments such as questionnaires, but it is quite difficult to make a creditable connection between what can be measured with such devices and the impact on the corporate financial results. This whole area of intangible benefits is one of the major problems that make benefit measurement and management hard.

2.3.4 Benefit evolution

There is a third issue that makes benefit identification, and especially early benefit identification, even more elusive and that is the propensity for benefits to evolve. The benefits of ICT are not stable; some benefits dry up while others, which may originally not have been foreseen, materialize some time after the original investment. In short when planning an ICT investment it is extremely difficult to look into the future and create a comprehensive catalogue of potential benefits. No matter how thoroughly the feasibility study or the business case is prepared, it is normally impossible to foresee all the future ramifications of a proposed information system in advance. Forecasting is notoriously difficult. For this reason, it is perhaps unrealistic to expect a high degree of success at future benefit identification. This is especially true in an environment in which business is rapidly changing.

Information systems will generally have some easy-to-identify or obvious initial benefits that will be sustainable over a period of time. As the development project proceeds and the ramifications of the system are more fully understood, new ideas about potential benefits will start to become apparent. This will have been due to the process of creative dialogue between the principal stakeholders, which will bring to light new business processes and practices.

It is important to emphasize that, for many organizations, potential benefits should not be seen as being static, but rather seen to be evolving. Such benefits become clearer as a greater understanding is gained of the organization and the role that the system will eventually play in it. Of course, as mentioned above, other benefit suggestions that were originally identified may turn out to be illusory.

These three problems explain why ICT benefits have been so difficult to identify and are the prime reasons why estimates of benefits and value have traditionally been so hard to pin down.

Lacity and Hirschheim (1995) summarized the problem thus:

> The problem is that meaningful measures of departmental efficiency do not exist for IS.

Fortunately we are seeing some improvements in this unsatisfactory state of affairs. For the past decade, business executives, as opposed to information systems executives, have been demanding a new approach to the management of information systems. They have been doing this by expressing their dissatisfaction at the way in which information systems departments or functions have been operated.

2.4 Investment, value and economics

One of the first questions that need to be addressed in coming to terms with a new approach to ICT management is the fact that ICT investment has no direct value in its own right. ICT investment has a potential for derived value. It is now widely agreed that ICT benefits are not directly a technology issue as such, but are to do with how businesses use the technology. Therefore, ICT investments need to be measured and managed by P&L[4] people focusing on business processes and practices.

To understand how this investment actually works in an organization it is useful to rethink the role of information systems investment by going back to some fundamental concepts. To use the language of classical economics, an information system is a capital, producer or investment good. A capital, producer or investment good is something that is not acquired or valued for the utility it delivers in itself in its own right. Simply, capital goods do not have any intrinsic utility or

[4] A P&L (profit and loss) person is someone who has corporate responsibility to make all or part of the organization's profit. This role is contrasted with a staff or specialist person who does not have the responsibility to make profit, such as a personnel manager or an information systems manager.

value as a jacket, a meal in a fine restaurant, listening to a guitar concerto, a tennis racket, a holiday in the sun,[5] etc., do.

A capital, producer or investment good is desired because it can be used to produce other goods and services, which in turn may offer us utility and value such as a jacket, a meal or a holiday.[6] Capital, producer or investment goods are essentially tools with which to make other things. A bulldozer is a clear example of a capital, producer or investment good. A bulldozer on its own has no intrinsic value. In fact to many individuals and organizations a bulldozer could be seen as a huge liability as it takes up much space, is costly to move about, requires expensive maintenance and needs a highly skilled and costly operator. A bulldozer's value is only derived as a result of its use, i.e. the hole in the ground, the levelling of the old building or the preparing of the ground for a new road or motorway surface that results from its use. The value potential of the bulldozer is thus linked to the result that may be obtained by its appropriate use.[7] The same principle applies to ICT or to information systems and is illustrated in Figure 2.1, which shows a similar logic to that developed by Soh and Markus (1995).

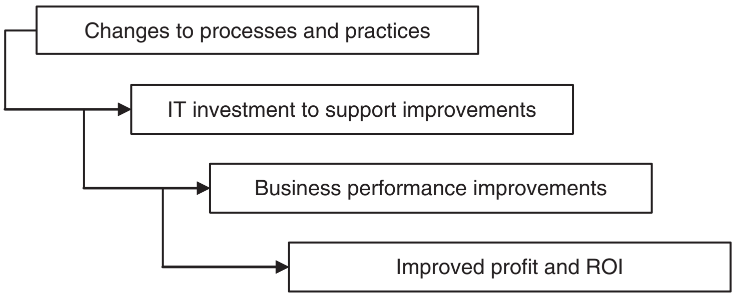

Figure 2.1 The relationship between business process and ICT investment and derived value

As a producer good, ICT has a derived or second-order value that is realized when it is used as a component of an organizational or business process or

[5] A jacket, a meal or a holiday is referred to by economists as consumer goods.

[6] The classification of a good as a producer rather than as a consumer good really depends on the purpose to which it is put. Thus a motor vehicle purchased for pleasure is a consumer good, albeit a durable consumer good. A motor vehicle purchased for an engineer to inspect equipment which is being manufactured is a producer good.

[7] Of course it is possible that some extraordinarily eccentric and very wealthy individuals might actually collect bulldozers and in such a case a bulldozer would indeed become, in classical economic terms, a consumer durable good.

practice. In fact for the value of ICT to be generated or realized, it is necessary that the business process or practice to which it contributes actually improves the effectiveness, economics and/or efficiency of the enterprise. In as far as these organizational or business processes or practices produce improvements to the business they will, at least in the medium term,[8] positively affect one or more of the corporate performance variables. In turn this will show in the corporate performance indicators and thus be seen to be delivering value.

Quite specifically, if the process innovation and improvement which is to be supported by an ICT investment is to improve productivity, then the ICT investment will be judged primarily on whether that has been achieved.[9] An improvement in productivity would mean that more goods and services are produced for the same amount of input, or that the same number of products or services is produced for less input. This is essentially a cost or pricing issue (Handy 1998). However, such a system might also improve the quality of the products being produced and perhaps also have a positive impact on the morale of the manufacturing workers. If this were the case then it would be appropriate to evaluate the process innovation and improvement on all three of these variables.

On the other hand, if the process innovation and improvement were to enhance customer satisfaction then the ICT investment needs to be judged on whether that has been achieved. Some instruments such as a ServQual scale (Parasuraman *et al.* 1988) could be used to measure an improvement in customer satisfaction. In such a case it might not be all that useful to try to reduce these benefits to equivalent monetary values. On the other hand, these benefits are clearly measurable and they can give the organization a major competitive advantage in the marketplace. Such a system might also improve the cost effectiveness of serving customers and if this were the case then it would be appropriate to evaluate this process innovation and improvement also in terms of its financial impact on the organization.

In practice it will seldom be appropriate to evaluate a process innovation or improvement in terms of one metric alone. Typically this type of evaluation

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[8] Traditionally in economics the short term was under one year and the medium term was more than one and up to five years. The long term was something further away. Keynes is famous for cautioning us against relying too much on what could happen in the long term by pointing out that in the long term we are all dead.

[9] Several variables are combined here and thus it is possible that the ICT has delivered the improvements intended but some other aspect of the process improvement has been faulty and thus no overall improvement is observed.

requires multi-metric analysis, and this needs to be managed by the principal stakeholders.

To ensure that the value of the innovation or improvement is fully exposed, a process approach needs to be taken to its assessment. This is similar to the process perspective suggested by researchers such as Brynjolfsson and Hitt (1995), Barua *et al.* (1995), McKeen *et al.* (1999) and Mooney *et al.* (1995).

At the outset of the business intervention the process owners therefore need to be quite specific about their objectives and goals and these need to be stated in a business case, a value proposition, or a business model. They need to be quantified where possible and a timetable needs to be established setting targets for when they can realistically be achieved. The next step is to identify in some detail the exact changes to the current procedures and practices that will have to take place and which individuals will be affected by these changes. Then responsibility must be allocated for these changes to take place, together with the necessary resources including time for training, etc. Finally a review mechanism needs to be established, along with a procedure to follow if the proposed changes are not happening. One way of managing all these issues is described in Chapter 14 and is referred to as Active Benefit Realization.

As a consequence of the above, it is clear that ICT investment only derives its value to the organization through its business applications, which can best be effected in the hands of the systems' principal stakeholders. It is these individuals who need to manage the evaluation of the investment.

2.5 ICT investment as an asset

The question of whether an organization's management of its ICT resources is improved if it regards the funds that are spent on this activity to be in the accumulation of an asset, as opposed to simply being part of recurrent expenditure, is an interesting one. It has been argued that by emphasizing the asset or capital nature of ICT expenditure, the organization will somehow manage it more attentively. There does not appear to be universal support for this assertion. It was argued above that an information system has no intrinsic value in its own right. This is certainly what Strassmann (1990) was saying when he pointed out 'a computer is worth only what it can fetch at an auction'. The line of argument espoused by Strassmann suggests that, by itself, an information system is nothing more than a sunk cost that has been spent on a collection of hardware, software and communications equipment (and the cost of this 'kit' is normally a very large amount indeed). In fact it may be argued that there is no overriding reason to see information systems as an asset, except for the fact that they are reusable, i.e. not instantly consumed. Today many personal computers and other small components and systems are written off (in accounting terminology, expensed) immediately and thus do not appear in the balance sheet,[10] being treated merely as an operating cost. This is further explored in Chapter 8.

Once the computer is successfully integrated into a business process then the whole picture changes and to be fair to Strassmann, he did recognize this in his book. It is now generally agreed that an information system only acquires value when it is used in collaboration with other resources as part of a business process or practice that will result in the enhancement of the effectiveness, economics or efficiency of the organization. This conclusion begs the question which business processes or practices should be supported by ICT and how should this actually happen?

2.6 Processes, practices and people

Business processes or practices are made to function or operate by people working in groups, or individuals mostly in line or profit and loss (P&L) positions.[11] In the private sector these people make, sell and support the products or services which the organization was created to produce. But this argument does not only apply to profit-orientated business. In the public and not-for-profit sectors, government and other organizations focus on services at the national, regional or local level. In these organizations managers also use information systems to best support their organizational efforts. It is the efforts of these managers in private or public organizations that make the ICT investment a success or a failure. Furthermore they intrinsically know what benefits are actually being delivered and if the information system should be regarded a success.

[10] Except as a reduction in the retained earnings!

[11] It is perhaps important to note that information systems are not in any way restricted to line or P&L positions within the organization but are used in all sorts of functions and processes including staff or support activities. However, the value arguments will be more easily seen in functions where the organization's profit is at stake.

2.7 People make ICT work

In summary, only when ICT is coupled with other resources, and especially the efforts of the principal stakeholders,[12] can any benefits or value be perceived. There is no standard way of combining ICT with other resources or with people. Davenport pointed out the importance of people in information systems' success when he wrote:

> Information and knowledge are quintessentially human creations, and we will never be good at managing them unless we give people a primary role. (Davenport 1997)

Combinations of information systems, people and other resources are entirely dependent on the context of the business process or practice. There is no generic model as to how this should be done.

2.8 Primary stakeholders

The P&L people are normally the primary or principal stakeholders of the ICT investment. By 'primary stakeholder of the ICT investment' is meant the individual or group of people who have the most to gain or (less frequently) the most to lose if the investment is or is not a success. The characteristic of the principal or primary stakeholder that is of most interest is the fact that he or she or they can directly influence the success or failure of the information systems by their actions. Most often the principal stakeholders are the user-owners[13] and it is the user-owners who can make all the difference between success and failure. It is worth drawing attention to Strassmann's comments on this point:

> The lack of correlation of information technology spending with financial results has led me to conclude that it is not computers that make the difference, but what people do with them. Elevating computerization to the level of a magic bullet of this civilization is a mistake that will find correction in due course. It leads to the diminishing of what matters the most in any enterprise: educated, committed, and imaginative individuals working for organizations that place greater emphasis on people than on technologies. (Strassmann 1997)

[12] Some authors refer to a champion and/or a sponsor as the principal stakeholders.

[13] The term user-owner has been coined because of the fact that the word user has for some people a negative connotation. A user-owner would own the system in the sense that it would be an important tool for him or her to achieve his or her corporate objectives.

Recognition of these line people as the principal or primary stakeholders[14] in any information system requires a fundamental shift in thinking for many organizations. In the 'old days' it was thought that the systems belonged to the information systems people. Having information systems people as systems owners frequently resulted in a most unsatisfactory relationship between P&L people and ICT people. This gap, sometimes referred to as a culture gap, has been analysed by several authors.

This approach of focusing on the people aspect of the affective use of ICT largely eliminates that culture gap.[15] This does not in any way diminish the contribution of the information systems professional to the successful use of business computing. It simply changes the locus of responsibility for the ICT investment decision and the locus of responsibility for ensuring that the new business process is a success.

2.9 The locus of responsibility

Placing the principal or primary stakeholders at the centre of the information systems investment repositions the locus of responsibility[16] for the success of the information system and puts it squarely where it should be, with the line managers and user-owners. There are several reasons why the user-owners need to be centre stage in any information systems investment, but by far the most important is that the chances of the information systems delivering the type of support required by the business process or practice, i.e. being relevant, are substantially increased when this is the case. The problems that arise when the user-owners are not regarded as the primary stakeholders are well articulated by Davenport who said, when talking as an information systems professional:

> We have spent a great deal of time and money bringing water to the horse, but we don't even know if he is thirsty, and we have no idea how to get him to drink. (Davenport 1997)

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[14] Svendsen (1998) provides a general definition of the word stakeholder as follows: 'The term stakeholders refers to the individual or group who can affect or be affected by a corporation's activities. In the information systems environment the stakeholders are all those individuals and groups who can affect or be affected by the information system.'

[15] The culture gap is a term used to describe the difficult working relationship between ICT people and non-ICT people, i.e. what we have called P&L managers.

[16] The idea of locus of responsibility is similar to that of ICT governance. The locus of responsibility would include issues such as how money is allocated to investment, who can give the go-ahead for ICT investment and who are able to comment on the success of these investments. Putting the user-owner in this position is indeed controversial.

2.9.1 The user-owner – not the only stakeholder

The user-owners are not the only stakeholders in an information systems investment. The group of ICT professionals who will work on the technical development of the information system are clearly stakeholders of some considerable importance. They supply the ICT expertise that will make the technology aspects of the new processes work. Traditionally in-house ICT professionals have accepted a large part of the responsibility for the success of the ICT investment. Indeed, one of the most common models is for ICT professionals to develop information systems for their so-called end-users. However, the ICT professional still has a very indispensable role to play in any ICT investment project. The ICT professional should be seen as a critical adviser to the user-owners who will ensure that the appropriate technology is acquired and employed. The role of the ICT professional has also been complicated by the fact that some organizations have outsourced the supply of ICT expertise. Thus an outsourcer can also be an important stakeholder.

Outsourcing has been a familiar aspect of the supply of ICT competencies in many organizations over the past years. Few organizations have ever used contractors or from time to time employed consultants. However, it has only been in recent years that organizations have outsourced all, or the major part of, the ICT operation. Today organizations increasingly use a portfolio of ICT expertise, which includes both internal and external people and organizations. All these sources of ICT expertise may be stakeholders in their own right and are shown in Figure 2.2. In fact there are usually several of these groups involved as stakeholders in any given ICT investment.

ICT Professionals
• ICT staff seconded to user-owner department • Departmental ICT staff • Contractors • Consultants • Outsource contractors

Figure 2.2 The more usual sources of ICT expertise

The next group of important stakeholders are the financial managers and administrators. Financial managers and administrators are always stakeholders in any corporate investment as they are instrumental in making the funds available for the purchase of the equipment, etc.

They will arrange the contracts and ensure that goods are received and that payments are made, etc. Financial managers and administrators are often involved with the detail of the business case accounting, as user-owners may not be familiar with the costing approaches required. ICT investments that are made to improve business processes and practices can affect the internal controls within the organization, and for this reason both internal and external auditors may be required to advise on the propriety of new proposals. Figure 2.3 lists some of the stakeholders that fall into this category.

Financial Services
• Financial managers • Accountants • Capital budgeting staff • Corporate treasury staff • Corporate planners • Corporate strategists • Internal auditors • External auditors

Figure 2.3 Some of the financial managers and administrator stakeholders

2.9.2 Refocus the traditional role of the ICT professional

In the light of all of the above, it is clear that the traditional roles of the information systems professionals need to be refocused. Information systems professionals need to become more involved as advisers and educators, while retaining the role of doers, as they still need to play their part in making the technology work. Information systems professionals should be slow to initiate the innovative processes and practices that are responsible for the benefit of creation and delivery.[18] Nor should they be responsible for identifying benefits or justifying the expenditure. The business case for information systems development needs to be created by line managers, maybe with the help of the other principal stakeholders who will use the system to improve their personal or group efficiency and effectiveness.

[18] There is an issue of technological leadership within an organization. The ICT group are sometimes thought to have a technological leadership responsibility. But this is usually focused on 'thought leadership' rather than being involved in pushing systems towards users.

2.10 Summary

The way forward in reducing the degree to which ICT investment benefits have been elusive requires the recognition that ICT investment needs to be an integral part of a wider programme of process innovation and improvement. The success of the ICT investment is then tightly coupled with the success of the process innovation and improvement. In fact the ICT investment cannot be evaluated independently of this process.

If the process innovation and improvement improves productivity, then the ICT investment will be judged on that achievement. On the other hand, if the process innovation and improvement were, say, to improve customer satisfaction then the ICT investment needs to be judged on whether that has been achieved. It is also necessary to accept that some ICT investment benefits cannot be satisfactorily stated in monetary terms alone. Despite this, such benefits are real business benefits and they need to be taken into account in the drawing up of any investment evaluation equation.

Having established the process innovation and improvement element of an ICT investment it then follows that ICT professionals may not be the most appropriate individuals to initiate or lead such projects. The principal stakeholder of these ICT-enabled or even ICT-driven process improvements needs to be a P&L manager, who is at the same time the information system user-owner.

It is important to recognize the fact that ICT investment benefits have been difficult to identify because of the issue of information systems reach,[19] the nature of tangible versus intangible benefits and the question of benefit evolution. A process approach is required for both the delivery and the assessment of ICT benefits.

Finally the locus of responsibility issue needs to be clearly focused on the user-owners if ICT benefits are to be identified and evaluated.

[19] The notion of an information system's reach refers to the fact that information systems can have knock-on effects in various parts of the organization which were not originally envisaged.

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The role of instinct in ICT benefits assessment

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Long run is a misleading guide to current affairs. In the long run we are all dead.
John Maynard Keynes, *A Tract on Monetary Reform* (1923)

3.1 Introduction

Despite the range of concepts and approaches to ICT evaluation described in Chapter 1, when it comes to making decisions about ICT investment and its resulting benefit streams, many managers use little more than 'gut feeling'. Many researchers who have investigated the practice of ICT investment decision making have found that, when it comes to complex decisions, managers often rely on methods that do not fall within the traditional boundaries of so-called rational decision making.

It seems that managers sometimes base decisions on 'acts of faith' – a phrase that (in various forms) crops up consistently in the literature (Farbey *et al.* 1993, 1999); other examples are 'blind faith' or 'gut instinct' (these expressions are sometimes euphemistically replaced by the term 'strategic insight' which really means the same thing). When managers are not relying on their intuition or instincts, studies of *decision* practice indicate that managers frequently fall back on a relatively small repertoire of techniques involving some variety of simplistic cost benefit analysis.

For both theorists and advocates of rational decision making these are worrying phenomena. After all, there is no shortage of innovative ICT evaluation techniques. Berghout and Renkema (1994, 1997) list 60 while Katz (1993) cites Wilson as having identified over 160! In the light of such a plethora of techniques it can only be concluded that either theory has completely lost touch with reality, the theoreticians have failed to get their message across to practitioners or that the body of theory is still immature and in all probability far from complete.

First, it is argued that a weakness in much of the current research is the fact that the definition of value is usually unclear, frequently inadequate, often partisan and sometimes completely absent from the discussion. Until there is a better understanding in the ICT community of what value is and how managers attempt to optimize it, current ICT evaluation methods for complex decision-making purposes will often be neither credible nor effective. Second, it will be argued that the way decision makers evaluate complex ICT investments is subtle and that current methodologies are at best crude approximations to the reality of this process. In order to understand the nature of these complex decisions a different approach to understanding the situation, i.e. a better model, is needed.

3.2 A question of perspective

Considering the breadth and depth of research on ICT evaluation, the volume of research into the subject of ICT value *per se* is remarkably small. Many papers on ICT evaluation either take value for granted and assume that there is a common understanding of the concept, or define it in a narrow sense to serve a specific purpose. Thus, for example, Brynjolfsson states: 'Productivity is *the* fundamental economic measure of a technology's contribution' (Brynjolfsson 1993, p. 76, emphasis added). This narrow perspective is (perhaps deliberately) limited in its understanding of the nature of ICT value. When the banker/economist Stephen Roach describes the productivity gains of the computer age as 'just a myth' (Griffith 1997) he is reflecting not only a purely economic (or even accounting) viewpoint, but a particular subset of monetary values. As the list of value adding goods and services not measured by conventional accounting and economics is legendary, the ICT industry probably ought not to be unduly concerned about views like this of ICT investment performance. On the other hand, if management actually believes that conventional productivity is the only ICT benefit issue and that using conventional accounting metrics is the only way of understanding this, Roach's assertion probably has some degree of validity.

Observation suggested that there had to be something profoundly wrong with Brynjolfsson's and Roach's diagnoses. Over the past 30 years, the computer industry has grown to vast proportions. If Roach is correct, then an entire generation of global managers must be responsible for a colossal and collective act of enormous folly. Organizations would not have made ICT investments on this scale if it were as irrational as some economists claim. The real lesson here may well be that pronouncements by accountants and economists on ICT value tell us more about the inadequacies of accounting and economics than about the inadequacies of ICT investment.

The severe criticism in the professional and business press of ICT value has, not surprisingly, provoked the IS community into trying to respond in order to demonstrate how worthwhile their endeavours actually are. Although there are those who support the notion of the value of ICT such as Davis and Davidson (1993) when they said:

> By 2020, 80 percent of business profits and market value will come from that part of the enterprise that is built around info-businesses.

There are also those whose research makes it clear that IS has not been generally valued. For example, Lacity and Hirschheim (1995), looking at the development of ICT outsourcing, reported that:

> senior management in the participating companies do not value information systems in the way they account for the function. In eleven of the thirteen companies,

> the IS departments are set up as overhead accounts. As an overhead account, the IS function is viewed as a necessary cost, but one that does not add value directly to the company.

In the IS research world, this debate has developed into what Farbey *et al.* (1993) call the 'great benefits hunt'. There have been two primary lines of counterattack. The first, exemplified by Brynjolfsson, Loveman, Hitt and others, might be loosely termed econometric and tries to find relationships between input and output data. This approach takes on the economists on their own ground and using their own weapons – a questionable tactic that has led to much confusion with successive announcements of the productivity paradox followed by contradictory statements usually called something like paradox lost and paradox regained. An alternative approach, but one which still uses essentially the same weaponry, has been the process view. Soh and Markus (1995) have reviewed and endeavoured to synthesize a number of such methods. While this approach looks at value creation as a process, the value concepts used, though much more refined and wide ranging than simple productivity (e.g. 'improved organizational effectiveness'), are still essentially economic.

The results obtained from all these econometric approaches are not very satisfactory. The data is problematic, the appropriateness of the methodology debatable, the theoretical models open to challenge and the conclusions either weak, contradictory and/or intuitively suspect. The problems with the type of numbers produced by this approach were well expressed by Bernstein (1996) who said:

> Our lives teem with numbers, but we sometimes forget that numbers are only tools. They have no soul; they may indeed become fetishes. Many of our most critical decisions are made by computers, contraptions that devour numbers like voracious monsters and insist on being nourished with ever-greater quantities of digits to crunch, digest, and spew back.

Over the past couple of decades, the challenge to the tyranny of numbers has grown. Boyle (2001), in an amusing but devastating critique of this type of thinking, says of numbers that:

> . . . they can't capture the sheer complexity of human life. They simplify, and they pile up unused in databanks, as if they were the repository of all truth.

Despite this, the work of those who seek to solve the problems of evaluation with economic data has received widespread publicity. The press thrives on bad news and, on the other side, the ICT industry for its part is only too happy to seize on any bit of good news at all, no matter how doubtful its provenance. Meanwhile the overwhelmingly important question persists:

> if the return on ICT investments is so uncertain, why is the ICT industry still growing at double-digit percentage rates per annum?

One obvious answer is that managers and executives know intuitively that ICT returns value, and that the business and human concept of value is deeper and wider than the narrow rationalism than these economic and accounting models are able to identify. Glazer (1993) pointed this out when he observed that managers themselves are the best judges of the value of the variables with which they work.

If this management insight or intuition is right, then the approaches described in the preceding paragraphs are simply not looking in the right place. Oscar Wilde's classic definition of a cynic comes to mind when describing the work of Roach and others: people who appear to know 'the price of everything and the value of nothing'.

But if not with the business input output variables, then where and how should the benefits and the value be sought?

The alternative is broadly sociological and/or organizational and uses a wider definition and conceptualization of benefits. This places value in a broader context than accounting and economics, taking into account both hard and so-called soft or intangible benefits. This approach uses multiple perspectives to emphasize the location of IS evaluation in social/organizational contexts. This clash of perspectives reflects different approaches, implicit or explicit to value. To understand this different approach to ICT evaluation, it is necessary to consider the nature of value itself.

3.3 Some aspects of value

In most of the literature on ICT evaluation, the concept of value is taken to be self-evident or axiomatic – so axiomatic that it need not even be formally defined. Absence of a clear conception of value can, unsurprisingly, lead to some serious misconceptions about the usefulness of metrics designed to measure it. Business value can be deceptive. For example, increases in market share and capacity utilization, both frequently cited 'benefits', can in the wrong circumstances be accompanied by a drop in both absolute profit and/or profitability. There are also ambiguities in and contradictions between traditional measures of value. Even where value is formally defined there is a broad range of definitions used.

The concept of value is clearly complex since it may be regarded as a measure of the organization's effectiveness. Accountants use the concept of 'monetary measurement' which in crude terms may be stated as 'everything has a price'.

One would expect that if an unambiguous definition of value were to be found anywhere it would be in accountancy. However, even accountants are ambivalent about the concept.

Information Economics takes a different view of ICT value based on Porter's value chain. Value, in its definition, may be summarized as the ability of ICT to enhance the business performance of the enterprise. Others differentiate between value and benefits, asserting that value is both larger and more important than benefits. For example, users will develop a strong attachment to an old system. The system thus acquires a sort of value, despite the fact that it may be out of date and inefficient. Berghout and Renkema (1997) define value as the outcome of financial and non-financial consequences of the ICT investment – definitely a more flexible definition!

Others argue that ICT does not create benefits as such any more than does R&D. Like R&D benefits, ICT benefits are the result of complex lagged effects.

Finally, this subject is also plagued by conflicting evidence. For example, Huff (1990, p. 43) states that:

> While the findings have not been totally consistent, generally market leaders have been shown to have invested heavily in ICT, as a percentage of sales, than have average performers.

However, the Kobler Unit (1987) based at Imperial College, albeit looking only at the UK and using a small sample, found that there is *no* difference in ICT spend between market leaders and laggers. Given such a spectrum of definitions and evidence, managers might be forgiven for feeling a degree of exasperation when trying to deal with this topic.

It is clear from the above brief review that the definition of value is far from universally agreed especially among information systems academics and consultants. The word 'value' is quite ambiguous. (Classical economics states that there are two types of value. There is value in exchange and value in use. Accounting is based on value in exchange where the amount of money for which a product changes hands is its value. Although only of limited use this notion has the great advantage of being clear and simple to understand and apply. Value in use is more complex to understand and is problematic to quantify. The problem which arises in the IS evaluation setting is that value in exchange is not of much help in assessing the success of an investment as there is no exchange. We are therefore forced to come to terms with the quantification of the value in use concept and this is loaded with problems.) Given this, it is not surprising that, in searching for value or benefits, a variety of routes have been tried and the findings are sometimes contradictory and the subject of fierce debate.

3.4 A taxonomy of techniques

Investment decisions are based on perceived value, however measured. An understanding of how value translates to decisions can be aided by classifying approaches to evaluating ICT investments into three basic techniques that can be used in two different ways.

The first level consists of the basic approaches to evaluation, which can be termed *fundamental*, *composite* and *meta* methods.

1. *Fundamental* measures are metrics which attempt to reduce some characteristic or closely related set of characteristics of the investment down to a single measure. Fundamental measures vary from capital budgeting techniques such as return on investment and internal rate of return to non-financial performance metrics such as anchor values (e.g. cases processed per employee) and user satisfaction ratings. The defining characteristic of such methods is that they provide a single score or statistic by which to assess the investment (or compare competing investment options). Return on investment being required to pass a hurdle rate is a classic example. Measures of this type are not confined to the purely financial, although financial measures are the most common.
2. *Composite* approaches combine several fundamental measures to get a 'balanced' overall picture of value/investment return. Composite measures include Information Economics, the balanced scorecard and spider/web diagrams. Some composite approaches (like the balanced scorecard) are highly structured and standardized in order to provide some sort of industry comparison or benchmarking capability. Composite measures may also be *ad hoc* as in conventional weighted ranking. Even where the structure is predetermined, as in Information Economics, different weighting and scoring schemes may be used to alter the balance of the factors affecting the decision. The ultimate output of these methods may be yet another single number score. In this sense, they might be considered super-composites, i.e. a composite made up of other composites (it is an interesting question whether incorporating such items as return on investment or strategic match into such a supra-composite risks an element of recursion). There are few organizations that would try to evaluate their information systems'

activity today without using some variant of the composite approach. Of course many 'fundamental' methods are themselves inherently composite in nature. Even a net present value is derived from net cash flows, which in turn are derived from a range of other factors and computations. Cost benefit analysis is also based on using money as a metric for combining many factors, some of which are distinctly non-monetary in origin. This repertoire of techniques has evolved into a shopping list of methods that are applied in day-to-day ICT investment evaluation. A brief scan of the literature will reveal numerous cases where these methods are cited or where researchers have endeavoured to find out which of these methods are used in practice. Notwithstanding this, the distinction is a valid one in practice.

3. *Meta* approaches attempt to select the optimum set of measures for a context or set of circumstances. This meta orientation is not usually structured. By definition, there is no question of the organization wishing to use this approach for any sort of benchmarking other than for internal comparison between different projects and/or possibly over time when the same meta approach is being applied.

Although these evaluation methods may be, and in practice often are, used separately as single evaluation techniques they may also be used in combination. Of course this would require the need for some consensus among the various stakeholders involved.

These three approaches may be applied in two different ways:

1. *Positivist/reductionist* is where the decision maker allows the methodology to make the decision. In this approach the investment with the highest return (say) or with the best overall score in some ranking is chosen. The decision maker establishes a series of mechanical operations which reduce the decision to a single score, either by using a preferred basic method, combining several such methods with a composite technique or using a meta approach to select a single method. The latter two can be combined, i.e. using a meta method to select an optimum set of techniques to be used and an *ad hoc* composite method to combine them.
2. *Hermeneutic* is defined here as methods of interpretation of data which use non-structured approaches to both understanding and decision making.[1] The decision maker takes on board several different metrics directly and

[1] This approach, which used qualitative data or evidence, is contracted with the positivist approach which will rely on numbers.

combines them in his or her mind in a manner that often cannot be formally stated. Various techniques are used to provide a level of visual support to this process: spider charts and cognitive maps being two of the best known. It is in this area that instinct and intuition play the biggest role. It is sometimes argued that this is the most important aspect of decision making.

This concept is illustrated in Figure 3.1.

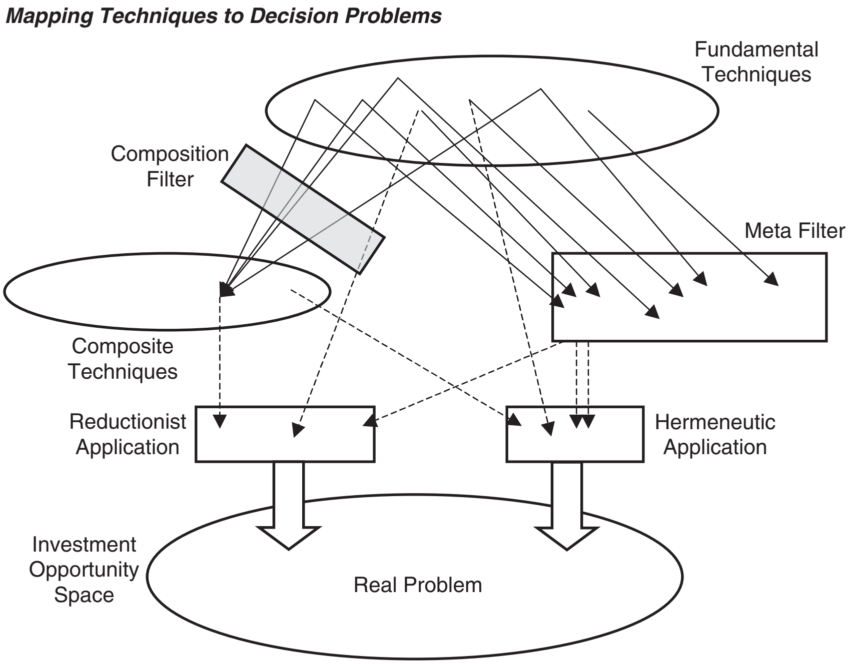

Figure 3.1 Three techniques and two approaches to ICT evaluation

It is clear that much of the current research into ICT evaluation is focused on the former (positivistic) at the expense of what is perhaps the more interesting, but much more difficult to confront, qualitative analysis. However, hermeneutics is pervasive and there are strict limits to the purely positivist approach. The number of evaluation methodologies and approaches is distinctly finite. On the other hand, there is an infinite number of possible ICT investment/expenditure situations. The latter might be termed the investment opportunity space and, loosely speaking, it can be considered as a continuum of possible decision-making situations. It follows that there is an infinite number of possible mappings from the set of evaluation techniques onto the investment opportunity space and vice versa. Clearly some subset of the investment opportunity space can be meaningfully evaluated using an appropriate single basic measure of value. However, once one steps outside of this subset, an immediate tension between positivism and hermeneutics arises. This can be seen in what the composite and meta methods try to achieve:

- Composite (and, to a lesser extent, meta) approaches try to model how some sort of ideal decision maker should (or would want to) make the evaluation. This is nothing more nor less than an attempt to map the mind of the decision maker; an attempt, by weighting and scoring, to externalize the interior process of decision making. Formalized composite methods, such as Information Economics, are, therefore, tantamount to a semi-prescriptive or normative statement that this is the way an ICT investment decision should be made. Given that there is an infinite number of decision-making situations, this seems highly presumptive. The very linearity of Information Economics implies that the mind works in straight lines, something that is manifestly not true. At most, therefore, composite methods provide a substitute for hermeneutics and an implicit recognition of the need for interpretation.
- The meta approach attempts to match decision to technique. Meta methodologies may be useful in helping to identify the most appropriate evaluation technique, i.e. given this decision problem, this is the best technique or type of technique to use. The shortcoming in the meta approach is the necessity to try to derive general rules for a continuum of decision-making situations from a finite set of tools (although, as already noted, Farbey and others have endeavoured to find ways around this problem). Inevitably, the conclusion of this process will often be tantamount to saying 'there is no perfect tool, but here is something which may be the next best thing'. But, meta techniques are themselves in part hermeneutic – the user is invited to use interpretative techniques to arrive at a positivist method of evaluation. This runs the risk of spurious rationality.

All formal methodologies and combinations of methodologies bump up against the limits of physical representation by numbers, two-dimensional diagrams and the boundaries of modelling human reason using such tools. It may be that the closest that it is possible to get to actual workings of the managerial mind in complex situations is to use such tools as Likert scales, cognitive maps and spider charts. They may be two dimensional, but at least they are not trapped in the linear world of many other evaluation models.

The focus here is instinct, which occurs as a subset of the evaluation techniques or approaches that employ hermeneutic methods and which *cannot* be easily handled by the traditional approaches. Such situations probably constitute a significant proportion of decisions and they are often the largest, most strategic and hence most critical decisions.

Irrespective of whether a composite approach or a meta approach has been taken to the ICT investment analysis, eventually a decision has to be made and this means some form of hermeneutic assessment. No matter how quantitative the analysis has been, some person will, soon or later, have to make a judgement, which is the most difficult part to comprehend.

In order to move towards an understanding of this process it is necessary to look to other fields of complex decision making. How do individuals arrive at their options on such complex issues as suicide, human cloning, or for that matter what constitutes great art or what makes a good teacher? Anybody who has witnessed or participated in an argument on suicide, for example, will be aware that many people faced with such a complex issue, one which has moral, religious, social, medical, political and economic overtones, arrive at a stance that says something like 'suicide is wrong, but there are circumstances where it can be justified', but when asked to justify this stance, cannot do so in strictly logical terms.

This sort of decision making or judgement making is not irrational or at least it need not be. But it is often made without going through the apparent rational step-by-step processes which management decision makers are expected to follow. That is where instinct or intuition comes into play.

Although one can normally differentiate between the value of an ICT investment to an organization and to the decision makers, in practice, in the mind of the decision makers, both are confounded. It is simply not part of human nature to make totally detached decisions about anything, never mind about choices that will affect them personally. People bring what Gadamar (1989) calls their own prejudices to the decision. Our decisions are influenced not only by the clinical analysis of numbers and costs, but by cultural, political, personal and a host of other subliminal factors; what Dunne (1993) calls the subsoil of the psyche. This is more than a mere acknowledgement of human bias as widely discussed in the decision theory literature. This part conscious, part subconscious digestion of a mass of information, prejudices, personal values, experience, sense of duty as well as internal and external pressures is what decision makers often go through when making complex decisions about ICT investments. They could not easily rationalize this process even if they tried. Instead they call it 'gut instinct', faith, intuition etc.

Instinct is not, therefore, necessarily something to be condemned – abandonment by the decision maker of reason. Rather it is often a different and subtler kind of reasoning – a taking into account of how the world really is rather than simply what the spreadsheets say. Instinct, intuition or gut feeling is not, *per se,* non-rational or irrational. They are perhaps best regarded as super rational which effectively means that they incorporate the processes of reasoning, but at a much higher level than is taken when a problem is worked out step by step. The value of intuition in solving complex problems is recognized by psychologists (Claxton 1998).

A model of this decision-making process might be as shown in Figure 3.2.

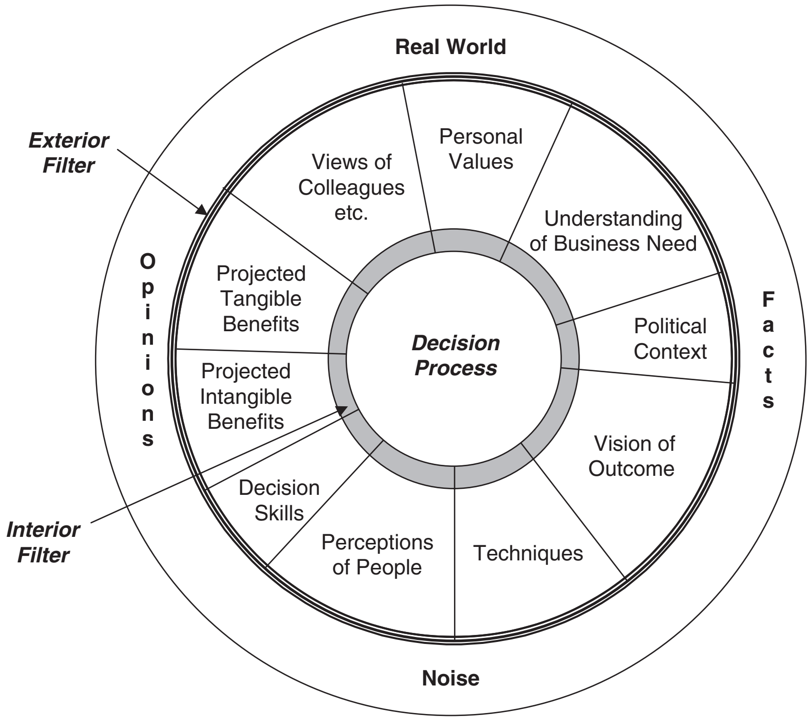

Figure 3.2 Decision process model

Any decision is influenced by a range of factors, some rational, some non-rational, some explicit, others implicit. These factors clearly carry different weights in the mind of each decision maker. Each is derived from external information of various types which itself may come through various filters such as subordinates, consultants, journalists and salespeople. The term external filters may be used to describe these.

This information then goes through a further interior filter of personal experience and psychological make-up, before being assimilated and weighed up to make a decision. A large component of the interior filter is the decision maker's perception of value. The role played by rational decision-making technique needs to be understood in this context. Finally, it should be noted that even this relatively complex model simplifies various aspects of decision making, in part by ignoring the issue of process. In practice decisions emerge over time. There is a point at which the decision is made, but there may be a prolonged gestation period, even after the sources of external information have ceased supplying new data.

3.5 Summary and conclusion

Sound management decision making requires a combination of different talents. Rational thinking processes alone are not good enough. The American humourist James Thurber powerfully proclaimed the inadequacy of reason alone when he said:

> Man, with his powers of reason, has reduced economics to the level of a farce which is at once funnier and more tragic than Tobacco Road. (quote in Clifton Fadiman, *I Believe: The Personal Philosophies of Certain Eminent Men and Women of Our Tim*e (1939))

To be successful management decision making requires at least external rationality plus instinct.

It is clear that instinct (and intuition) is a central part of all decision-making processes and especially the management decision-making process. Without an understanding of instinct one would only have a very incomplete understanding of management. The issue of instinct is sometimes associated with subjectivity and the importance of this is clearly expressed in the words of Wheatley (1992):

> We inhabit a world that is always subjective and shaped by our interactions with it. Our world is impossible to pin down, constantly and infinitely more interesting than we ever imagined.

Human decision makers, even working in groups within large organizations, are rarely as logically rational as many commentators, including themselves, would like to believe. Philosophers dating back as far as Aristotle have pointed out that the technical model of reason has strict limitations. Many ICT investment decisions, maybe even a majority, are made or apparently made, and rightly so, on purely technical rational grounds. Such decisions may be made using the same type of formal structure that might be used to buy a factory, develop a new product, build a house or play bridge. But much of the time, the process of evaluating ICT is the application of phronesis, a praxis, the application and the absorption of a range of input information. The information can include data, evaluation techniques, personal experience, personal knowledge, corporate or departmental politics, personal desires and intuition; a process of filtration and distillation of frequently complex data, information and knowledge to levels manageable to the human mind.

Whether the incorporation of all of these factors is conscious or unconscious, they are always present. Models that try to provide surrogates for such 'irrational' factors may be employed, but should they conflict with the inner conviction of the decision maker(s), they may be rejected. The technical rationalist may describe such a rejection as 'irrational', but this view is based on the premise that the decision maker shares the same values and has access to exactly the same knowledge as the observer. In practice, this will rarely be the case. The uncomfortable fact remains that good business decisions are sometimes taken in the teeth of the 'evidence'. It is this ability to make intuitive leaps that often distinguishes the great manager from the competent functionary.

This decision-making process is often known as or expresses itself in the terms of 'instinct', 'gut feeling', 'intuition' and other equivalent terms. In order to influence and improve ICT investment decisions, it would be very useful to have a deeper understanding of this interior practice or functioning of the managerial mind. Hitt and Brynjolfsson identified this challenge succinctly when they observed that:

> The problem of ICT value is far from settled.

In fact according to Lacity and Hirschheim (1995):

> The problem is that meaningful measures of departmental efficiency do not exist for IS.

And they go on to say that:

> much of the knowledge required to make efficient economic decisions (related to information systems) cannot be expressed as statistical aggregates, but is highly idiosyncratic in nature.

This internalized, subjective and idiosyncratic knowledge and knowledge processing which is referred to in this chapter as instinct, is an essential part of the decision-making approach and should not be in any way disregarded or denigrated. This instinct should not only be defended, but it should be celebrated as part not only of that which differentiates man from machine, but of that which separates mediocre from top flight managers.

After all value, like beauty and the contact lens, remains in the eye of the beholder and the eye of the beholder in business and management situations needs to be cultivated. Were it any other way, there would be far fewer poor or bad business decisions – whether ICT related or not.

4

The total ICT investment

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Not everything that can be counted counts, and not everything that counts can be counted.

Attributed to Albert Einstein[1]

4.1 Introduction

As described in previous chapters, over the years researchers have dedicated a great deal of time and effort to the problem of measuring ICT value and managing ICT benefits. However, this area of research has tended to focus on either *ex-ante* or *ex-post* evaluation of benefits, or the effectiveness of IT in the organization. While these are important concerns, we have not yet fully addressed the question of how much organizations have actually invested in ICT systems.

There are few organizations that can give a satisfactory answer to the question: 'How much have you invested in your organization's information and communications technology (ICT) systems?'[2] In fact some organizations even have difficulty in producing a comprehensive list of their current ICT hardware. Keeping an accurate asset register requires a level of good organization and tight procedural discipline that many organizations find hard to maintain.[3] People are frequently surprised that the task of taking stock of the computer equipment used in an organization is so difficult. Computers are moved from one department to another. They can be mislaid; they can be lost; they can be stolen from organizations; they can be taken home by employees who forget to bring them back. Computers can be bought without proper corporate authorization and thus not correctly entered into the records of the organization or they can be purchased under the wrong expense heading (such as office equipment or training materials). In fact ICT equipment[4] is

[1] Found at http://www.quotedb.com/quotes/1348, 10 July 2006.

[2] Two examples reported by Gartner research demonstrate this: (1) The CFO of an IT department in a large US-based manufacturing company reported that only about half of the company's total IT spending was visible to him, i.e. only half of what the company knew it was spending on IT could be tied to specific products, services and labour in the IT department. (2) One state government, which believed its total ICT budget was approximately $8 billion annually, discovered that it was spending closer to $9 billion on IT (Gomolski and Snyder 2005).

[3] It is a requirement to keep an asset register and all large-scale equipment purchases are normally entered in this record keeping system. In the case of ICT there are often relatively minor acquisitions such as upgrades which may not be included in the asset register.

[4] This chapter has focused on the computer and data communications elements of ICT and has thus not directly included telephony aspects. Manufacturing organizations may also have sizeable investments in factory automation including robotics and some researchers would expect this type of equipment to be included in an evaluation of ICT investment.

often bought by a combination of central purchasing, individual departments and actual users. There are normally controls over computers bought by central purchasing, but even here there can be discrepancies between the corporate records and what is actually on the premises or in the hands of corporate users.

Departmental and user purchases come out of decentralized budgets and as such sometimes purchases made by individual departments are just written off as an expense. Consequently it becomes difficult to calculate the overall ICT expenditure. But even where this doesn't happen it is still difficult to come up with a total figure for the value of the ICT assets[5] employed by an organization.

4.2 Why is it difficult to account for ICT equipment?

There are a number of reasons why ICT assets are not always easy to count or why it can be difficult to establish a total value for such assets. The first reason is that there was a tradition for some years of ICT equipment being leased or rented and thus the equipment did not actually belong to the organization using it. As such the value of this equipment was only recorded in the financial books of the leaser and not the lessee. This is sometimes referred to as off balance sheet funding and this approach to acquiring assets is popular in organizations where funds for the purchase of capital equipment are in short supply or where there are tax advantages from this method of acquiring the use of assets. A variation on this problem is the fact that the current trend to outsource has also made it more difficult for organizations to know what value they have tied up in their ICT as once again the equipment will largely only be reflected in the books of the outsourcer and not the user of the equipment (although the processes of transferring assets to an outsource supplier usually requires preparation of an accurate inventory of ICT assets if one does not already exist).

Another reason is that the item by item expenditure on personal computers and laptops can be quite small and may not be capitalized by the organization.[6] Small purchases are sometimes just written off as an expense. Of course a large number

[5] Assets are items of value that have been acquired, not for the purposes of resale but for use in the conduct of the organization's business. Assets are normally usable and reusable over an extended period of time. Assets should be contrasted with expense items which are normally consumed when they are used. Only items of a significant value are treated as assets. Small items below a certain limit, even though they may be reusable, are usually treated as an expense.

[6] Rules concerning what is capitalized and what is written off vary from organization to organization. Also tax authorities may have guidelines which the organization needs to follow.

of small expenses soon accumulate into an even larger number as will be seen in the hypothetical example given below.

Finally, it needs to be mentioned that there is a real cost to the type of detailed accounting of ICT assets required to develop an accurate up-to-date picture of the total ICT investment. There are managers who question whether this type of expenditure is really necessary or justified.

4.3 The importance of knowing what has been spent

Some individuals in the ICT community take the view, 'Why should we care what was spent on ICT?' This view is driven by the belief that ICT expenditure is after all a sunk cost[7] and what organizations should be worried about is their current expenditure on ICT and what type of benefit stream this investment will deliver. Of course both these questions are important. However, this chapter focuses on the former question of establishing the assets already in use.

Despite all the challenges mentioned in the introduction to this chapter the answer to this question is important for a number of reasons.

First, the value (here meaning the cost) of the investment in ICT is usually underestimated. When a figure is calculated it often causes considerable surprise. Senior managers can be quite naïve about this subject and will sometimes only focus on the cost of the large central processing computers or servers and perhaps the central telecommunications networks. As will be seen there is much more to this than these two elements. One of the reasons why it is useful to know how much has been invested in ICT is that it can be a wake-up call for those who think that the ICT investment is a relatively trivial figure.

Second, having even a rough estimate of the investment in ICT gives management a starting point from which to formulate a risk assessment statement. It is not easy to decide how much risk prevention to undertake if the value of the assets to be protected is not understood.

Third, knowing what previous ICT costs were is a guideline as to what it might cost to enhance systems or to replace them. It is true that the price/performance ratio of hardware has been steadily improving over the past four decades. But the costs of software and the other related costs such as commissioning or

[7] A sunk cost is an expenditure which has been made and which is irrecoverable and which should not influence other decisions, especially decisions related to current or future investment.

developing an ICT system have not been declining and in many cases have risen in real terms. It is important to be able to understand how organizations' ICT costs arise and how they vary.

Finally, there is the question of the need to comply with a new international standard which has been developed to help organizations to prove they are performing Software Asset Management (SAM)[8] to a standard sufficient to satisfy corporate governance concerns. This standard is published by ISO[9] (International Organization for Standardization) and IEC (International Electro-technical Commission), ISO/IEC 19770-1:2006. Compliance with this standard will ensure a fairer representation of the value of the software investment.[10]

4.4 The total cost of ownership (TCO[11])

Before exploring a framework with which to answer the question 'How much have you invested in your ICT systems?', it is important to say that this approach is focused on the normal accounting principle of looking at what it costs to acquire the ICT assets. This means that the TCO[12] will not be used as a basis of determining a cost. The TCO is a useful concept for understanding the commitment which accompanies the acquisition of an ICT system. But by its nature it is forward looking and therefore does not answer the question of what amount has already been invested in ICT.

4.5 Establishing a framework

There are three major categories of ICT assets employed by every organization. These are hardware assets, software assets and data assets (it is argued by some that

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[8] The SAM model was developed in Harvard University by Henderson and Venketraman (Aitken 2003).

[9] See http://www.iso.org/iso/en/ISOOnline.frontpage for more details of the IOS.

[10] Refer to http://www.channelregister.co.uk/2006/05/12/sam_becomes_iso_standard/ for a report on this issue.

[11] See http://en.wikipedia.org/wiki/Total_cost_of_ownership. Since much software is not 'owned' (but licensed), it has been argued that the 'total cost of ownership' is a misnomer: 'total cost to use' and 'total cost to lease' are considered by some to be more appropriate terms when applications software is being considered. Wiggers *et al.* (2004, p. 69) define TCO as 'all costs associated with the owning, operation, usage and disposal of a computer through its life cycle'.

[12] The total cost of ownership or the TCO is a notional cost of the hardware, software and all other service costs which the ICT system will require for the economic life of the system. Thus the TCO is a projected or forecast figure and can vary substantially depending of the assumptions about the length of the asset's economic life.

people can be regarded as assets, but conventionally these are not so recorded in the accounts). These assets are very different in nature and need to be treated differently in establishing their value. In general the amount invested in hardware will be relatively easy to determine. The amount invested in software will be more challenging to establish whereas the amount invested in data may present some extremely difficult challenges and will rely heavily on management judgement, and to some extent will be subjective. This is shown in Figure 4.1.

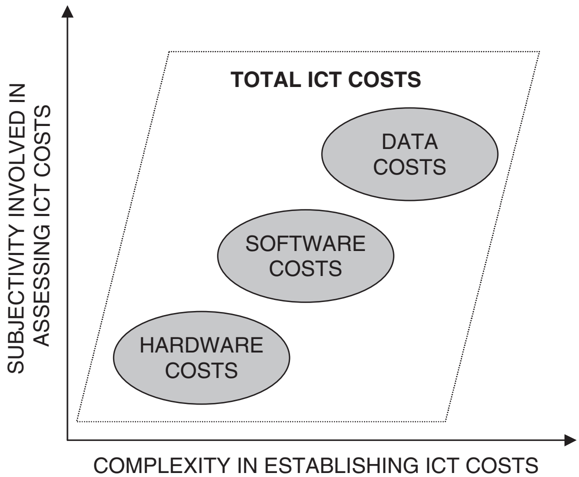

Figure 4.1 Identifying ICT costs

The objective of this framework is to offer a suggestion as to how an ICT asset list might be created and to discuss some of the issues involved in arriving at an investment value for the different categories of ICT assets in the asset list.

4.5.1 The amount invested in hardware assets

There are six categories of ICT equipment which may conveniently be placed under the general title of hardware assets. All these assets are tangible and therefore are comparatively easy to value. These are:

1. Centrally managed large-scale computers including servers and data storage
2. Distributed computers which are mainly desktop and laptop computers
3. Peripherals such as printers, scanners, cameras, etc.
4. Network equipment
5. Distributed telecommunications equipment
6. Other fixed assets such as buildings, power generators, air conditioners, etc.

The first step in establishing hardware costs is to perform a physical audit or inventory. This is a matter of locating and counting every device or piece of equipment. If the organization is located on one site this may be a straightforward task. However, if multiple sites are involved then the audit can be a major challenge. Other complications can be caused by definition. For example, is the standby electrical power generator classified as part of the ICT infrastructure? If raised flooring has been installed specifically for ICT, is this part of the inventory or just part of the building? In general, such problems tend not to be major, but there are circumstances when they can become contentious, for example where services are shared and costs have to be apportioned between departments or operating units.

Some of these cost items for large-scale computers are relatively easy to establish whereas others are not. The purchase of centrally managed large-scale processors is usually accompanied by a contract and the amount paid for the systems will be stated on such contracts. Of course what is actually delivered and commissioned may be different to that which was specified in the contract, but such differences will often be minor. Nonetheless as part of this process it is worthwhile checking the contracts with what was actually paid.

Auditing the desktop and laptop computers and associated peripherals is a more demanding exercise (Chen 2002) and may require each individual to specify what equipment they are currently using. Relating these back to actual cost will also take time.

Peripherals are even more problematic. Devices such as printers and solid state memory devices (data sticks) can proliferate and may well not be visible on the corporate accounting radar. Sometime, all that can be done is to take a pragmatic approach and ignore all devices below a certain cost, but there are risks with this approach. Portable devices are prone to ‘walk’ and in a large organization, the cost of such leakage can add up to a sizeable amount.

The network equipments will be closely associated with the organization’s telephony and it may in some cases need to be separated. On the other hand, some organizations may regard their telephone investment to be part of their ICT infrastructure. Typically records of payment for the installation of such equipment will provide the costs, but communications networks often grow organically and sometimes in an *ad hoc* fashion. Tracking investment in such circumstances can be challenging.

Distributed telecommunications equipment will only be relevant for the bigger organization. In such organizations it could include microwave transmitters and receivers, multiplexers, various internetwork processors, etc. Here again, it may be necessary to decide what is ICT and what is telephony and whether this distinction should be maintained.

Finally, other fixed assets such as designated buildings or floor space, power generators and business continuity equipment also need to be included. In some cases where the need to guarantee continuity is vital, the centrally managed large-scale computers may need to be effectively duplicated.

4.6 The amount invested in software assets

The term software is used here in its broadest sense and includes systems software, middleware and application software. Software is sometimes regarded as an intangible asset and therefore its valuation has the potential to be more difficult than the valuation of hardware. This is particularly the case where software is developed internally. There are even suggestions that a valid or reliable measure to value software does not exist (Bontis and Chung 2000). Various categories of software assets may be determined. These are:

1. Purchased enterprise systems software
2. Purchased middleware
3. Internally written enterprise applications
4. Purchased enterprise packaged application software
5. Purchased enterprise custom built application software
6. Purchased personal computer application software
7. Software licensing agreements

If a company wished to acquire a traditional mainframe computer, it can buy or lease. Whichever of these it does, the operating software will normally be leased. In such circumstances, there is no asset purchase involved. Most companies today, whether they are mainframe users or not, will have a large number of servers in the form of Unix or Windows machines. Here the software is usually purchased[13] with the machine (or in the case of some variant of Unix, may come free or at a nominal charge). The problem of valuing such systems software may be summarized in two questions: (1) If the software has no resale value independent of the machine on which it runs, should it be valued separately? (2) Given that software does not wear out, but instead is superseded by new versions, how should it be depreciated? One solution to this is to write it off on acquisition; another is to consider that the software has no enterprise value separate from the machine and

[13] Software vendors like to refer to the software being licensed to the user and thus they will tend not to use the word purchased.

regard the total package (machine and software) as a single investment and depreciate it as such. Only if it is the case that the software is likely to be moved to a new piece of hardware would it make sense to value it separately.

Middleware presents a different type of valuation problem. The difficulty here is that the term is so wide and may encompass anything from the network protocol to the relational database. One helpful aspect of this is that much middleware is low cost or even more or less free (e.g. open source software such as the Apache web server). The objective here is to identify those items of middleware which have material costs. In compiling such costs, the cost of installation should, ideally, be included though in practice most organizations will not capture such data. Examples of expensive middleware that needs to be identified and costed include databases, object request brokers and transaction processing monitors.

There are different schools of thought about whether internally written applications for large systems should be capitalized or written off as an ongoing expense. It is clear that these programs are assets, but it has often suited organizations to write them off if this will generally reduce the tax payable in the relevant accounting period. Where these programs are capitalized there are several ways in which they could be costed and this in turn leads to debates as to which is the most appropriate. One view is that these programs should not carry any allocated overhead, but should simply reflect direct labour costs. Another view is that in-house developments should carry an appropriate share of the overhead, i.e. full costing should be used. These issues can be quite controversial and may lead to heated arguments. Two other factors which cannot be ignored here, as elsewhere, are the auditors and the taxman. Auditors may well insist on capitalization of large development expenditures as necessary to reflect accurately the cost of running the business. The tax authorities may not be willing to accept what they deem to be excessively aggressive treatment of tax write-offs. While internal management accounts do not have to follow such rules quite as rigorously, it is not a good idea for the financial and management accounting conventions to drift too far apart.

Purchased application software for large systems would generally be included in the total for ICT investment in much the same way as hardware items would. The problem again is depreciation. This problem is further compounded by the extent to which the software is kept up to date. The principle should be that the software is written off over its expected useful lifetime, probably on a straight line basis as it has no market value and more elaborate methods are not justified. This begs the question of what the useful lifetime is. Some organizations arbitrarily use a figure like five or ten years. In certain circumstances software can become redundant (e.g. in a merger) and may have to be written off completely.

As the purchased personal computer application software normally has a short economic life these are often written off when they are purchased. Thus they are not always seen as a part of the ICT investment figure although some organizations regard all such expenditure as capital in nature. An important trend in recent years has been the slowing pace of turnover of such assets. Machines that, in the early 1990s, might have been replaced every two to three years, are now kept in use for five years or more. This trend is likely to continue. The risk with expensing (writing them off against current expenditure) such equipment is that, if a large number of devices need to be replaced at around the same time, the cost can distort the profit and loss situation of the organization. There are no hard and fast rules on this. The approach will be based on a combination of levels of expenditure, rate of turnover, taxation considerations and the views of the auditors.

4.7 The amount invested in data assets

If the costing issues related to in-house software development can be controversial, then the attributing of a value to data has the potential to be highly contentious, even divisive. Not many organizations make serious attempts to value this data.

No one would disagree with the proposition that corporate data is an asset. Of course it is an intangible asset which has a particular shelf life which can range from a few weeks to several years. Further, corporate data could be seen as even less tangible than normal intangible assets. Perhaps the term 'virtual asset' might be more appropriate. In some ways these assets are a form of goodwill, i.e. an intrinsic part of the value of the company like a brand or a reputation. Most of the time corporate data is only an asset when it is being used. Admittedly corporate data also has a value in exchange, i.e. there is a market for it, but in many countries this market is regulated by laws such as the Data Protection Act. These laws can be very restrictive as to how this data may be used.

Data assets may be categorized into two major groups. These are:

1. Centralized data resources
2. Data stored on personal computer and laptops

The centralized data resource comprises the corporate-wide databases which are used for accounting and other statutory record keeping purposes as well as a whole range of other business purposes, for example it might include customer databases, personnel files or product structure information. Some of these record keeping activities are required to comply with legal requirements in terms of company law as well as taxation rules and are the raw material from which management reports are produced. The cost of these activities may be quite substantial. They are normally regarded as an essential operating overhead. However, in as far as this record keeping is simultaneously creating information which may be used for other business purposes such as customer relationship management, inventory optimization policy, product diffusion information, to mention only three examples, the database so created is a valuable asset. The same sort of argument may be made for the value of data held on personal computers by individuals throughout the organization.

There are no generally acceptable rules for valuing the data assets of an organization. It would be difficult to determine what portion of the cost of the record keeping activity could be proportioned out of the overhead cost to the asset development cost. On the other hand, this type of asset cannot easily be bought in. One approach is to estimate the cost of compilation. This may be possible in some cases – say where data is keyed in *en masse* by clerical staff. More often it is hard to do because so many people are involved in both data entry and update. Tracking this may become virtually impossible. Another approach is to try to estimate the cost of reconstructing the database if it were lost. In practice, the real value of such data may be more properly reflected by its value in use than in its cost of assembly. Placing a value on customer histories gathered over a decade of doing business is almost impossible. The solution may be simply to assign an arbitrary figure. Again, this is akin to accounting for the intangibles of any business such as goodwill. But it needs to be remembered that the cost of the investment is what is actually required.

Whatever approach is used to value the data it will be essentially a question of management judgement, which is after all how many of the other corporate asset values are ultimately determined. In the case of the data the management judgement is difficult and there is the additional issue of whether the users of the data or some other central function such as finance should make this judgement.

4.7.1 Creating an ICT asset statement

The summarized ICT asset statement shown in Table 4.1 represents the three major categories of assets mentioned above. It also includes an estimate of the investment in buildings and other physical infrastructure required to operate a large-scale ICT system. The numbers provided in the table are intended to be indicative of the relative scale of the investment in each of the four different categories rather than an example of any particular type of organization.

It is important to note that it is not a balance sheet in any sense. It is simply a statement whose value is to focus attention on the importance of ICT to the organization. The relative size of the different investments should be noted. In this example four investment amounts are as shown in Table 4.1.

Table 4.1 A summarized ICT asset statement (in millions)

1. ICT hardware	628
2. Buildings for ICT etc.	192
3. Software	1042
4. Data assets	1550
Total	3412

4.8 Intellectual capital

Although the statement of assets in Table 4.2 is considerably more comprehensive than most organizations would have for the value of their ICT investment, as noted above, there is one element which is omitted and which some members of the ICT community believe is essential. The missing element is ICT expertise or the intellectual capital needed to make use of the ICT assets. This is probably one of the most difficult areas to evaluate. Intellectual capital theorists have argued that the validity and reliability of hard measures for knowledge asset valuation are difficult to develop (Bontis *et al.* 1999; Bontis and Chung 2000). There are at least two levels at which intellectual capital is needed. The first of these is the competencies that are required by the ICT professional staff, which includes technical knowledge of the hardware and the software. It also includes knowledge of the application areas in which the hardware and the software are being used. The second is the ICT knowledge vested in the business individuals who actually use the technology for achieving their role objectives. This may include the use of personal productivity tools but it may also involve having considerable user knowledge of specialist software. It is most difficult to make any assessment of the cost of intellectual capital, never mind the value that it brings to the organization. Furthermore, this is not unique to ICT. The same problem exists with regards the knowledge and skills in sales or manufacturing or even management functions. While experienced industry commentators have been known to suggest that this intellectual capital aspect of the use of ICT could account for as much as 70 to 80% of the total cost of operation, the idea that somehow ICT human assets should be valued when other corporate human assets are not is open to question. On the other hand, investors do value such assets. The share price of companies (such as

Table 4.2 Creating an ICT asset statement (in millions). (Source: Based on *Shaping the Future*, Peter Keen, 1991)

Cost category	Comment
1. ICT hardware investment	
Centrally managed computers: this constitutes large-scale computers, storage and output devices. These are machines which were traditionally called mainframes and mid-range machines.	This is the most obvious component of the ICT base and the one that accountants usually track carefully. These will be included in the organization's central asset registers. They are often only a small part of the organization's ITC assets.
Distributed computers: mainly desktop and laptop computers.	Some of these will not be bought centrally and thus some of this equipment may be capitalized but others will not. Furthermore the proliferation of laptops has made this figure hard to track.
Network equipment	Telecommunications facilities, often distributed across many different budgets and only some of this will be reflected in the firm's asset registers. Increasingly this investment may have been taken 'off balance sheet'.
Distributed telecommunications	Local area networks and departmental equipment. This equipment is unlikely to be capitalized in most firms' accounts.
Total ICT hardware (1)	
2. Hardware related fixed assets	
Data centre and operations: buildings, air conditioners, power generators, false floors, cabling.	Much of this will be capitalized but usually not included with the other ICT items. However, buildings are usually entered at cost price and not adjusted thereafter and therefore may reflect very unrealistic values.
Total hardware related fixed assets (2)	
3. Software investment	
Purchased systems software for large systems such as operating systems and languages.	These types of systems software can often be leased rather than purchased. This can make accounting for the use of this type of asset difficult.

(*Continued*/)

Table 4.2 (/Continued)

Cost category	Comment
Application development: Although some purchased software and even bespoke applications may be included under this heading the major software investment consists of mostly internally developed applications.	Software development expenditures are frequently treated as expenses. The organization often has no idea how much it had spent to build the software in use, nor did the accounting system make it easy to find out.
Purchased application software for large systems.	The value of this asset should be easy to establish.
Purchased personal computer systems and application software.	This figure is an educated guess. Few organizations, if any, have control over this area of expenditure. These are certainly assets but they are very seldom capitalized. Replacement costs, which a firm's IT planners estimate to be at least $1.2 billion, is also a major problem here.
Total software (3)	
4. Corporate data	
Centralized data resources: these assets are composed of the various corporate databases which may actually be almost impossible to reconstruct.	This is the estimated cost of salaries, processing power and storage requirements incurred in creating the on-line data resources that are the basis for products and services. This is a reusable asset but one which requires constant maintenance. Although data resources do not wear out as they are used they can quite rapidly degenerate over time.
Data stored on personal computers and laptops. These may contain items of strategic value which can hardly be replicated if lost.	Very difficult to estimate the value of this asset.
Total corporate data (4)	
Total investment (1) + (2) + (3) + (4)	

investment banks) has been known to fall when a key individual leaves. So there is a case for what is called in the entertainment world, 'talent management'. There is just no convincing argument why this should be unique to ICT. This is a field of considerable interest and it is one which is being given increasing recognition by both academe and business alike.

4.9 Summary and conclusion

This chapter has addressed the issue of ascertaining the amount invested in an organization's ICT. It has not attempted to calculate the value of this investment. That has been extensively discussed in Chapter 3 and in any event, as Strassmann (1984) said, the value of an information processing system is what it will fetch at an auction.[14]

Asset registers are generally not adequate to provide a comprehensive evaluation of ICT assets. They are often out of date and incomplete. Items that are not bought outright are often not included. Valuations of key assets, such as data, are difficult. It would be unusual to find any data assets listed in an asset register.

Nonetheless, creating an ICT asset statement is a useful exercise[15] which brings to the attention of all those involved the substantial amounts invested in the ICT activity. It can open management's eyes to how valuable and important the ICT function actually is and what would be at stake if it were lost. Furthermore, the ICT asset statement is an important tool in conducting a comprehensive risk assessment as it gives some idea of the level of risk if there were to be a catastrophic disaster which destroyed the corporate ICT activity. Suppliers of disaster recovery services have plenty of war stories about companies going out of business when they lost their computer systems in flood or fire. Thus in a sense an ICT asset statement is a prerequisite for corporate business continuity planning.

It is not envisaged that the values used in the ICT asset statement will be precise or accurate to even a few thousand pounds. Some of these values will have to be estimates and some will have to be the result of management judgement. From Table 4.2 it may be seen that there will be high values involved and thus depending on the size of the organization a figure accurate to a million pounds may be sufficient.

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[14] This delightfully dismissive remark of Strassmann's must have been tongue-in-cheek!

[15] Care must be taken not to underestimate the time and resources required to create an ICT asset statement. Some sources (e.g. Adams 2005) suggest that such an exercise could take up to 18 months.

In general it is expected that the amount invested in corporate data will be the largest and that corporate data will also be the most difficult to replicate if it were destroyed or lost. Software will usually constitute a larger element than hardware especially where centralized large-scale computing is required for record keeping and there is an extensive network of personal computers.

In addition to the three categories of assets there is also the question of the intellectual capital required to make optimal use of the ICT systems in place. This is a different type of investment which is beyond the scope of this chapter but it is generally thought that this will be a large number.

The importance of establishing the value of an organization's ICT investment may be further understood when the comment of Lord Kelvin[16] is brought to mind.

> When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind.

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[16] Found at http://www-history.mcs.st-andrews.ac.uk/history/Quotations/Thomson.html, 10 July 2006.

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5

Costing ICT

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> *Expenditures on IT capital were less effective than any other type of expenditure considered. The reason is that firms focus too much on how technology is used instead of what it is used for.*
>
> D. Schnitt, Re-engineering the organisation using information technology, *Journal of Systems Management*, January 1993

5.1 Introduction

There is an implicit assumption in most of the ICT evaluation research literature that while ICT benefits may sometimes be difficult to estimate, calculating ICT costs is straightforward. This assumption is implicit in the remarkable paucity of discussion within the literature of how such costs are measured. This may be because many ICT researchers are unaware just how complex ICT costing is or it may be that they consider it to be an accounting problem and thus the concern of others. However, ICT costing is far from straightforward. Even experienced cost accountants are frequently frustrated by the problems they face when it comes to recording and computing the cost of ICT. How to account for costs is often a question of interpretation and organizational politics and, on occasion, can be more of an art than a science.

From an evaluation perspective, a further complication is the fact that cost may be seen through the lens of the accountant or the economist – and there are significant differences between these two mindsets. In general, cost accountants accumulate data in order to be able to determine what was actually paid to achieve a specific objective. An economist, or a manager taking an economic perspective, considers the question of investment alternatives and will usually impute opportunity costs. These two positions can be challenging to reconcile.

This chapter discusses these costing issues and proposes a possible solution to them in the form of an ICT cost reference model. The purpose of this model is to provide a framework within which ICT costs can be systematically classified. In order to derive such a model, it is necessary to have a thorough understanding of the problems that arise in ICT costing. In arriving at such an understanding, only costs which are material and of a size sufficient to have an impact on managerial decisions and their subsequent evaluation need be considered. It does not make sense to waste time and effort chasing minor sums of money or spurious accuracy in the understanding of corporate ICT costs.

Costing is contentious and some of the continuing debates about costing are reflected in this chapter. There are arguments for and against different costing methods such as total absorption costing (sometimes called traditional costing), contribution costing, marginal costing and activity-based costing. A full exploration of these is beyond the scope of this chapter, but some of the more pertinent problems with different methods will be explored.

5.2 Background – a gap in understanding

It is something of a truism that senior managers are concerned about the substantial amounts that their organizations are spending on ICT. This is not a new phenomenon. A typical example was articulated by *Computer Weekly* as long ago as 1991 when it stated:

> Time has run out for ICT managers who act like a protected species. Their threefold failure to understand the business they are supposed to be part of, to communicate with their business colleagues, and to deliver cost effective systems has led to a collapse of faith in the ICT department itself.

There is ample survey and other evidence that this concern has persisted over the intervening years. Another continuing corporate concern about the scale of ICT expenditure, which is perhaps even more fundamental, is that many managers do not even know how much their information systems cost in the first place. The problems related to this were discussed in Chapter 4.

A common understanding of cost measurement is important if discussion of, say, return on investment or value for money are to have meaning throughout the academic, corporate and consulting worlds. As ICT expenditures have continued to climb, understanding of ICT cost structures and cost behaviour has become progressively more important and in need of attention.

This is a gap in knowledge that needs to be filled. Even such research on ICT costs as there is, is mainly concerned with visible costs, i.e. those costs that appear in ICT budgets. However, research has shown that up to 40% of ICT costs may be incurred outside of the traditional ICT budget. In a typical example of such research, Hochstrasser (1994, p. 156) estimates that as much as 30–50% of ICT costs occur outside the official ICT budget, commenting that:

> . . . a need has been identified to be better aware of the true costs of ICT projects . . .

There has been little effort to study this missing 40%. The evidence of surveys such as those cited above suggest that only a minority of organizations have any real understanding of their ICT costs. Surveys of ICT evaluation practice discuss in depth the various types of evaluation methods used and how to choose the best evaluation method, but few concern themselves with the basic mechanics of arriving at the actual cost figures against which any benefits should be measured.

It is, of course, quite feasible to evaluate something without any reference to its cost. One can, for example, assess whether an information system has been effective and possibly even efficient without knowing how much has been paid for it in monetary terms. One can also use cost proxies such as man-days. Additionally, other non-cost-based evaluation techniques like ServQual can be used to measure user satisfaction as a surrogate measure for ICT effectiveness without any reference to the investment involved (these techniques are discussed in detail in Chapter 10). Such techniques are useful in specific contexts, but in general an accurate knowledge of costs is central to ICT evaluation given the pervasive use of capital budgeting, cost benefit analysis and variance accounting as ICT pre- and post-investment evaluation methods. It is an inescapable fact that a considerable part of ICT evaluation, be it pre- or post-investment, is predicated on knowing what the costs are.

5.3 A framework for looking at cost issues

The scope of ICT costing is so wide that it is useful to have a framework within which to conceptualize it. In order to evaluate anything, it is first necessary to define clearly what is to be evaluated. A review of the literature suggests that ICT evaluation is most often (though not exclusively) applied to one of the following categories:

- corporate ICT expenditure
- ICT projects and
- subsets of ICT operations

the latter encompassing such things as:

- A business unit (e.g. a bank branch)
- A department (e.g. production)
- A process (e.g. order processing)
- An application (e.g. office automation)
- A piece of software (e.g. the Executive Information System)
- An infrastructural component (e.g. the network)

While the three categories have much in common, each presents different challenges to the evaluator in defining the expenditure whose outcome or value is to be assessed. This is shown in Figure 5.1.

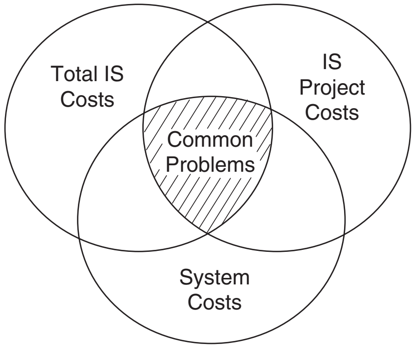

Figure 5.1 Costing problem classes

The various issues that arise in ICT costing and the importance of each issue varies with the category of cost as portrayed in the figure.

5.4 Conceptual problems in ICT costing

Costing problems can be divided into two major groups: conceptual problems and practical problems. While several costing problems exhibit characteristics of both, it is useful to differentiate between the two types. There are several conceptual problems in costing information systems including:

- Defining total investment cost
- Defining total running cost
- Defining system and project cost boundaries
- Defining temporal cost boundaries
- Marginal costing
- Opportunity costs
- Dis-benefits (sometimes referred to as soft costs)
- The cost of risk

Each of these is briefly examined below.

5.4.1 Defining total investment cost

As discussed in Chapter 4 a common question that confronts the evaluator is 'What is the investment cost?' It has been shown that it is not easy to define total ICT cost for the organization as a whole. It is even more difficult for many projects and can be exceedingly tricky for certain classes of subsystem. Costing of corporate ICT requires identification of all ICT related external expenditure on capital and consumable goods and services plus internal wage and infrastructural costs incurred in creating the system. As already noted investment costs include the overheads they attract and these can be difficult to pin down. Identifying such overheads is even more problematic with a subsystem because, unlike the organization as a whole, the boundaries of a system within an organization are often unclear. Furthermore, a change in one area can affect several others and how to account for this may not always be obvious.

5.4.2 Defining total running cost

A related set of issues arises when one asks the question: ‘How much is system “X” costing per annum?’ For many organizations it is important to know what different parts of their ICT operation are costing to run so that divisional and departmental managers can make appropriate decisions about their budgets. This is a particular problem with subsystems in an age of integrated and distributed computing when defining the boundaries of systems may be difficult if not actually impossible. Even if the front-end cost (i.e. the costs incurred before a system is commissioned) is known, as soon as a new system is put into production, a series of other costs are immediately incurred. Some of these may be dis-benefits (q.v.). For example, productivity may suffer in the short term as users become familiar with new systems or procedures; there may be disruption to current operations; existing systems may need to be interfaced; there may be industrial relations problems, etc.

One proposed solution to determining running cost is the ‘Total Cost of Ownership’ (TCO) concept (Gartner Group 1997). Using this, Gartner Group estimated the typical three year cost of running a single networked PC was in excess of $27 000. This figure has been widely disputed, but in defence of Gartner Group, the figure one gets depends on the assumptions one makes and the extent to which one takes knock-on costs into account. TCO has been extended beyond PCs to any identifiable unit (such as software packages, remote access workstations and mainframes). It is at its most complex and debated in the area of networks.

5.4.3 Defining system and project boundaries

Defining the boundaries of systems and projects for costing purposes often presents well nigh intractable problems. In theory an ICT project’s boundaries should be definable and this should be a major factor in ensuring its professional management.

Project management theory states that a well-managed project should have clear boundaries including a clear beginning and a clear termination.

If the project boundaries are clear, so should be the costs. Unfortunately, few ICT projects are either clear cut or proceed in isolation. They are often part of a much larger ICT programme. Furthermore, almost all ICT projects use and share existing resources and this immediately raises the question of cost apportionment (see below). ICT projects frequently disrupt other activities and these disruptions push up the organization's total costs by reducing the efficiency of one or more of the other components of the business system.

Similarly, systems boundaries are not always clear. Many systems are porous, affecting several departments and incurring costs in some or even all of these. The CAD system may be self-contained, but the network and the ERP system may span every department in the organization.

5.4.4 Defining temporal boundaries

Temporal boundaries are a feature of all three categories in the framework, but are particularly relevant to investment costs and project costing. A project needs to have a point when it is deemed to be complete. As has already been observed, in many ICT projects this point is not clear. Even where termination is achieved, additional post-acquisition or post-commissioning costs almost invariably emerge – for example, where additional resources are necessary to ensure the successful management of the new system or unanticipated knock-on effects are encountered which create dis-benefits or costs elsewhere.

5.4.5 Pre-acquisition costs

Costing of ICT projects and systems is frequently distorted by accident or design. Key costs are often overlooked. A common omission is pre-acquisition costs, which are regarded as 'sunk' costs, and not relevant at the point at which the go/no-go decision is made. Pre-acquisition costs can be substantial and include the cost of investigating the feasibility of the project as well as compiling a thorough business case for the investment. On the one hand, there is no point or purpose in including costs already incurred which will not affect the outcome of the project; on the other, omitting costs such as pre-investment investigations may not reflect the time, effort and expense of the work required to be sufficiently confident to proceed with the particular investment.

5.4.6 Marginal costs

Omitting pre-acquisition costs is often done when using a traditional marginal or decision cost approach. While it employs theoretically sound discounted cash flow (DCF) logic by concentrating on future incremental costs, marginal costing may fail to capture the aggregate long-term impact of an ICT investment. An unscrupulous manager can easily manipulate numbers to make the cost of an investment in the short term appear quite low, hiding from view longer-term costs. One way of doing this is to keep long-term capital costs relatively low through writing off a disproportionate amount of pre-acquisition cost as current expenditure. Such behaviour is often encouraged at the highest levels within the organization as it can substantially reduce short-term tax liabilities. It also holds an instant appeal for those managers that are directly responsible for the decision as the artificially reduced investment enhances the prospects of a favourable evaluation of the decision later on.

5.4.7 Opportunity costs

Managers and economists tend to view costs in a different way to accountants. These differences surface in their varying approaches to modelling total cost and marginal cost. They can also arise in the modelling of investment decisions. Here, the accountant's pre-occupation with revenue and cost flows, which are likely to appear in the corporate accounts as a result of a new investment, can militate against the inclusion of opportunity costs. These, by definition, will never show up in traditional accrual accounting systems as these systems capture the costs and revenues only of those activities actually undertaken. Accountants and accounting systems focus on the cost of what is or has been done; opportunity costs are associated with what is not done. Whereas the accountant will frequently ask what the cost of a project is, a manager will often ask what the cost of not investing in the project is. This approach incorporates the economist's notion of opportunity cost.

Opportunity costs arise in a number of different ways, one of which is when there is little or no organizational slack and where resources need to be diverted from other established or proposed activities to the project under evaluation. Any benefits lost from the activity thus impoverished or deferred are regarded as costs of the driving project. Organizations with slack can often commit considerable resources without impinging on other core activities. Opportunity costs have become more important with the success of business process re-engineering (BPR) in eliminating slack. As organizations become leaner and meaner, such flexibility decreases with the result that greater attention to opportunity costs as a factor in decision making now appears to be justified.

5.4.8 Dis-benefits

Computer systems can have an adverse impact on company performance leading to what are sometimes called dis-benefits or soft costs that do not generally find their way into the ICT cost equation. These can involve losses in productivity for a variety of reasons including:

- badly designed systems
- mistakes made due to inadequate training
- staff's adverse reaction to the new system
- slow system response
- loss of business during downtime
- ICT enabled time wasting

Dis-benefits are often difficult to identify let alone quantify. For this reason they are sometimes disregarded because they are considered to be too difficult to evaluate. Dis-benefits are discussed by a number of commentators. Strassmann (1988) suggests that many ICT investments are driven by considerations of efficiency rather than effectiveness and he regards this rather narrow view of the impact of ICT to be in itself a dis-benefit.[1]

Dis-benefits can be external or internal, direct or indirect. This is illustrated in Figure 5.2.

	Direct	Indirect
External	Change in Market Economics Profitable Product Displacement	Hacker Attack Loss of Customer Confidence
Internal	Increased Risk of Fraud Disruption	Lower Morale Loss of Productivity

Figure 5.2 Classification of dis-benefits

External dis-benefits arise when investment in technology leads to a loss in benefits/profit from the products or services that the technology is supporting. This leads to some difficult questions. Where a new technology alters the structure and the economics of a market the result may be a much less profitable business,

[1] Dis-benefits have sometimes been referred to as intangible or soft costs.

but a company may have no option other than to invest in this technology if it wishes to survive. The only means of accounting for this type of phenomenon may be to use the concept of opportunity costs, but, as noted above, these have no place in the typical corporate accounting system.

Dis-benefits are not restricted to external competitive effects. Introduction of new technology can lead to more time wasting by employees, greater stress, new health problems, greater exposure to security risk, etc. The introduction of web facilities into organizations has led to a significant increase in ICT enabled distractions in the workplace. In Ireland it has been estimated that the television programme *Big Brother* cost small businesses £30 000 a week as employees logged onto the programme website during working hours (*Irish Times*, 5 September 2000). In the UK, the figure is estimated to have been £1.4 million per week (*Financial Times*, 25 August 2000). Whether such activities merely displace other non-productive activities (such as doing the crossword or gossiping at the water cooler) is an open question and might make for an interesting research project in its own right. In the absence of solid research, intuition suggests that web availability does lead to its use for some less than productive purposes. This is a dis-benefit.

Dis-benefits can be subtle and complex to measure, but this is no reason for disregarding them. They impose real costs on a business. Kaplan's (1992) observation about:

> conservative accountants who assign zero values to many intangible benefits prefer being precisely wrong to being vaguely right

can be applied with equal validity to difficult-to-measure dis-benefits.

5.4.9 Cost of risk

Computerization can open up an organization to a range of risks to which it would not otherwise be exposed, and such risks are not normally converted to a monetary cost. These can range from project related risks, such as overruns on cost and/or time, to operational risks such as catastrophic system failure or loss.

The risk associated with any project or system development may be wholly or partially offset by, for example, using an external, reputable supplier and by including penalty clauses in the contract. Suppliers will usually charge for assuming this risk. This additional cost is in effect an insurance premium. In contrast, a company that chooses to go with a low cost bidder may be assuming additional project risk. Like not insuring anything else, this is a hidden cost.

A company can choose to take out insurance to cover the operational risk of major system failure, i.e. the type of failure which could lead to significant revenue losses (for example, in a brokerage or an airline) or have tragic human consequences (for example, in a hospital or a signalling system). Such insurance is typically in the form of a business continuation plan with backup sites, hot standby facilities, etc. This may be supported by limited financial cover provided by an insurance policy. These are clearly identifiable ICT costs. On the other hand, if a company chooses not to insure against increased risk (or decides against having a contingency plan or backup site), it is, in effect, self-insuring. This risk premium is a hidden cost and will not be recognized in the accounting system.[2]

5.5 Costing system weaknesses

In addition to conceptual problems, there are several potentially practical weaknesses within costing systems themselves and these are to do with the challenge of recording the actual costs. Four of these problems may be described as data capture difficulties and these include:

- omitted/missed costs
- misassigned costs
- intertemporal problems
- inadequate or inappropriate costing and accounting policies and methods

Figure 5.3 gives an overview of these.

One of the key features of Figure 5.3 is the fact that even where costs are captured correctly, inappropriate allocation and other accounting policies can lead to what might be called *cost leakage*, i.e. the loss of accurate and relevant cost information from the information system. The problems raised by these data capture weaknesses will now be considered. Policy issues are considered in the next section.

5.5.1 Omitted costs

The first type of data capture weakness is *omitted costs*. Omitted costs are defined as costs which should have been identified and allocated to a particular cost point or centre, but which for one reason or another have not been. The question of with

[2] In high profile or listed companies, such unprotected or uninsured risks will almost certainly be recognized in the capital markets and be reflected in the form of higher borrowing costs for the organization and/or a lower share price.

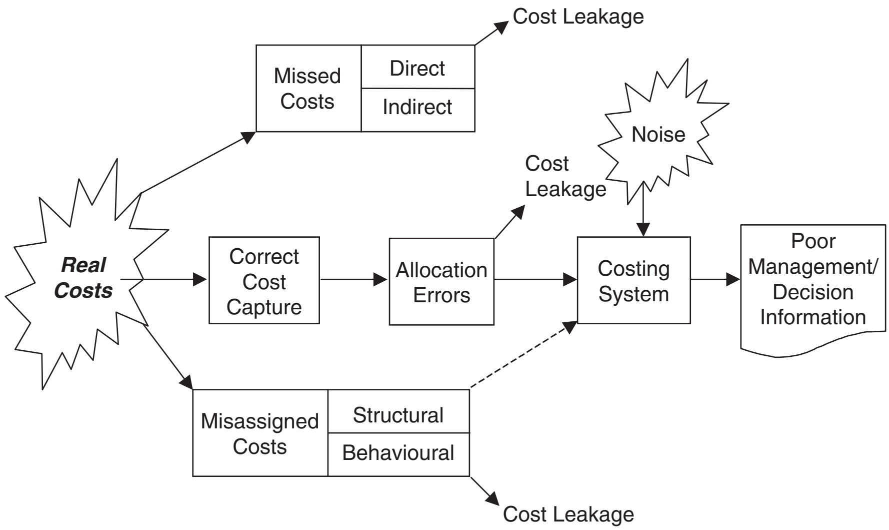

Figure 5.3 Costing system weaknesses

which cost point an item should be identified will depend upon a number of factors including whether the organization is following a direct or a full costing approach. For example, in a full costing approach the payroll costs of non-ICT staff engaged in ICT related activities could be regarded as an ICT cost, whereas in a direct costing environment they would not be.

Some costs which are often not identified, and in some cases not even captured, by the typical accounting system include disruption and displacement costs as well as dis-benefits. Kaplan (1992) has shown that new systems implementation is often accompanied by a short-term loss in productivity as systems are disrupted and users adapt. Omitted costs occur because there is no mechanism whereby the accounting system can separate and capture the data at a sufficiently low level of granularity for proper analysis.

5.5.2 Misassigned costs

These are best illustrated with an example. A Manchester-based database administrator (DBA) goes on a three day course in Paris. The cost of the airfare is recorded by the accounting system as a travel expense, the accommodation as a miscellaneous expense and the other expenses as subsistence when in reality all three are ICT training costs. Of course, the air fare is a travel expense. A good accounting system will capture the fact that not only is it a travel expense, but that it is also a departmental expense, a project expense, a training expense and an ICT expense. Data of this type is inherently multi-dimensional. Unless the accounting system is designed with this multi-dimensionality in mind it will not be able to distil out the different facets of the primary data. Weak accounting systems may, for example, capture only the first or the first two of the five dimensions of the administrator's air fare. It is an interesting question how often, where such data is comprehensively captured by sophisticated coding and accounting systems, the resulting richness of this information is used to its full potential in planning, control or decision making.

Accurate data capture requires two things:

1. **A well-designed chart of accounts**: If the chart of accounts does not have appropriate headings, costs will usually be charged into the nearest convenient heading. If an organization has not changed its chart of accounts in many years, it may be quite unsuitable for the way the business currently operates. This might be called *structural misassignment*.
2. **Using the accounting system correctly**: Even where the chart of accounts is well designed staff sometimes deliberately miscode costs, a process colloquially referred to as 'burying' costs. Sloppy or careless coding is also a problem. A common behaviour is to code costs to a heading where there is still some unused budget rather than to a correct heading which is over budget. Another is to deliberately miscategorize goods to circumvent company purchasing rules. This is *behavioural misassignment*.

Another common source of misassignment is user costs (such as learning costs, errors, consultation time, etc.). Even in professional organizations such as accountancy firms, consultancies and legal practices which record staff activity, sometimes to the nearest minute, accurate computation of user costs requires both an appropriate costing system and a high degree of user discipline. Even good data capture systems are prone to bias and manipulation, especially if budget or actual expenditures are linked to a personal reward system. Agency theory also suggests that people massage reported data to meet the criteria by which they perceive that their performance will be judged. From a different perspective, Walker and Johnson (1999) report that slack-building can result as a result of budget incentives. This phenomenon makes the identification of the real cost even more difficult to establish.

5.5.3 Intertemporal data capture problems

The effectiveness of capture of ICT costs is also time related. The further from the period or point of investment that an expenditure occurs, the more difficult it is to tie the cost back to the investment. This ripple effect is illustrated in Figure 5.4.

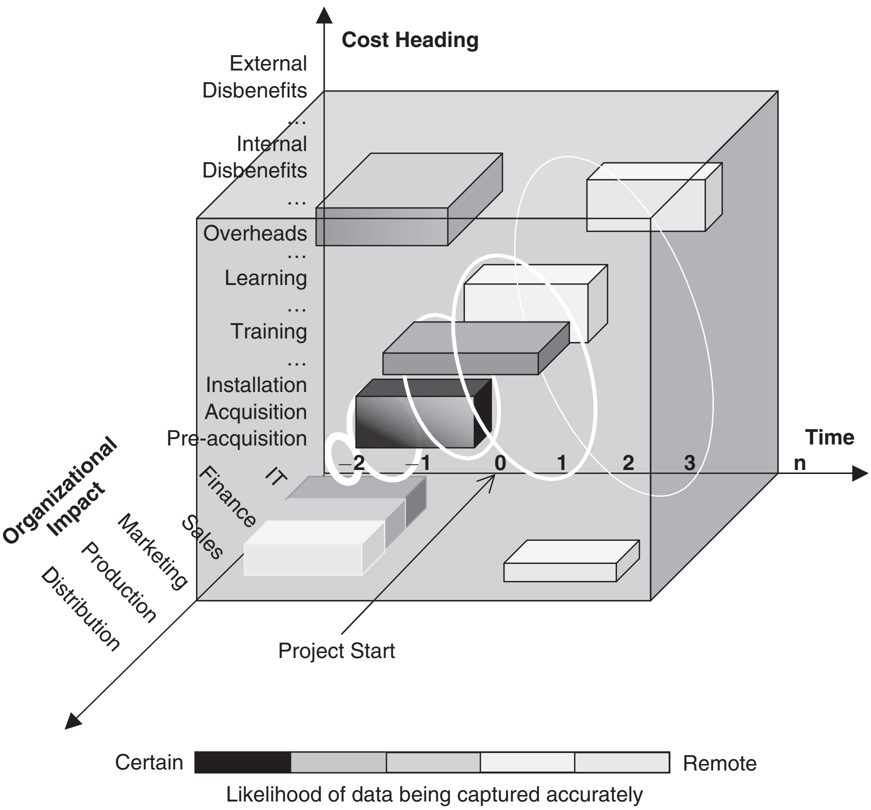

Figure 5.4 The ripple pattern of cost accumulation

Over the life of any ICT investment, the cost impact diffuses over time to incur more and more remote effects while the ability of current systems to capture these costs decreases. The ripple effect occurs in three dimensions: cost type, time and organization. For example, the impacts of a change in the financial system may be felt initially in ICT and finance, but may eventually percolate out to sales, marketing, distribution, etc.

There are two questions that need to be addressed here. At the pragmatic level, the accounting system needs to be able to relate costs over a long time period and in different locations. Project accounting systems can do this, but many organizations either do not have such systems or are unable to capture the data necessary to drive them. At a deeper level, the time horizon for a given cost needs to be determined. It does not make sense to track post-implementation costs indefinitely. At some point the 'project' must cease and the system become part of normal operations. The question is where should the cut-over point be? It should be remembered that many of the dis-benefits and risk related costs associated with projects may show up in the later phases of the project. The risk of late failure always needs to be considered.

5.6 Accounting policies

Weaknesses can arise in a costing system from inappropriate accounting policies. These can occur due to failure to apply proper accounting standards or due to simple misjudgement. Among the areas where difficulties can arise are capitalization/amortization policies, the early adopter problem, overhead allocation and chargeback.

5.6.1 Capitalization and amortization

Two related questions that affect the quantification of ICT costs are the capitalization of expenditure and its subsequent amortization. Capitalization refers to the treatment of certain expenditures as acquisition of assets which then appear on the corporate balance sheet. Amortization relates to the manner in which this expenditure is subsequently written off in the income statement over a number of years. Different firms are likely to approach capitalization in different ways. Some will prefer a conservative approach, capitalizing the minimum that is consistent with the accounting standards and the practices in their industry. To this end the advice of auditors is usually sought. Despite this accounting frame of reference, which is governed by various formal statements of standards, accounting practice can give a significantly erroneous view of the aggregate cost of an ICT investment.

The rate at which an organization amortizes its assets is also dependent upon a number of variables. In the first place the organization may try to match the amortization schedule to the useful economic life of the asset. When the organization is quite profitable and there is a high degree of uncertainty as to the likely duration of an asset's economic life, there may be pressure to accelerate the amortization schedule. When profits are not adequate the reverse can happen. Further complications arise from the fact that internal management accounting reports need not comply with external reporting standards and to compound the difficulties, for evaluation techniques that use after tax cash flows, the amounts allowed for amortization by the tax authorities are likely to differ from both of these. It is therefore essential that caution is exercised in the use of both capitalized and amortized calculations or measures.

5.6.2 Early adopters and the hotel night problem

Another problem that can distort ICT costs is the so-called early adopter or 'hotel night' problem. Because hotels have large fixed overheads, the cost per guest in a hotel falls as the room occupancy increases. Hotels do not charge guests extra because there are fewer of them (on the contrary, they are likely to reduce prices to attract more guests). Perversely the converse of this logic often occurs when a new system is implemented and early adopters can end up paying a disproportionate amount of the cost. If initial take-up is slow (or is restricted to a small group) the cost per user is high. As the use of the technology spreads, the cost per user drops. Failure to account properly for this phenomenon, i.e. to use appropriate time horizons, leads to both poor decision making and corporate game playing. The former can arise when the long-term cost per user of a system is misunderstood leading to short-sighted decisions. The latter arises when 'clever' managers let other departments absorb the expensive upfront costs of a new system and then 'piggy back' on the apparently lower costs of the system when it settles in.

5.6.3 Overhead allocation

There are few more troublesome problems in cost accounting than that of overhead allocation. Overhead allocation is the subject of both theoretical debate and sometimes intense practical contention. Inappropriate overhead allocation not only results in poor management information, it can also distort user and manager behaviour leading to counterproductive or sub-optimal actions. Overhead allocation can be the cause of bitter disputes in organizations. Worse, there is seldom an unambiguously right or wrong way to allocate overheads, so judgements made are always open to criticism.

Within the ICT function itself there is a large range of potential overheads including:

- Shared devices (printers, storage, tape drives, etc.)
- Shared infrastructure (network cabling)
- Shared services (helpdesk, system administration, backup)
- Administrative costs (insurance, legal, etc.)
- ICT management
- ICT research

To apportion these costs in a reasonable and fair way, the accountant or manager is faced with the problem of which criterion or criteria to use as the basis of allocation. This is seldom easy as any choice will typically favour one group and disadvantage others. The list of possible bases for allocation is formidable and includes:

- Headcount
- Number of screens
- Number of devices
- Total capital investment
- CPU usage
- Disk usage
- Network usage

etc. All of these can give rise to different distortions in information and behaviour.

The following illustrates the type of problem which can arise.

In a large professional services organization, a small specialist department which made up under 5% of the staff had approximately 8.5% of the organization's PCs. The cost of central ICT services (including the mainframe, the servers, the user support group, the help desk and the network) was allocated on the basis of PC count, thus assigning the department almost twice as much ICT overhead cost per head as other departments. In fact, due to the high level of technical expertise in the department, the staff tended to solve most of their own problems and, pro rata, made less use per capita of help and support services than other departments. Because of the nature of their work, they also made less use of the mainframe so the cost allocation system was doubly unfair. As the overhead cost was a charge on the department's profitability and the bonuses of the department's managers were linked to their departmental profit performance, the allocation of ICT costs became a personal and highly political issue. As a result, a large amount of time was squandered in meetings and resentment festered, damaging both productivity and morale.

5.6.4 Chargeback

Cost allocation may be effected in a number of ways. One common method involves the assignment of a periodic charge to user departments. More complex systems of allocation may involve a formal system of chargeback. In some organizations, an internal market is created whereby the supplying department becomes a profit centre aiming to maximize revenues while user departments aim to use the minimum of such service that is consistent with the achievement of their own objectives. These systems are usually more controversial than their more basic counterparts noted above, not least because they aim to influence managerial behaviour and decision making. Whatever the theory, many management textbooks suggest that such goal congruence is hard to achieve, not least because of the continually changing external environment (e.g. demand, price and tax rates) and changing relationships between supplying and consuming departments. A good example of this line of argument can be found in Horngren *et al.* (1997, chapter 25).

Many chargeback systems use a standard cost approach (i.e. they do not attempt to deal with the hotel night problem described above). The standard cost is based on a budgeted or anticipated level of usage. Like any standard costing system, standardized chargeback may under- or overabsorb costs. This is due to the fact that standard chargeback normally involves a single charge per 'unit' of consumption that combines the cost of fixed and variable expenses incurred in the supplying department. Standard costing is also unsuitable for activities of a non-repetitive nature and a great many ICT related activities are non-repetitive.

5.7 An ICT cost reference model

5.7.1 Standards do help

The long list of potential problems and difficulties discussed in this chapter suggests that there is a need for a standardized approach to costing of ICT. The purpose of a set of standards would be to ensure that there is a consistent approach to costing of information systems investments and expenditure in a manner analogous to that used by the financial accounting profession to ensure consistency of financial reporting. The latter are set out in broad terms as Generally Accepted Accounting Principles (GAAPs) and formally enshrined in such publications as Statements of Standard Accounting Practice (SSAPs), Financial Reporting Standards (FRSs) and the emerging statements of International Accounting Standards (IASs). It is not proposed that the standards or guidelines for costing of ICT should try to emulate the formal/quasi legal status of an SSAP (the status of these standards varies between countries; most are self-policed by the professional accountancy bodies). It is important to recognize that while the accounting standards bodies can set strict rules for financial accounting and reporting, in the looser world of cost and management accounting, it is much more difficult, if not actually impossible, to be so prescriptive. A certain degree of flexibility is necessary to allow for the great variety of circumstances that can arise in costing generally. Nonetheless, there is a strong case for at least an agreed set of guidelines for computing of ICT costs whether such costs are to be used for internal corporate decision making or for cross industry benchmarking.

The arguments for a model are summarized at the end of this section. First, a proposed approach is outlined.

5.7.2 An ICT cost reference model

One approach to creating such a set of guidelines for ICT costing is to define a reference model. The term 'reference model' is adopted to reflect the fact that such a model would contain a set of standards for good practice to which users can refer and from which they can select such components as are relevant to their circumstances. Such a model should have some or all of the following characteristics:

- A definition of what costs are to be included in it
- Guidelines for data capture
- Standards and methods for allocation of overhead costs
- Filters to remove irrelevant data or noise
- Compatibility with existing external accounting rules and standards
- Compatibility with cost accounting practice in comparable areas
- Guidelines for defining temporal boundaries
- A mechanism for defining organizational interdependencies

An outline of the proposed model is shown in Figure 5.5.

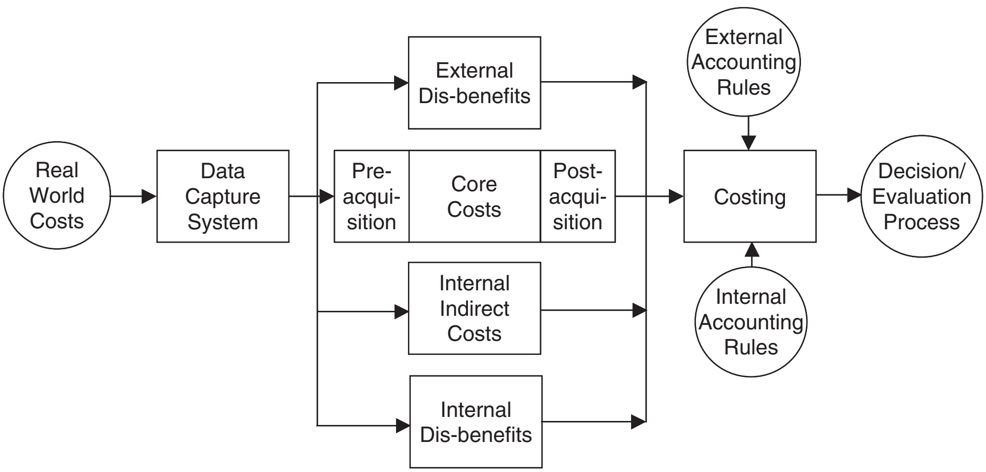

Figure 5.5 An ICT cost reference model

Each component of this model will contain some or of all of the following:

- Recommended policies
- Recommended procedures

- Definitions
- Checklists

For example, under pre-acquisition costs, the nature of these costs will need to be defined as well as a set of examples provided. In addition the reference model will provide rules on when pre-acquisition costs may be expensed and under what circumstances they should be included in the investment cost carried forward. Recall that the key objective is to define good practice – a code of conduct for effective costing which would, in this case, seek to eliminate the possibility of managers manipulating such costs to try to achieve a more favourable outcome in a subsequent evaluation.

5.7.3 Example of a component

The purpose of this chapter is to propose the framework and it is beyond its scope to examine any of its components in detail. However, the following is an illustration of the type of supporting detail that such a model might involve for internal dis-benefits.

There has been considerable research into and discussion of soft benefits and how to measure them. Many of the concepts and ideas developed in this research can be applied or adapted to dis-benefits. It is therefore possible to categorize internal dis-benefits and suggest metrics that can be applied to them. One approach to analysing dis-benefits is to combine them with the opportunity costs of *not* taking the action in order to arrive at a balanced measure. Policy here might state that:

- All dis-benefits must be identified
- Dis-benefits should be classified into significant and ignorable
- Significant dis-benefits should be specified and costed

Applying these rules to, for example, implementation of making access to the Internet available on all desktops might result in something like:

Dis-benefits

- Loss of staff time and productivity due to inappropriate surfing
- Loss of productivity by staff using the net for other non-work related purposes
- Risk of staff accessing inappropriate websites (pornography, etc.) with possible legal or other exposures to the company
- Risk of staff downloading illegal software
- Risk of staff downloading viruses

- Exposure of the firm to tracking of its activities by outsiders using cookies
- Loss of control over purchasing, particularly of small items

Significant dis-benefits
Of the above:

- Loss of staff time and productivity due to inappropriate surfing
- Loss of productivity by staff using the net for other non-work related purposes
- Loss of control over purchasing, particularly of small items

Cost of dis-benefits

Estimated staff time spent on unproductive Internet related activity per week	3.00 hours
Less estimated cost of displaced non-productive activity	1.75 hours
Net additional time lost per week per staff member	1.25 hours
Number of staff	100
Hours lost	125 hours
Cost per hour	€20
Total cost per week	€2500
etc.	

5.7.4 A reference model

The arguments in favour of a reference model can be summarized as follows:

1. **There is currently much poor practice that could be improved**: It is clear that current costing systems and procedures are often flawed. There may be many reasons for this including inadequate design, historical inertia, poor understanding or, in rare cases, deliberate deception. A reference model would help users to overcome the first three of these and at least make the fourth more difficult.
2. **There is a need for consistency for evaluation purposes**: Unless costs are broadly correct, evaluation, or at least evaluation which seeks to identify return on financial investment or value for money, may be meaningless. Currently, two organizations in similar circumstances using the same evaluation techniques, but different costing methods, could conceivably arrive at quite different views about the same ICT investment.
3. **It would increase transparency**: It was noted at the outset of this chapter that many managers feel that they do not fully understand their ICT costs.

Computing ICT costs using a standard approach/model should go a long way towards ameliorating these concerns.

4. **It would make for more useful decisions about ICT expenditure**: Under- or overstatements of ICT cost (as with any other cost) can lead to poor decisions. In a similar manner, poor design of chargeback systems can lead to sub-optimal behaviour at an organizational level as individuals and departments seek to optimize their own positions.
5. **It would save users time and effort**: Like any set of guidelines, an ICT costing reference model should provide procedures and policies which can be adopted or adapted by users and managers. This avoids re-inventing the wheel, ensures that what is being done complies with good practice and can save much time and expense.

5.8 Summary

This chapter has examined a range of theoretical and practical problems in ICT costing and suggested a model which addresses these. Without an understood cost basis, comparative financial evaluations of ICT are suspect and individual evaluations may be invalid – in colloquial terms, evaluators can find themselves mixing apples and oranges.

The structure outlined above is based on an examination of the ICT management, ICT evaluation and cost accounting literatures. In addition, the authors have drawn on their professional experience obtained over many years working in this field. Applying this model in practice will help with the understanding and the control of ICT costs.

Clearly there is much to be gained from a better understanding of ICT costs. If organizations and ICT professionals were to use a common reference model such as the one proposed here then there would be an opportunity for the community of ICT users, developers, consultants and academics to have a much more useful dialogue about the awkward question of 'how much did that system actually cost?'

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6

Issues and techniques for ICT evaluation

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> *Although there are no certainties about the overall impact of IT on business economics, there are numerous large-scale examples of IT investment with little or no associated process change. The most prevalent use of computers by individuals in business is word processing – hardly a process innovation . . .*
> *. . . If nothing changes about the way work is done and the role of IT is simply to automate an existing process, economic benefits are likely to be minimal.*
>
> Thomas Davenport, *Process Innovation: Reengineering Work through Information Technology* (1993)

6.1 Measuring business performance

Before embarking on the discussion of how IT effectiveness may be measured and the role of cost benefit analysis in this process, it is appropriate to consider some of the general questions related to the matter of assessing business performance.

There is a deep need in Western industrial culture to regularly measure business performance. There are several reasons for this, including the need to enhance performance as well as ensure growth. Both performance and growth enhancement are required to meet stakeholder expectations including increased salaries, wages, profits, dividends, etc. Although business performance measurements take a variety of forms and are therefore difficult to describe in general terms, business performance assessments frequently focus on the issues of liquidity, activity, profitability and future potential. In assessing these dimensions, a variety of ratios are used such as EBIT%, NP%, GP%, stock turnover, ROI, ROE, administration costs/turnover, asset turnover, capital intensity, etc. The number and type of ratios used vary from organization to organization and from industry to industry and reflect both the nature of that industry and size of organization as well as management culture or style.[1] Organizations sometimes change their performance measurement indices or ratios as they attempt to improve the meaningfulness or information content of the measures they use. Occasionally new metrics are driven by business fads. During the height of the dot.com era, for example, it was fashionable to value companies on a dollar per customer basis – a measure subsequently and rightly discarded. Evolution works in business as in other spheres and over time all industries develop a set of measures and methods of evaluation that suit their circumstances.

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[1] Although performance ratios have been used by almost all companies, the management of Harold Geenen at ITT is often cited as being an example of one of the most ratio intensive management styles ever known.

6.1.1 What constitutes good performance?

The question of what constitutes good performance is, therefore, one that is asked regularly. For example, is a net profit (NP) of 10% good? Is an ROI of 20% satisfactory or is a stock turnover of 5.2 poor? Of course this question of good performance cannot be answered in isolation. To be able to assess performance it is necessary to know in what industry the organization is functioning, the size of the organization, the history of the organization and, especially, the approach and the goals of management. For example, an ROI of 15% might be exceptionally good for an organization in the iron and steel market, and absolutely terrible for an organization in the electronics industry. A large organization in a highly concentrated industry might require a net profit of 10%, whereas a small organization may be quite content with a net profit of 5%. Factors that affect accepted levels of return include the level or risk, the level of competition and the weighted average cost of capital faced by the organization. Perhaps the most important factor with regard to the question of good performance is the expectation of management. If management has set an ROI of 15% as one of its objectives, then good performance is the realization of this target, i.e. an ROI of 15% or better. Poor performance is then an ROI of less than 15% (all other things being equal).

6.1.2 Ratios

A common approach to the use of performance ratios is to consider them over a period of time in order to establish a pattern or trend. Thus, if over the past five years the ROI has been steadily increasing it is probably true to say that performance has been improving, although it may not yet be at a stage where it could be considered good. In using this longitudinal approach to ratio analysis, it is necessary to be aware of possible changes in accounting practices that can affect the basis of the way the ratios are calculated, and thus produce apparent movements in the ratios without there being any substantive change in business circumstances. Also, if a measure such as ROI is used and if the organization is not continually replacing its assets, especially its fixed assets, routine depreciation policy may generate increasing ROI percentages without any improvement occurring.

6.1.3 Inflation

Another difficulty that needs to be addressed when using financial ratios is the deterioration caused to the value of money by inflation. Inflation can play havoc with conventional accounting. It can cause profits to be overstated and assets to be undervalued in the organization's accounts. As a result of inflation, ratios may become significantly distorted and present a seriously misleading picture.

6.1.4 An art and not a science

It is most important to stress that the measurement of business performance is not a pure science, but contains a large element of art. Two different financial analysts may take diametrically opposed views of the health of a business, and these opinions may be based on the same data set. In the final analysis only future performance can be the arbiter of who is right.

6.2 When is performance measured or not?

There are certain circumstances in which performance is either not measured or is measured with less care and attention than maybe it should be. These circumstances include, but are not limited to:

- Where the amount of funds involved is not substantial
- Where the performance or value is taken for granted
- Where the organization classifies the expenditure involved in an activity as an ongoing expense rather than as a capital investment

Funds spent on running the finance division, other than for computing purposes, are generally not analysed too closely. This is because the sums are relatively low, the need is commonly agreed, and the accounting treatment does not require the expenditure to be capitalized. Exactly the same argument applies to the personnel division and to public relations. In the manufacturing environment the size of the investment is typically much bigger and the expenditure is treated as capital. This leads to a more analytical approach being taken.

Although the size of marketing spend is considerable, as it is usually regarded as a necessary expenditure, the concern about the measurement of its effectiveness is not always expressed in an interest for detailed metrics. The time span of marketing effort being relatively short, it is treated as an ongoing expense. Also, because of the closeness of marketing to the survival of the business itself, expenditure may not be questioned in the amount of detail that might otherwise be the case. R&D expenditure is frequently treated similarly.

Looking at this from a slightly different point of view one of the decisions that managers have to take is which aspects of the business should be regularly evaluated.

This leads to some interesting questions for which there are no ready answers. One of these is what constitutes investment? As noted in Chapter 4, in ICT, the division between capital and current expenditure is not always clear. This is also true in other areas. For example, the cost of running the finance function or the marketing department of a company is normally regarded as a running expense, written off in the period in which it is incurred. Such costs are usually treated by the costing system as overheads which may either be allocated to product costs or paid for by product contribution. Performance measurement in areas like finance and personnel can, therefore, be quite difficult. There are no standard ratios such as HR personnel/industrial relations problem or accountants per transaction. Other areas, such as sales and production, are much easier to measure (e.g. sales achieved by representative or units produced per production worker). In between these two fall departments such as ICT and R&D. In ICT, some of the work will be in support of existing systems and akin to what happens in the finance department; other work will be in new systems and projects and more akin to conventional investment. This duality is at the heart of some of the problems of costing (see Chapter 5) and evaluating IT.

6.2.1 Why IT investment is heavily scrutinized

The IT investment qualifies for detailed analytical scrutiny for several reasons:

- The amounts of money are frequently quite substantial
- Because many IT investments are not perceived as being close to the revenue or profit-making aspects of the business
- Because there is not always common agreement as to the IT investment need, or of its value to the organization and how its performance could be assessed
- Much of IT expenditure, especially on hardware, has traditionally been capitalized and capital expenditure has traditionally been scrutinized
- Because there has been growing dissatisfaction at the performance of IT functions

To these five reasons should be added the question of risk. IT projects have traditionally been seen as high risk. This is because there have been a number of IT failures over the past 40 years, many of which have involved large amounts of funds and have received quite a lot of visibility. In addition, top management frequently has little or no understanding of the IT function and therefore considers all IT activity to carry a high risk.

All of these factors have led to senior managers requiring a detailed and analytical approach to the assessment and evaluation of IT investments. It is frequently argued by IT professionals that demands for estimates and projections seek an unrealistic level of precision and detail. Many IT managers wonder why other functions in their organization are not subject to the same degree of scrutiny.

6.3 The assessment of IT effectiveness

The assessment or evaluation of IT, and especially IT effectiveness, needs to be undertaken with considerable care. Furthermore, it should be clear from the outset why the assessment is being undertaken, as the approach to the evaluation depends on the purpose for which it will be used. In practice an important consideration is the requirements and/or perspective of the person who commissions the IT effectiveness study.

If an accountant is asking the question of effectiveness, then the answer is probably required in terms of ROI, the formula for which is described in Appendix C. The calculated ROI number on its own is generally regarded as being of little value. This statistic becomes much more valuable when the IT ROI is compared to either the organization's cost of capital or perhaps to the ROI for the organization's total assets. A standard such as an industry average would also be considered very useful in this respect.

If a marketing manager examines effectiveness then he or she may wish to look at the organization's ability to produce better forecasts or improved customer response times or achieve a higher level of service satisfaction. A production will have quite a different perspective such as lower defect rates or lower machine downtime to mention only two issues.

The nature of the evaluation is also affected by the level in the organization that sponsors it. If the question of effectiveness is being asked by the operational management, the focus of the question will probably be directed at the question of whether the organization is getting the most from the IT investment in terms of operational improvements. This question cannot be answered by simple reference to an ROI measure, as the investment may be showing quite an acceptable ROI, but may not yet be realizing its full potential. Equally, it may be quite difficult to convert operational improvements into the kind of data needed to feed an ROI calculation. For example, improved customer satisfaction should, *ceteris paribus*, translate into increased business and profit, but making the link between this and the IT investment may be almost impossible, especially if the impact is lagged and there are other external variables (such as better staff training) to muddy the waters. Here, what can be achieved needs to be known and the performance of the system to this standard is the essence of the answer to the question. What can be achieved can only be ascertained by comparison to some other installation, either in another department or in another organization.

At a different level, if the board of directors is asking about effectiveness, then the focus is probably on the question of whether the system is enhancing the performance of the business as a whole. This sort of question is often couched in strategic terms such as: are the systems contributing to the organization's ability to realize its corporate strategy? This means that a much wider view needs to be considered as it is possible for a computer to enhance departmental effectiveness at the expense of the overall corporate strategy.

6.3.1 How well is the ISD doing?

Some organizations feel the need to ask how well their ISD is doing in order to answer the question: is our IT budget being well spent? There is no simple answer to this. Some organizations are content with establishing whether their objectives for the system are being met. This is relatively easy, especially if business objectives and key performance indicators were specified in the original specification of requirements or project objectives.

Other organizations want a more absolute evaluation. There are basically only two ways of approaching this type of evaluation. One is for organizations to compare themselves to their competitors. Organizations can often obtain a significant amount of information about the way competitors are using IT and they can obtain a rough idea of how much that IT activity costs. The organization may interview clients and also the clients of competitors to establish their relative performance. This type of evaluation is, at the end of the day, quite subjective.

The second approach to answering the question of how well the ISD is doing is to compare current performance with historic performance. This requires knowledge of the situation *ex-ante* which in turn may require the existence of a database of detailed measurements of past performance and IT expenditure. Few organizations have this and even where they do, it is a less than satisfactory way of answering the question. In practice, not many organizations have the required statistical history to be able to perform this type of analysis so the point is moot.

6.4 Purpose of the IT investment

The purpose of the investment is most critical to the process of defining the approach to its evaluation and to its performance measurement. As mentioned in the previous section, IT investment that is used to improve efficiency requires efficiency measuring techniques such as work study or cost benefit analysis. IT investment, which has been implemented to enhance management effectiveness, requires value added analysis, value chain assessment, etc. IT investment for business advantage or business transformation requires measuring techniques such as strategic analysis, relative competitive performance, etc. Table 6.1 suggests how different investment types may be treated.

Table 6.1 Investment purposes, types and evaluation techniques

Investment purpose	Investment type	Evaluate/measure
Business survival	Must do	Continue/discontinue business
Improving efficiency	Vital/core	Cost benefit
Improving effectiveness	Critical/core	Business analysis
Competitive leap	Strategic/prestige	Strategic analysis
Infrastructure	Architecture/must do/corn seed	Long-term impact analysis

6.5 Matching assessment to strategy

It is important to focus assessment efforts, especially when dealing with systems that have the potential to generate a competitive advantage. Specifically, strategic IT investment may be seen as having an impact on the organization's ability to function as a low cost leader or as a differentiator.

6.5.1 A strategy of differentiation

If the organization's strategy is one of differentiation then the following are the issues on which the IT performance should be measured:

- Does IT enable the company to add information to the product?
- Does the IT application make it easier for the clients to order, buy and obtain delivery of the goods or service?
- Are there fewer errors in processing the business?
- Have the after sales service aspects of the business been enhanced?

6.5.2 A strategy of cost leadership

If the strategy is one of cost leadership then the following are the metrics on which the IT's performance should be measured.

- Will the IT application result in direct product/service cost reductions?
- Will the application result in overhead cost reductions?
- Will the time to market improve?
- Will there be better capacity utilization?
- Will inventory levels be reduced?
- Will the system enable or facilitate economies of scale?
- Will inventory turnover be increased?

The matching of benefits to systems purpose is really a key aspect to understanding and managing IT benefits.

6.6 Different approaches to measurement

There are two generic approaches to measurement. These are common to all forms of measurement, whether they relate to speed, obesity, water flow, beauty contests, weighing potatoes or assessing information systems. Measurement may be based on:

- Physical counting
- Assessment by ordering, ranking or scoring

Whether the contents of a tanker, the weight of a boxer or the speed of a jet plane are being measured, units are being counted. When it is difficult or impossible to count, the assessment is made by ordering, ranking or scoring.

Both of these fundamental approaches are used as the basis of a variety of techniques such as cost benefit analysis and strategic match analysis.

A first approach to measurement of IT effectiveness is to compare the system's objectives to the actual achievements of the system. For such an exercise to work the system's objectives need to have clearly been stated with key performance indicators (KPIs) having been specified in advance. Objectives without KPIs are of little value, as objectives that are set without attention as to how the business will know if they are achieved, are frequently too vague to be meaningful. Table 6.2 shows some satisfactory and some poor objectives. The definition of the objectives and the KPIs should be clearly laid out in the system specification. Unfortunately this is not always done.

Table 6.2 Examples of satisfactory and poor systems objectives

Satisfactory objectives	Poor objectives
To reduce inventories by 5% by value and 10% by volume within the next 180 days	To improve profitability
To increase the organization's ROI by 1% by the end of the financial year	To reduce errors
To reduce the amount invested in debtors so that the debtors' days decline from 80 to 68	To improve staff morale
To improve staff acceptance of the new IT systems as reflected by the attitudes expressed in regular satisfaction surveys	To enhance cash flow
To deliver detailed proposals of typeset quality to clients within 48 hours of being given leave to present such documents	To obtain a competitive advantage

Even when the objectives and the KPIs have been defined, it is not always possible to measure the actual impact of an information technology application, simply because the effects may be indirect, or rendered invisible by surrounding noise in the system. In designing KPIs it is therefore necessary to bear in mind their measurability. If you cannot get the data, the KPI is not going to be of any value.

6.7 Intangible benefits

Intangibles are, almost by definition, hard to measure. Nonetheless they matter. Where it is hard to directly observe the effect of the ICT, the following methodology can be used to help assess the nature of the benefits of the system.

The steps involved include:

1. Conceptualize the chain of cause-and-effect events that may result from the introduction of the system.
2. Identify how it will be possible to establish the changes that are likely to occur as a result of the introduction of the information system. Here the focus is on the direction of the changes, i.e. will the inventories rise or fall? Will more phone calls be taken, etc.
3. Consider how the size of the change may be measured.

4. Where the effect of the system is clear, the analyst may proceed with the next two steps.
5. Measure the size of the change.
6. Put a cash value on the changes that have been observed. Use techniques such as payback, ROI, NPV, IRR, etc., to assess whether the information system investment will produce an adequate return to justify proceeding.

This six-step methodology is a useful framework for approaching IT evaluation studies, even where it is hard to identify benefits.

The following is an example of how the method could be used. Suppose a new billing system is being introduced by an organization. The six steps might be something like:

1. The new billing system will reduce errors, get out invoices in less time, etc. It will do this by checking prices, discounts and business terms automatically, eliminating current manual tasks. Month-end statement will be run two days after month end instead of ten days.
2. Changes:
   – fewer customer queries
   – fewer journal entries
   – fewer reconciliations
   – less clerical manual work
   – fewer errors
   – reduced working capital
3. Measurements:
   – keep a register of queries
   – count journal adjustments
   – record time on reconciliations
4. Check interest paid on overdraft, and interest earned on cash available.
5. Time released multiplied by the salary paid, or where overdraft is eliminated, interest not paid.
6. Monitor number of billing queries from customers using standard calculations.

Obviously, there are several refinements that could be added to the above example, but it is sufficient for illustration purposes.

The above six-step approach to measuring ICT benefits is susceptible to a number of problems of which the following three are the most frequently encountered.

6.7.1 Noise

Noise refers to the fact that the effect of the ICT investment may be masked by other events in the environment. Thus, although the inventory levels should (say) have fallen due to the new system, an unexpected fall-off in customer demand produced an increase in inventory that overwhelmed the benefits of the system.

6.7.2 Fluctuations in the short term

Sometimes ICT benefits are hidden behind short-term fluctuations due to seasonal changes in demand, cost or prices. To make sure that such fluctuations do not obscure the presence of ICT benefits, measurements need to be taken at regular intervals over a period of time. A common problem is found when a new system exposes heretofore hidden problems elsewhere in a system (such as high rates of data keying error or poor quality customer master records).

6.7.3 Lies, damn lies and statistics

All measurement techniques are based on assumptions and these assumptions may often be manipulated by unscrupulous managers to show the required results.

6.8 Specific methodologies

There are several different methodologies available to assess the performance of IT. The following are a few of the most commonly used:

1. Strategic match analysis and evaluation
2. Value chain assessment (organization and industry)
3. Relative competitive performance
4. Proportion of management vision achieved
5. Work study assessment
6. Economic assessment – I/O analysis
7. Financial cost benefit analysis
8. User attitudes
9. User utility assessment
10. Value added analysis
11. Return on management
12. Multi-objective, multi-criteria methods

Each of these is briefly discussed in the following paragraphs.

6.8.1 Strategic match analysis and evaluation

This is a ranking or scoring technique that requires the entire primary ICT systems to be assessed in terms of whether or not they support the organization's generic corporate strategy. The two main generic strategies are differentiation and cost reduction. If a system helps improve customer service it may help the organization differentiate itself in the market (depending on how competitors are performing), while if it helps to reduce costs it is generally supportive of a cost reduction strategy.

Table 6.3 shows a list of the more important applications in a large organization and this list may be used to assist in the categorization of the systems.

Table 6.3 Key business applications

Function	Low cost	Differentiation
Product design and development	Product engineering systems Project control systems CAD	R&D databases Professional workstations Electronic mail CAD Custom engineering systems Integrated systems to manufacturing
Operations	Process engineering systems Process control systems Labour control systems Inventory management systems Procurement systems CAM including ERP systems Systems to suppliers	CAM for flexibility Quality assurance systems Systems to suppliers Quality monitoring systems for suppliers
Marketing	Streamlined distribution systems Centralized control systems Economic modelling systems Telemarketing On-line sales Customer self-configuration	Sophisticated marketing systems Market databases ICT display and promotion Competition analysis Modelling Data mining High service level distribution systems
Sales	Sales control systems Advertising monitor systems Systems to consolidate sales function	Differential pricing Office–field communications Sales support Dealer support

(*Continued/*)

Table 6.3 (/Continued)

Function	Low cost	Differentiation
	Strict incentive monitoring system Telesales Teleordering On-line sales	Systems to customers Personalization Customer relationship management systems
Administration	Cost control systems Integrated financial systems Quantitative planning and budgeting systems Office automation for staff reduction	Office automation for integration of functions Environmental scanning and non-quantitative planning systems

Weights can be associated with the more important systems, and a score given on the basis of the degree to which these systems have been implemented and are achieving their objectives.

Table 6.4 shows a strategic match evaluation form used with simple unweighted ratings of 1 to 10, where 1 represents low impact systems and 10 represents high impact systems.

Such an evaluation technique is useful if applied each year so that the organization can obtain a feel for the direction in which the ICT function is progressing.

Table 6.4 Completed evaluation form

Function	Low cost possibilities	Actual systems	Rating
Product design and development	Project control systems	Project control systems	6
Operations	Process control systems CAM	Process control systems CAM	3 7
Marketing	Telemarketing	Telemarketing	5
Sales	Sales control systems Systems to consolidate sales function	Systems to consolidate sales function	4
Administration	Cost control systems Office automation for staff reduction	Cost control systems Office automation for staff reduction	8 4

6.8.2 Value chain assessment (organization and industry)

This is another scoring or ranking system. In this case the Michael Porter value added chain is used as the basic checklist to which the organization's application systems are compared. This process may be conducted in terms of the organization's internal value activities as well as the industry value activities. For a thorough analysis, both approaches should be used. In a similar way to the strategic match analysis, evaluation weights may be associated with the more important systems and scores may be given based on the degree to which these systems have been implemented and are achieving their objectives.

6.8.3 Relative competitive performance

Some organizations assess their performance by comparing themselves to their competitors. This requires monitoring their competitors' acquisition of IT, the way they use it to achieve their corporate strategy as well as being able to estimate their costs. These are quite difficult processes and frequently rely on subjective evaluations involving ranking and scoring. Some industries pool such information through a trusted agency which then provides industry average information against which individual firms can compare their performance.

6.8.4 Proportion of management vision achieved

This is another ranking and scoring technique that has a high degree of subjectivity. Managers are asked to assess the current systems in terms of what their original plans were. When a large number of managers are involved a questionnaire or survey approach may be used. Despite being subjective, this approach can be applied in an objective way by conducting regular assessments on, say, a six or 12 monthly basis.

6.8.5 Work study assessment

The work study approach to ICT benefit evaluation requires regular reviews of how the work in the department is being performed. During these reviews the volume of work is carefully recorded as well as the time required to perform all the necessary tasks. Work study assessment can be relatively objective particularly if work study professionals conduct it. The results of a work study appraisal may be used as input to subsequent cost benefit analysis.

6.8.6 Economic assessment

An economic assessment is a theoretical approach to ICT benefit evaluation. It requires the development of a model expressed in mathematical terms in which the relationship of input and outputs is expressed. Although applying rigorous mathematical terms, this method also relies on subjective views of the nature of the relationships between the input and output variables. As in other types of evaluation, the problem in economic modelling is parsing out the effect of different factors. In practice models of this type are of limited practical application in individual organizations.

6.8.7 Financial cost benefit analysis

There are a number of different approaches to financial cost benefit analysis and some are described in Chapter 8.

6.8.8 User attitudes

User attitudes may be used to assess how IT is performing within the organization. Here a survey method is used to extract attitudes towards the importance of ICT to individual users, as well as how the ISD is performing in its delivery. This issue is explored in Chapters 10 and 11.

6.8.9 User utility assessment

It may be argued that systems that are heavily used are more successful than those that are not. By establishing the frequency of use of a system it is believed that it is possible to assess its value to the organization. This technique involves counting the level of activity sustained by the system, measured in terms of its input, processing and output. Excellent systems have been known to fail for trivial reasons, while poor systems have survived for years and therefore this approach leaves many questions unanswered. A further problem with this method is that the high level of usage may be due to factors that are little to do with productivity or effectiveness. A good example of this is access to the Internet which is heavily used in many organizations that allow such access. Whether it is being used to the benefit of the company is a different matter.

6.8.10 Value added analysis

Using this technique the value of the system rather than its cost is first assessed. This involves a careful study of exactly what the proposed system will do and how this new functionality will affect the business. Often a new system will improve a business process and if this is the case it needs to be clearly spelled out together with the value of the benefits that will be derived. Once the value or benefit has been agreed then a cost of commissioning the system is calculated. This costing needs to be modular so that the ensuing work may be undertaken one step at a time. At the end of each step an assessment is made as to what value has been obtained and what that value has cost the organization. Once this has been completed then the organization proceeds to the next stage in the ICT application's development.

As this process continues the system is actually developed on a prototyping basis using relatively low cost increments.

6.8.11 Return on management

Return on management is a concept proposed by Paul Strassmann initially in his book *Information Payoff* (Strassmann 1985) and again in *The Business Value of Computers* (Strassmann 1990). The return on management (ROM) method is a value added approach that isolates the management added value (MVA) and then divides this by the management cost (MC).

When expressed as a formula:

$$\mathrm{ROM} = \frac{\mathrm{MVA}}{\mathrm{MC}}$$

MVA is the residue after every contribution to an organization's inputs is paid. If MVA is greater than management cost then management efforts are productive in the sense that outputs exceed inputs.

This approach attributes surplus value to management rather than capital and, as such, it is a departure from the approaches used in classical economics. It is based on the philosophical notion that in contemporary society, the scarcest resource is not capital, raw materials or technology, but rather management. In Strassmann's view 'good' management makes all the difference between success and failure and ROM recognizes this fact.

The method used for calculating management value added could be demonstrated by considering Figure 6.1.

Revenue is described as being composed of purchases and taxes and business value added. In turn the business value added consists of:

1. Shareholders' value added
2. Operations costs

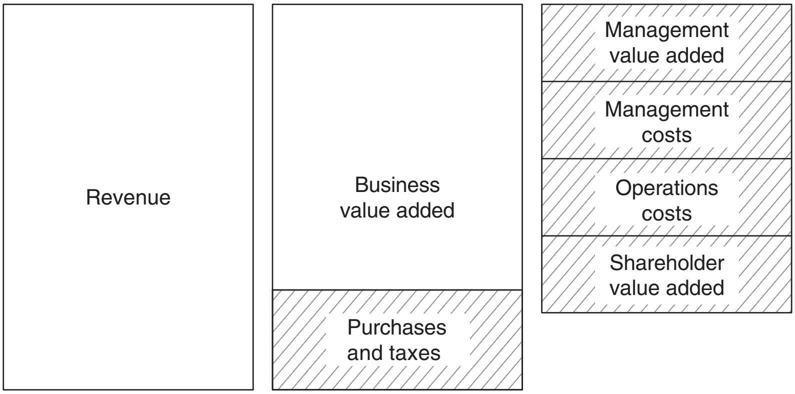

Figure 6.1 Calculating management value added

3. Management costs
4. Management value added

The calculation procedure used is an exhaustive method. First, the purchases and taxes are subtracted from the revenue to derive the business value added. The business value added is then decomposed by first subtracting the shareholders' value added, which is the dividend, then subtracting the operations costs, which are all the direct and overhead costs. At this stage only management costs and management value added remain in the figure. When management costs are subtracted only the management value added remains.

Strassmann claims that the ROM method is a superior measure because it combines both financial statement and balance sheet entries, it is self-indexing, it isolates the productivity of management, and it makes possible diagnostic evaluations.

6.8.12 Multi-objective multi-criteria methods

Multi-objective multi-criteria (MOMC) methods are semi-subjective methods for appraising the value of different outcomes in terms of the decision makers' own preferences. There are a number of ways in which MOMC may be used but they are often seen as a way of understanding management preferences for the more soft criteria involved with investment success. MOMC assumes that the value of a project or IT investment may be determined or measured in terms other than money. The philosophy behind multi-objective multi-criteria methods is that different stakeholders may have different ideas about the value of different aspects of an IT investment and that these may not be strictly comparable in money terms. This technique allows different views and values to be investigated and assists in exposing potential conflicts at the decision-making stage.

MOMC methods are most useful when strategic choices have to be made between quite different alternatives.

6.9 Classification of methodologies

Each of these methodologies leads to the development of a metric that allows the IT to be evaluated. Sometimes this metric is compared to a corporate or industry standard or sometimes relative metrics are compared, for competing systems. In most cases a single measure is not sufficient to make an evaluation. Two or three metrics will usually be required but six or seven measures should be avoided. These methodologies may be categorized as primarily objective or subjective in nature. Even in the more objectively oriented approaches the calculation of the metric will almost invariably be based on subjective criteria and any suggestion that the method is totally objective should be resisted. Table 6.5 categorises these measures in terms of their relative subjectivity/objectivity.

Table 6.5 Classification of evaluation approaches

Classification	Evaluation approach
Partially objective	Cost benefit analysis
	Economic analysis
	System usage
	Quality assurance
	Relative competitive performance
	Work study assessment
Fully subjective	User attitudes
	Management vision
	Value chain assessment
	Strategic match analysis

The key to using these metrics is to attempt to maintain a high level of consistency between the evaluations of different systems.

Before directly addressing any of these techniques themselves there are several philosophical questions that need to be addressed including asking to what extent costs and benefits are a question of definition. Some interesting questions are:

- What assumptions underlie the cost and benefit calculations? What goes into the investment? Most commentators would agree that the hardware cost should be included, but there is considerable disagreement as to the amortization policy for hardware. Some organizations capitalize their software, while others insist that it needs to be treated as an expense. With some systems, training can represent a substantial proportion of the total costs and this is seldom capitalized. Should it perhaps not be treated as an investment cost? Few organizations bother to attempt to account for staff time, especially management time, while frequently this is known to represent a sizeable element in the development cost of many systems.
- What costs should be attributed to a system? Direct costs are relatively easy to identify, although those associated with end-user computing may be difficult to identify. Computing or allocating overheads or corporate burden often represents a major challenge. Should the information systems department carry part of the cost of the international headquarters and the chairman's Rolls Royce? In addition the notion of being able to state the cost of a system implies a final date that can be fixed in time. Systems typically do not behave like this as they evolve and consequently do not lend themselves easily to a cut-off date. The problem of costs in discussed in detail in Chapter 5.
- What benefit streams have been identified and for how long? How far into the future can the continued viability of the system be assumed to last? Does the organization have a rigidly controlled policy on investment horizons?
- How are future benefit (and cost) streams adjusted for inflation? What levels of inflation have been assumed? Are different estimates of inflation being used for different factors of production?
- In the case of international organizations, how are multi-currency situations to be handled and how are future exchange rates accommodated?

Hardly any of these questions can be answered by objective facts. Each one is loaded with opinion, subjectivity and value judgements. The problem of producing sound, objective, unbiased IT evaluations is considerable.

All approaches to IT benefit assessment have significant conceptual or practical flaws. This does not mean that they cannot be or should not be used, but practitioners should be aware of their limitations.

Strategic analysis and evaluation

1. Highly subjective
2. Issues not always well understood
3. All but top management may be unaware of strategy

Value chain assessment

1. Highly subjective
2. Difficult to obtain hard data
3. Not well understood by many managers

Relative competitive performance

1. Information available about historical performance may be sketchy or missing
2. Difficult to compare benefits of different systems
3. Uncertainty about competitors' plans

Proportion of management vision achieved

1. No hard data
2. Virtually no objectivity in this approach to assessment
3. Not always easy to get top management to admit to failure

Work study assessment

1. Objectivity may be relatively superficial
2. Changes in work patterns may drastically alter the assessment
3. Most managers are not familiar with these techniques

Economic assessment – I/O analysis

1. Requires an understanding of economic analysis
2. Relatively abstract
3. Attempts to avoid detailed quantification of monetary terms
4. Isolating the impact of different factors may be difficult
5. Most managers are not familiar with these techniques

Cost benefit analysis based on financial accounting

1. Subject to manipulation
2. Accounting requires a sound infrastructure, which many organizations do not have
3. Financial accounting normally cannot extend beyond the monetary and thus many aspects of value are omitted

4. May have a considerable element of subjectivity
5. Has a long-established acceptance in business

Quality assurance assessment

1. A highly technical approach
2. Not many practitioners available
3. Has only a low relevance to operating managers
4. Users may not tell the truth or may exaggerate
5. Users may have vested interests in presenting a particular viewpoint
6. Corporate culture may colour users' views and the interpretation of the outcome
7. Limited range of applications

Value added analysis

1. A practical approach
2. Keeps costs under control
3. Useful for prototyping
4. Difficult to apply in other circumstances or where prototype is impractical

Return on management

1. A major break with classical economics
2. Not widely understood by most managers
3. Not easy to operationalize
4. Useful to stimulate rethinking

Multi-objective multi-criteria methods

1. An unquantifiable method
2. Not useful as a post-implementation tool
3. Useful to stimulate debate

6.10 Choice of evaluation methodology

There is in fact a bewildering choice of evaluation methodologies available to management. Each methodology is designed to assess the organization's ICT effectiveness in a different way. A key skill is to be able to select the methodologies most appropriate for the organization's particular circumstances.

It is important to note that in many cases an organization's understanding of its ICT performance may be improved by choosing more than one of the methods described in this chapter. Thus an organization might like to explore its performance in terms of its strategic match as well as I/O analysis and also cost-benefit analysis. Undertaking a range of different ICT performance analysis is sometimes referred to as multi-dimensional performance appraisal and may involve anything from two to say, four or even five, different approaches. Each approach may be considered as an individual lens through which the ICT performance is viewed. Multiple lenses or multiple dimensions (MD) afford a richer picture of what is actually happening to the ICT within the organization.

The Balanced Score Card developed by Kaplan and Norton (1992) is a tool for the multi-dimension analysis of an organization's overall performance. The Balanced Score Card employs four dimensions which may be described as Financial Performance, Customer Satisfaction Performance, Knowledge and Creativity Performance and Process Performance. These four sets of issues are said to give a balanced view of the performance of the organization. It is beyond the scope of this book to provide a critique of this Balanced Score Card method. Suffice to say that it may be tailored to be used in the ICT arena and may be seen as a multi-dimension performance approach as described above. However, this book's multi-dimensional approach does not prescribe four sets of metrics. Some ICT investment situations may require only two metrics where others may require five or more. The MD approach described here does not suggest that the metrics need to be balanced. What these approaches have in common is the notion of multiple lenses which deliver a richer picture than any single lens approach.

6.11 Summary and conclusions

There is a wide range of ICT evaluation or assessment techniques available to the aspiring evaluator. Each approach has some strengths and weaknesses. In order to choose one that is appropriate, it is necessary to focus on the objective of the assessment and what decisions the evaluator intends to make with the results of the assessment. It is essential to bear in mind that all measurement techniques, by their very nature, have some element of subjectivity built in, and allowances should always be made for this.

7

ICT cost control

Building an information system, ... an online, distributed, integrated customer service system ... is generally not an exercise in 'rationality'. It is a statement of war or at the very least a threat to all interests that are in any way involved with customer service.

K. Laudon, *A General Model for Understanding the Relationship between Information Technology and Organisation* (1989)

Expenditures on IT capital were less effective than any other type of expenditure considered. The reason is that firms focus too much on how technology is used instead of what it is used for.

D. Schnitt, *Re-engineering the Organisation using Information Technology* (1993)

7.1 Introduction

The effective control of information technology costs is difficult. As mentioned in Chapter 5, vast amounts of funds are spent on IT by both private and public organizations and it is, in many cases, not entirely clear whether these sums are well invested.

According to research conducted in various parts of the world, one of the most frequently cited challenges facing IT managers today is cost containment. Despite the difficulties it presents, cost containment is drawing an increasing amount of interest from senior management who are insisting that IT costs be managed in a more effective way. This had led to researchers and consultants becoming increasingly interested in how IT costs are incurred, how they are planned, monitored, managed and controlled. There is still a degree of controversy as to the appropriate management policies to implement in order to ensure that IT costs are kept at a reasonable level, but this research has uncovered a number of useful findings.

7.2 An IT or IS department budget

It is useful to look at some typical budgets or cost profiles of IT departments to understand the nature of IT cost behaviour.

Figures 7.1 to 7.5 show cost outlines for IT departments under a variety of circumstances relating to growth, inflation, etc. In each case the total cost of running the department escalates consistently and in the last case the rise in cost over the ten year period is substantial indeed, amounting to a seven-fold increase. These increases in IT costs are regarded by many practitioners as being inevitable due to the very nature of the IT activity within the organization. There is certainly plenty of evidence that cost increases such as those described here are common.

The main assumptions underpinning the numbers in these IT budgets are that production/operations costs are a base amount of 100 units of currency. A unit of currency could be £1000 for a small organization or £100 000 for a medium organization or £1 million for a big organization. The total cost of maintenance of hardware, software and telecommunications is 38%. On new applications the organization will spend a constant amount of 25 units of currency per annum throughout the ten year period.

There are a number of important points that arise out of the projections shown in these figures. Figure 7.1 shows that even without any business growth the organization's IT expenditure doubles in ten years. With only a modest business growth of 5% the IT bill triples, whereas with some growth in business and application requirements and a small rate of inflation the IT expenditure increases seven-fold.[1]

Scenario one – no business growth										
	1	2	3	4	5	6	7	8	9	10
New applications	25	25	25	25	25	25	25	25	25	25
Maintenance	38	42	47	52	56	61	66	70	75	80
Production/operations	100	113	125	138	150	163	175	188	200	213
Total IS expenditure	**163**	**180**	**197**	**214**	**231**	**248**	**266**	**283**	**300**	**317**
Additional cash each year		17	17	17	17	17	17	17	17	17
Assumptions										
New systems completed PA		50%								

Figure 7.1 ISD cost scenario over a ten year period – no business growth

Scenario two – 5% business growth										
	1	2	3	4	5	6	7	8	9	10
New applications	25	25	25	25	25	25	25	25	25	25
Maintenance	38	44	51	58	66	74	82	91	100	110
Production/operations	100	118	136	155	175	197	219	242	267	293
Total IS expenditure	**163**	**187**	**212**	**238**	**266**	**295**	**326**	**358**	**392**	**428**
Additional cash each year		24	25	27	28	29	31	32	34	36
Assumptions										
Business growth		5%								
New systems completed PA		50%								

Figure 7.2 ISD cost scenario over a ten year period – 5% business growth

[1] Totals may sometimes appear not to be accurate due to spreadsheet rounding.

Scenario three – 10% business growth										
	1	2	3	4	5	6	7	8	9	10
New applications	25	25	25	25	25	25	25	25	25	25
Maintenance	38	46	55	65	77	89	103	118	134	152
Production/operations	100	123	147	174	204	237	274	313	357	406
Total IS expenditure	**163**	**193**	**227**	**265**	**306**	**351**	**401**	**456**	**516**	**583**
Additional cash each year		31	34	37	41	45	50	55	60	66
Assumptions										
Business growth		10%								
New systems completed PA		50%								

Figure 7.3 ISD cost scenario over a ten year period – 10% business growth

Scenario four – 10% business growth and 5% inflation										
	1	2	3	4	5	6	7	8	9	10
New applications	25	25	25	25	25	25	25	25	25	25
Maintenance	38	48	61	75	91	111	133	158	188	222
Production/operations	100	129	162	200	244	295	354	422	500	591
Total IS expenditure	**163**	**202**	**247**	**300**	**360**	**431**	**511**	**605**	**713**	**837**
Additional cash each year		39	45	53	61	70	81	93	108	125
Assumptions										
Business growth		10%								
New systems completed PA		50%								
Inflation		5%								

Figure 7.4 ISD cost scenario over a ten year period – 10% business growth and 5% inflation

Scenario five – 10% business growth, 5% inflation and 10% new application growth										
	1	2	3	4	5	6	7	8	9	10
New applications	25	28	30	33	37	40	44	49	54	59
Maintenance	38	48	61	77	95	117	143	174	210	254
Production/operations	100	129	163	204	253	312	381	464	561	676
Total IS expenditure	**163**	**204**	**254**	**314**	**385**	**469**	**568**	**686**	**825**	**988**
Additional cash each year		42	50	60	71	84	100	118	139	164
Assumptions										
Business growth		10%								
New systems completed PA		50%								
Inflation		5%								
Growth in new applications		10%								

Figure 7.5 ISD cost scenario over a ten year period – 10% business growth, 5% inflation and 10% application growth

A significant implication of the cash hunger of IT is the fact that the discretionary portion of the IT budget dramatically reduces over time. This financial pressure invariably results in shrinking of development expenditure. Figure 7.6 directly addresses the phenomenon of the shrinking development expenditure by showing

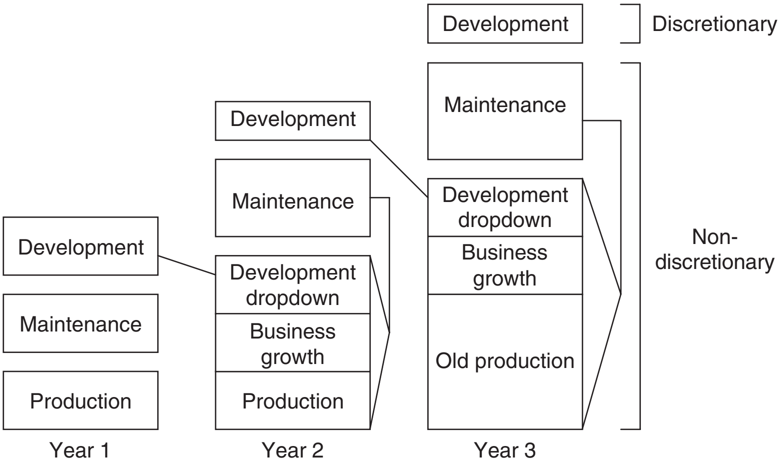

Figure 7.6 The phenomenon of increasing maintenance and shrinking development expenditure

how IT budget is often reallocated to accommodate growing production/operation and maintenance costs.

The situations illustrated in the above figures, which may be described as the traditional approach to information systems planning and management, need a radical review if information technology is to be used cost effectively in organizations.

7.3 Assumptions underpinning IS management

There are several fundamental assumptions underlying modern information management, which directly stem from the conditions prevalent in the early years of the computer age. These include the fact that information systems are thought to be difficult, expensive and unreliable. These perceptions can be seen as a major contributor to IBM's early success, when many organizations bought from 'Big Blue' because of the fear of purchasing a system from the seven dwarves (the smaller computer manufacturers of the time), who it was suggested could not be relied upon to deliver effective working systems. Thus the maxim *no one ever got fired for buying from IBM* came to be extensively believed. A corollary of this line is *inexpensive systems don't work*. Of course IBM has changed since those days and is now (of necessity) largely cost competitive, but the old belief in the necessity of having to have expensive IT solutions still lingers in some quarters.

Another assumption underpinning the use of IT was that big or large scale is beautiful. For this reason, many organizations wanted to build up their information systems departments. Bigger machines, more staff, etc. meant *economies of scale*. As a result, vendors were able, year after year, to sell more equipment on the basis of better price performance, as there was an underlying assumption of an insatiable corporate appetite for IT and especially for raw computing power. This resulted in overselling in many cases and consequently in IT budgets being bigger than necessary. As IT professionals have become more knowledgeable and the market more competitive, the incidence of such overselling has declined. Nonetheless, there are still enough cases of organizations spending far more than they need or than is wise. This was a common phenomenon during the dot.com boom.

Another critical assumption was that every organization large enough and capable enough should *have its own information technology establishment*. Bureaux (an early form of outsourcing) were generally believed, with few exceptions such as payrolls and share registers, to be only suitable for the smaller organization. To do it yourself was firmly believed to be the best approach and the concept of NIH (not invented here) became embedded in management thinking.

Today these assumptions are no longer tenable and IT cost management requires that such ideas be reassessed from first principles.

7.4 Situational audit

The first step in IT cost management is to perform an IT utilization audit. To do this, three basic questions should be asked (and answered!):

1. What is the organization actually using its IT for?
2. Why is the organization doing these things?
3. How effectively is the organization utilizing the components of its IT resources?

The first question will have an answer made up of many activities such as sales order processing, financial budgeting and reporting, materials requirements planning, etc. The work required here is a relatively simple matter of an information systems inventory. Notwithstanding this, the full scale of this can come as a surprise to senior managers. In some cases, hidden uses of IT are unearthed, often developed by users on PCs with desktop tools such as Access or Excel.

The second question will typically have an answer such as to support the sales fulfilment process, to ensure financial order, to provide periodic assessment of the performance of the organization and to improve the organization's ability to deliver the appropriate type, quality and quantity of goods. Answering this question is not a matter of a simple inventory, as each information system needs to be related back to the organization's objectives, strategy and critical success factors and then to business processes. This question in fact should trigger a process evaluation or information systems alignment study, which requires a considerable amount of discussion and debate involving top management. Information systems that do not have a direct link to the organization's objectives, strategy and critical success factors are by definition suspect and should be strongly considered for scrapping. This could be the trigger for a cost reduction exercise.

The third question will be answered by a description of the hardware and software platforms in use. The work in answering this question is similar to that described in Chapter 11 on value for money (VFM) studies.

It is worth noting that, in answering question two, processes may well be found to be inefficient and/or not to be making the most effective use of IT. Typical IT related problems include production of unnecessary paper, rekeying of data, multiple copies of data, etc. Typical process related problems include unnecessary steps in procedures, unnecessary procedures, reports nobody reads, etc. Fixing the latter is part of what is generally called business process re-engineering (BPR) which is a separate, and much larger, task than an IT audit. BPR is beyond the scope of this book.

7.5 Future requirements – a strategic information systems plan

Knowing the present situation in terms of the organization's IT is helpful, but is only the first step. The next step is to establish what the future needs of the organization are likely to be.

This is established by asking the following three questions:

1. What does the organization want to do with its IT in the future?
2. Why does it want to do this?
3. How does the organization want to implement these plans?

This is answered by a strategic information systems plan which is a lengthy and complex process, but which will result in a clear understanding of what is required, what is currently in place and the gap between the two. A strategic information systems plan will also spell out what must be done to ensure that the organization's

IT systems are able to support its business objectives. The question is now how to implement such a plan in the most cost-effective way.

7.6 Methods for cost improvement

There are three macro-strategies available for information systems cost reduction. These are:

1. Systems may be wholly or in part outsourced
2. Systems may be wholly or in part downsized or rightsized
3. IT may be harvested

Outsourcing is a strategy that may or may not be easy to implement, but it is almost always often difficult to manage. When projects that have been outsourced are going well then outsourcing is a most beneficial arrangement, but when they run into difficulty outsourcing may have horrendous implications for the organization. Outsourcing can reduce costs by having an organization, whose core competence is IT, manage all or part of the organization's information systems requirements. The outsourcer may be able to deliver the systems cheaper because of greater expertise and because it can achieve economies of scale. It is important to control an organization's outsourcing activities by means of formal contracts and it is not a trivial matter to ensure that such contracts are well drawn up. Outsourcing involves risks, both business and financial, and the advisability of outsourcing strategic information systems is a hotly debated topic. As some organizations regard much of their IT to be strategic it may be difficult for them to take advantage of this approach to cost curtailment.

It should also be noted that outsourcing may not lead to cost reductions. Outsourcing can reduce costs where the outsource supplier can take advantage of economies of scale or where an internal IT organization is inefficient. Where these conditions do not hold, outsourcing may increase costs. Furthermore, outsourcing can lead to short-term savings at the expense of long-term higher costs. Outsource companies often bid low to get business on the grounds that customers often underestimate the additional (and expensive) services that will be needed. There are many examples of outsource contracts costing a large multiple of initial estimates – one of the most famous of which is the UK Inland Revenue contract with EDS. Even when outsourcing is known to be more expensive, an organization may be willing to bear this additional cost for other reasons (such as allowing management to focus on core competencies). To establish that outsourcing will reduce IT costs and requires careful research and costing.

Downsizing or rightsizing, which usually involves replacing mainframes with mid-range machines or even networks of personal computers, is not as easy as has been claimed. The industry has hyped this issue far beyond its current capability and therefore there are many perils associated with this activity. In addition, although there have been some remarkable successes, many organizations who have downsized claim that they have not actually reduced their costs. There is some interesting research that shows that mainframe computers are often significantly less expensive for certain types of activity such as large-scale transaction processing. Another hidden factor is that the colour, icons and elaborate features of PCs often lead to less efficient work practices than the basic monochrome screens of older systems. There are many reasons why an organization might wish to move from a centralized system to a distributed one, but cost saving is rarely one of them. Again, good research and careful costing in advance are recommended.

IT harvesting, sometimes referred to as squeezing the lemon, refers to cutting back on development, postponing upgrades, reducing service and keeping old equipment beyond the usual period in order to reduce the organization's costs. Harvesting may be seen in terms of the strategic matrix, shown in Figure 7.7.

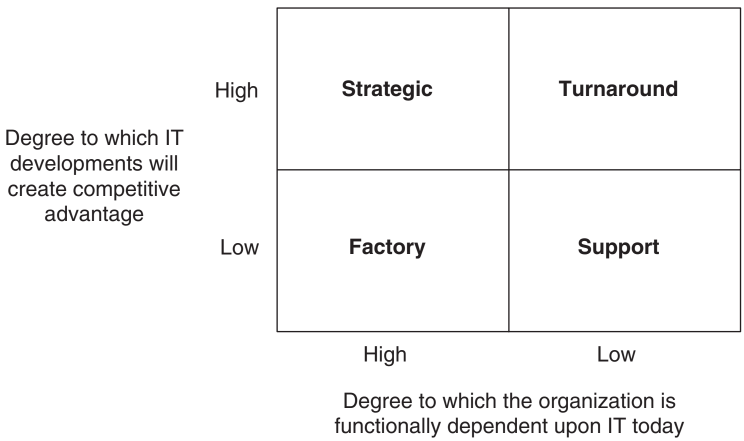

Figure 7.7 The strategic grid or matrix

Harvesting represents the discontinuance of activities in the turnaround quadrant and movement of systems away from the strategic and turnaround quadrants towards the factory and support quadrants. In fact in several cases of harvesting, even the factory quadrant has pressure on it as systems are pushed back to the support position.

As a short-term strategy harvesting can be effective in making the organization show better financial results. Its long-term effect may be problematic if not downright disastrous because at some point in the future all the cost cutting will have to be reversed and a more balanced regime of expenditure and investment reintroduced. Harvesting can sometimes pay off if an organization can skip a generation of technology when it finally has to upgrade. On the other hand, sweating IT assets, like sweating other assets, carries risk. In particular it carries risks of decreasing efficiencies and competitiveness. Furthermore, in the IT world, it runs the specific risk of legacy skill shortages which can be expensive to overcome.

7.7 The commercialization of the IT department

A more effective strategy, which transcends cost control but which ensures sensible IT expenditure, is the commercialization of the IS department. Rather than looking for the low cost solution, this involves making sure that costs and benefits are matched. What is being referred to here is not a simple matter of cost benefit analysis, but rather a new approach to IT investment. Commercialization means underpinning IT investment with business considerations that directly relate to material benefits and which directly or indirectly improve the organization's profits. There are two approaches to commercialization. The simpler one is to prepare a full business case for each IT investment and monitor performance against the projections in that business case. IT departments can be uncomfortable with this idea. IT managers are often not well versed in the language of investment and return. The second is to turn the IT function into a profit centre. The marching orders for such a centre may be to break even or to make money. In the latter case, a further refinement is to put the internal IT department in competition with external providers. Users can choose whether to go outside or to use the internal service. An internal service has several competitive advantages in this battle, but if it is highly inefficient, an external supplier may be able to undercut its price sufficiently to overcome these advantages. In other cases where a commercialization approach has been followed, organizations have attempted to sell the time of their IT staff and processing power at a price that will make a contribution to some part of their overall costs. This has meant that the IS department has become a sort of profit or investment centre and has been given the authorization to insource work from other organizations wishing to outsource. Although this approach may be effective in reducing the overall IT cost profile, it needs to be managed quite carefully. There is a danger that the IS department's priorities may become confused and it may lose its sense of direction and purpose, or simply acquire another, less appropriate sense of direction and purpose.

Other questions to be considered are micro-cost reducing strategies, which include using off-the-shelf packages rather than custom building, negotiating site licence discounts with suppliers and matching services to what users are prepared to spend. These are actually a subset of the greater picture described above.

7.8 Summary

There is no easy answer to IT cost control. Outsourcing, downsizing and harvesting can, in the right circumstances, provide quick solutions, which may or may not produce the desired results. The longer-term approach of commercialization requires much more care and attention to management of the organization as well as of the technology.

8

ICT business case accounting

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We are merely reminding ourselves that human decision affecting the future, whether personal or political or economic, cannot depend on strict mathematical expectations, since the basis for making such calculations does not exist; and that it is our innate urge to activity which makes the wheels go round, our rational selves choosing between the alternatives as best we are able, calculating where we can, but often falling back for our motive or whim or sentiment or chance.

John Maynard Keynes, *The General Theory of Employment, Interest and Money* (1936)

There are three kinds of lies: lies, damned lies and statistics.

Benjamin Disraeli, cited in: *Mark Twain, Autobiography* (1959)

8.1 Introduction

Having decided the direction of the organization's IT investment at a business level it is then necessary to perform some detailed analysis of the financial impact that the proposed investment is likely to have on the organization. This involves either business case accounting or cost benefit analysis.

The techniques used for this type of analysis include capital investment appraisal, which involves the calculation of financial ratios such as the payback, the return on investment (ROI), the net present value (NPV) and the internal rate of return (IRR).

8.2 Concepts required for business case accounting

There are many different financial concepts and issues involved in business case accounting. It is essential that all these elements be addressed in the financial analysis. In Chapter 5, the concept of IT costs was discussed and therefore does not require much further definition here. There are a number of different financial concepts that need to be considered when preparing an IT business case. These include:

- Hidden costs
- Opportunity costs
- Marginal costs
- Time value of money
- Discounted cash flow
- Interest rate or hurdle rate or cost of capital
- Horizon or economic life
- Terminal value

8.2.1 Hidden costs

A hidden cost is a cost of IT that is not evident to the user, usually because it is incurred by another department or function or because it will not appear until much later. Disruption of existing operations is a common hidden cost. IT projects can result in redeployment of staff, additional learning curves and sometimes additional operations and maintenance costs. As the impact of IT has become better understood there is much more understanding of IT costs, and thus less scope for costs to be hidden.

8.2.2 Opportunity costs

The opportunity cost of an investment or project is the amount the organization could earn if the sum invested was used in another way. Thus the opportunity cost of a computer system might be the amount that could be earned if the funds were invested in the core business, or if the funds were placed in an appropriate bank account.

8.2.3 Marginal costs

Cost benefit analysis is traditionally performed on a marginal cost and revenue basis. This means that numbers are based on the variable cost associated with the new IT investment and excludes the general overhead. When it comes to benefits evaluation the same rule applies and thus only new or extra benefits are included. The marginal costing approach prevents double counting of either the cost or the improvements.

8.2.4 Time value of money

The concept of the time value of money refers to the fact that money today is worth more to the organization than money tomorrow. It is on the notion of the time value of money that discounted cash flow is based and this is one of the most important methods for the evaluation of any investment proposal.

8.2.5 Discounted cash flow

Discounted cash flow is the way in which the time value of money is operationalized. Cash flow is discounted by calculating its present value, which requires the sum to be reduced by a discount rate equivalent. Determining this discount rate is not simple and the correct rate is the subject of some theoretical debate. A pragmatic, and common, approach is the organization's weighted cost of capital. An even more pragmatic and simpler approach is to use the marginal cost of borrowing or the organization's overdraft rate. This discounting is done for each year that it takes to obtain or to make the payment.

8.2.6 Interest rate or hurdle rate or cost of capital

The interest rate, hurdle rate and cost of capital are three different terms for the discount *rate* that is used in the discounted cash flow calculation. Whatever name is used for this interest rate, the number used needs to represent the rate at which the organization can earn on the funds under its control. Thus this is also sometimes referred to as the required rate of return.

8.2.7 Horizon or economic life

The horizon or economic life of the investment is the period for which it is believed that the investment will be useful and thus for which it will earn an economic return.

8.2.8 Terminal value

The terminal value of an investment is the amount for which the investment could be sold at the end of its economic life. In many IT projects this is zero or close to it.

8.3 Pattern of costs

As mentioned in Chapter 5 it is interesting to note that the distribution of costs when implementing new IT systems has changed dramatically over the past 30 years. Organizational costs have increased from about 20% to 50% of the total cost of implementation. This is clearly shown in Figure 8.1.

Given the continuing fall in hardware prices, the trend shown in Figure 8.1 is likely to continue for quite some time. The change in the proportion of cost is due both to the decline in hardware cost, but also due to the absolute rise in organizational cost. Organizational costs have escalated because of the much more comprehensive and integrated types of system that are now being implemented by organizations. The more comprehensive a system, the more organizational money will be required to design, build, implement and operate it.

The figures included in the cost estimates of a system should be based on the ownership costs over a projected five year system life. Many systems, particularly large enterprise systems, will last longer than this. Some payrolls have been running for well over 15 years. Systems lasting longer than this period will

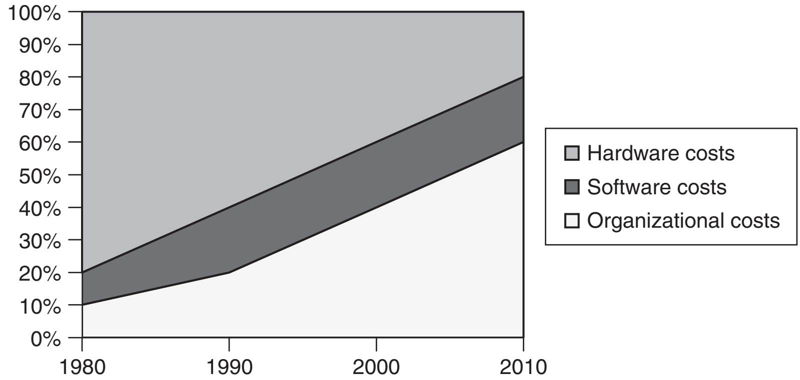

Figure 8.1 Increase in organizational costs incurred during IT implementation

produce a bonus for the organization. Systems that do not remain in place for five years could produce negative returns on investment, although this does not mean that the investment should not be undertaken as ROI and is not the only consideration in many business cases.

8.4 Sources of cost estimates

Obtaining reliable cost estimates has always been difficult and this has contributed to the ongoing problems with IT project budgets.

There are various sources of cost estimates. One of these is obtaining quotations from the different contributors to the project and includes suppliers, contractors, consultants, outsourcers, etc. The cost of these resources can often be negotiated on a fixed fee basis, which may then be used in the business case accounting exercise with some confidence in their accuracy.

Unless a project is fully outsourced, it will be necessary to estimate the cost of the development work to be done by the organization's in-house team. Typical internal tasks for which estimates must be prepared include an analysis of the problem, the creation of a project specification and the amount of time required to develop or write code for the system. There will also be the in-house costs of training the staff. The commissioning cost may also be incurred internally. These cost estimates are notoriously subject to error and some organizations cope with this by comparing the proposed project with previous similar developments. Most commonly, such costs are underestimated either through lack of experience or our desire to impress senior managers. There may also be a political motivation. A good example of this is salami tactics whereby costs are presented a small slice at a time to avoid the potential political risk of presenting the full cost upfront. Comparing projects to previous ones is a form of internal benchmarking and can draw on corporate best practice if this has been recorded and the projects are comparable. In practice, many IT projects are one off or first time, so there is little by way of comparative information available, at least within the organization. Many of the organizational costs shown in Figure 8.1 fall into the administration category and these are not easy to estimate. The idea of benchmarking can then be taken outside the organization where estimates of costs can be gathered by looking at similar projects in comparable organizations.

Whichever approach is taken to cost, estimates have to be produced with considerable care. A provision for contingency for cost escalation should always be included, though where possible, this contingency should be kept confidential from members of the team (who will otherwise be all too willing to spend it). Another approach to the uncertainty of costs is the use of risk or stochastic analysis, which is discussed in Chapter 9.

8.5 Business case accounting in practice

Cost benefit analysis can be defined as the process of comparing the various costs of acquiring and implementing an information system with the benefits the organization derives from the use of the system. In general, cost benefit analysis should be performed on a marginal costing basis. This means that only additional costs incurred by the new system should be included. Likewise only marginal benefits, i.e. new or additional benefits, should be compared to the costs.

It is sometimes suggested that only benefits are difficult to estimate. As many IT projects overrun their cost, this is clearly not the case. Considerable care must be given to cost estimation, especially where software development is concerned. Also ongoing costs should be carefully scrutinized. See Chapter 5 for more on the problem of determining IT costs.

Different approaches to benefit analysis are required for automate, informate and transformate investments. The following are among the most important.

8.6 Cost displacement

Cost displacement considers the cost of the investment and compares this to the other costs the system has saved. This is typically used in the more traditional data processing environments where computers are used to replace clerical workers or sometimes blue-collar workers. Cost displacement is not really appropriate for situations where the IT system is intended to add value rather than reduce costs. A cost displacement justification is a classic automate situation, although it may also have informate implications. Table 8.1 shows an example of cost displacement analysis of an investment for one year.

Table 8.1 The cost displacement approach – 1 year

Using IT to automate jobs **1 year**	**All costs in 000s**	
Cost displacement	**Year 0**	**Year 1**
Set-up costs		
Hardware – PCs, LANs and other peripherals	125	
Software – spreadsheet, word processing, database, etc.	98	
Training	75	
Installation and testing	52	
Total	350	
Monthly ongoing costs		
Staffing, including support		28
Maintenance and upgrades		20
General		8
Total		56
Monthly benefits		
Reduction in clerical salaries		42
Reduction in supervisory salaries		8
Reduction in other staff costs		13
Office space released		5
Other office expenses saved		3
Total		71
Improvement per month		15
Annual net benefit		180
Annual ROI		51%
Simple payback		2 years

It should be noted that the costs and benefits are marginal costs and benefits and therefore will not necessarily display the relationship described in Figure 8.1. The cost displacement approach is an *ex-ante* analysis of what the organization hopes to achieve with the proposed IT investment. It is nothing more than a statement of intent. To ensure that these intentions are carried out, a list of details about the system and the environment in which it will function must also be supplied. It is sometimes preferable to perform this type of analysis over a number of years. Tables 8.2 and 8.3 show the cost displacement approach for three and five years.

Table 8.2 The cost displacement approach – 3 years

Using IT to automate jobs **3 years**	**All costs in 000s**			
Cost displacement	**Year 0**	**Year 1**	**Year 2**	**Year 3**
Set-up costs				
Hardware – PCs, LANs and other peripherals	125			
Software – spreadsheet, word processing, database, etc.	98			
Training	75			
Installation and testing	52			
Total	350			
Monthly ongoing costs				
Staffing, including support		28	29	31
Maintenance and upgrades		20	21	22
General		8	8	9
Total		56	59	62
Monthly benefits				
Reduction in clerical salaries		42	44	46
Reduction in supervisory salaries		8	8	9
Reduction in other staff costs		13	14	14
Office space released		5	5	6
Other office expenses saved		3	3	3
Total		71	75	78
Improvement per month		15	16	17
Annual net benefit	−350	180	189	198
Simple annual ROI		51%	54%	57%
Simple payback		2 years		
Cost of capital	20%			
Discounted annual net benefit	−350	150	131	115
Discounted payback		3 years		
Net present value		46.09		
Internal rate of return		28%		
Profitability Index		1.13		

Table 8.3 The cost displacement over 5 years

Using IT to automate jobs						
5 Years	**All costs in 000s**					
Cost displacement	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Set-up costs						
Hardware – PCs, LANs and other peripherals	125					
Software – spreadsheet, word processing, database, etc.	98					
Training	75					
Installation and testing	52					
Total	350					
Monthly ongoing costs						
Staffing, including support		28	29	31	32	34
Maintenance and upgrades		20	21	22	23	24
General		8	8	9	9	10
Total		56	59	62	65	68
Monthly benefits						
Reduction in clerical salaries		42	44	46	49	51
Reduction in supervisory salaries		8	8	9	9	10
Reduction in other staff costs		13	14	14	15	16
Office space released		5	5	6	6	6
Other office expenses saved		3	3	3	3	4
Total		71	75	78	82	86
Net improvement per month		15	16	17	17	18
Annual net benefit	−350	180	189	198	208	219
Simple annual ROI		51%	54%	57%	60%	63%
Simple payback		2 years				
Cost of capital	20%					
Discounted annual net benefit	−350	150	131	115	100	88
Discounted payback		3 years				
Net present value		235				
Internal rate of return		47%				
Profitability Index		1.67				

There is considerable debate as to whether IT investments should be planned on a three, five or even seven year horizon. Some organizations use a three year period for personal computers, a five year period for mid-range systems and a six or seven year period for mainframes. A growing number of practitioners believe that three to five years is the maximum period for which IT should be planned. This does produce problems for some large-scale systems that can take three years to develop. Obviously in such cases a longer time horizon needs to be used.

8.7 Cost avoidance

Cost avoidance is another important component of many IT investment business cases. The problem with cost avoidance is that measuring it requires planning in advance, i.e. if the *ex-ante* position is not known before the project starts, it is difficult to compare it to the *ex-post*. Table 8.4 is an example of cost avoidance analysis for five year investment.

Table 8.4 The cost avoidance approach

Using IT to automate jobs						
5 Years	**All costs in 000s**					
Cost avoidance	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Set-up costs						
Hardware	345					
Software	299					
Training	345					
Installation and testing	179					
Total	1168					
Monthly ongoing costs						
Staffing, including support		55	58	61	64	67
Maintenance and upgrades		78	82	86	90	95
General		44	46	49	51	53
Total		177	186	195	205	215
Monthly benefits						
Staff not required		120	126	132	139	146
Other costs avoided		85	89	94	98	103
Total		205	215	226	237	249
Improvement per month		28	29	31	32	34
Annual net benefit		336	353	370	389	408
Annual ROI		29%	30%	32%	33%	35%
Simple payback		3 years				
Cost of capital	20%					

(*Continued*/)

Table 8.4 (Continued/)

Using IT to automate jobs						
5 Years	**All costs in 000s**					
Cost avoidance	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Discounted annual net benefit	−1168	280	245	214	188	164
Net present value		(484.05)				
Internal rate of return		−2%				
Profitability Index		0.59				

A cost avoidance analysis is similar to cost displacement, except that no cost has been removed from the system because the introduction of the IS has prevented cost from being incurred. Cost avoidance, like cost displacement, is typically used in the more traditional data processing environments and is generally less relevant to more modern IT applications. Thus, cost avoidance is most appropriate in automate systems.

8.8 Decision analysis – the value of information

One of the most difficult aspects of cost benefit analysis when applied to information systems is determining the value of information itself. Information can range from the extremely valuable to the more or less worthless. Most corporate information provided by IT lies between these two extremes and putting a value on it is challenging. For example, what value to a bank is there in knowing the distribution of late loan repayments? At one level, this is essential management information. At another, analysis of patterns of behaviour may enable the bank to anticipate potential long-term problems and take pre-emptive action. What is the latter worth? The answer is not obvious, but in cost benefit analysis, it is required to place a monetary value on it.

Decision analysis attempts to evaluate the benefits that can be derived from better information, which is assumed to lead to better decisions. In turn, better decisions are believed to lead to better performance. As it is hard to define good information, let alone good decisions, cost benefit analysis performed using this method is difficult.

The value of information is a topic handled within the field of decision analysis. In some cases, it is relatively easy to measure the effect and value of information, although there will frequently be noise in the environment that can obscure the effects of the system. The key to the decision analysis approach is to perform a rigorous business analysis of the situation before the introduction of the proposed technology. The types of business relationships at work and their effects on each other must be understood, and how the proposed IS will alter these business relationships, hopefully in a positive way, needs to be set out. A model of how information is used in the organization to make decisions and how these decisions impact upon actions, which in turn affect performance, is essential when conducting decision analysis of this type. Such a model is shown in Figure 8.2.

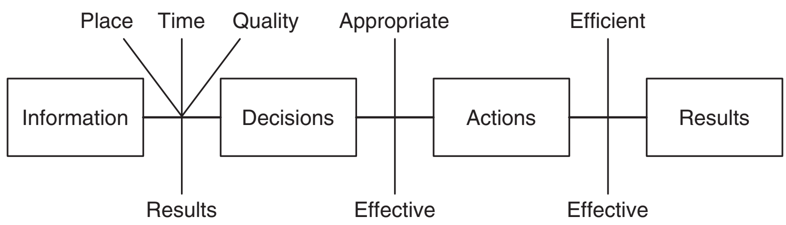

Figure 8.2 Decision analysis model

Sometimes, particularly where it refers to operational matters, this process is straightforward. Table 8.5 shows an example of this type of application of decision analysis. This case relies on understanding how the organization's credit control works, how the cash flow functions, and how investment availability impacts sales. In other cases, particularly where the potential effects are long term and uncertain, it can be difficult to do this type of analysis with any sort of precision.

Table 8.5 An example of decision analysis

Using IT to improve performance through more information
5 years

Decision analysis	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Set-up costs						
Hardware	555					
Software	450					
Initial training	250					
Commissioning	150					
Installation and testing	300					
Total	1705					

(*Continued*/)

Table 8.5 (Continued/)

Using IT to improve performance through more information 5 years						
Decision analysis	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Monthly ongoing costs						
Staffing, including support		292	307	322	338	355
Ongoing training		50	53	55	58	61
Maintenance and upgrades		95	100	105	110	115
General		120	126	132	139	146
Total		557	585	614	645	677
Monthly benefits						
Reduction in bad debts		25	25	25	25	25
Interest earned by faster receipts		50	53	55	58	61
Reduction in obsolete inventories		120	126	132	139	146
Increased sales – better availability		430	452	474	498	523
Total		625	655	687	720	754
Improvement per month		68	70	72	75	77
Annual net benefit	−1705	816	842	869	897	927
Annual ROI		48%	49%	51%	53%	54%
Simple payback		2 years				
Cost of capital	20%					
Discounted annual net benefit		680	585	503	433	373
Net present value		2573				
Internal rate of return		41%				
Profitability Index		2				

8.9 Impact or time release analysis

Impact analysis attempts to quantify the effect IT can have on the physical performance of employees. Impact analysis may have elements of automate, informate and even transformate, depending on the exact circumstances involved. Table 8.6 shows an example of impact analysis.

The primary benefit of time release is that staff can do other work, and when this leads to acquiring extra sales it can contribute to transforming the business. Note that analyses of this type contain a fair amount of subjective judgement and when compiling them, evaluators should engage with those best in a position to make

Table 8.6 An example of impact analysis

Using IT to improve sales force productivity	**All costs in 000s**
Investment costs for 10 systems	
PCs, cellular modems and peripherals	125
Software	23
Training	30
Installation and testing	60
Total initial cost	238
Monthly ongoing costs	
Staffing, including support	10
Communications costs	2
Maintenance	5
General	3
Amortization	6
Total monthly costs	26
Monthly benefit analysis	
Average no. of sales calls per day	6
Average value of sales per call	1.70
Reduction in average sales call time from 35 to 15 minutes	20
Reduction in time for daily form filling from 60 to 10 minutes	50
Total time release in minutes $(50 + (6 \times 20))$	170
Average travel time required between sales calls	25
Average increase in sales calls is therefore	3
Monthly revenue analysis	
Resulting additional revenue (3×1.5)	5.10
Profit margin %	4.00%
Daily profit improvement from 10 systems	0.20
Profit improvement per salesperson (22 days per month)	4.49
Annual profit improvement	539
Annual operating cost of system	312
Annual net benefit	227
ROI	95%
Payback	1 year

those judgements. In estimating the additional sales from the extra time available to sales staff in the example above, it would be wise to consult with the sales staff who will have to deliver this rather than relying on, say, the sales manager's opinion of what they should be able to achieve.

8.10 Putting a financial estimate to intangible benefits

Intangibles are, by definition, hard to value. A typical intangible IT benefit is the ability of management to perform what-if analysis on financial plans and budgets. More information of this type is clearly advantageous and valuable to management, but it is difficult to associate a particular financial value with this type of benefit, not least because the value obtained depends on how effectively managers use these tools.

There are only two ways of evaluating intangible benefits. The first approach is by negotiation and the second is by imputation.

The first approach in evaluating this type of benefit by negotiation is to ask the managers who are using a facility to place a value on it. For example, 'would you pay £10 for this report?' If the answer is yes, then the next question might be 'would you pay £10 000 for this report?' If the answer is no, then a binary search or chop can be conducted to find the value of the facility to the user between these two numbers. A binary chop refers to a computer algorithm, which in this context would involve adding the first suggested amount, i.e. £10, to the second suggested amount, i.e. £10 000, and then dividing the sum by two. The resulting number of £5005 would then be suggested to the manager as the value of the facility. If this number is rejected because it is still considered to be high, the £5005 will be added to the £10 and again divided by two. This would result in an offer of £2507. If the £5005 were considered to be too low then it would be added to the £10 000 and the resulting £15 005 divided by two. In this case the resulting offer would be £7502. The binary reduction process continues until an amount is accepted. The value so derived may be considered as the size of the intangible benefit. Of course, this approach produces a subjective evaluation of the benefit. It does result in an actual value as opposed to a simple comfort statement, and the number can be used in a cost benefit analysis calculation to see if the investment makes sense. This approach might be considered to be semi-hard or semi-soft analysis and is sometimes referred to as benefit negotiation.

The second approach is by imputation. Here the 'purse strings holder' says that 'If you want this system then the cost to the organization is such that you will have to increase your income or reduce your costs by £Xk. If you are prepared to formally agree to this and have it written into your management objectives which will be taken into account at your next performance review you may have the technology.' This is referred to as imputed because the amount of benefit required is not necessarily carefully calculated.

8.11 Transformate analysis

The type of analysis used to assess a transformate opportunity is the same as that analysis employed for any strategic investment. Strategic investments often involve many considerations that are particularly difficult to quantify. Issues such as competitive advantage, market share and new product development are just a few examples. Strategic investments are frequently considered so important that a full *ex-ante* cost justification is never undertaken, or if it is, the results of the analysis are simply ignored. Statements such as 'it's too important to ignore' or 'the cost of not doing it will be crippling' are frequently heard in association with strategic investments. Consequently, strategic investment appraisal studies will often contain more words than numbers. The descriptive part of the proposal will contain words such as those shown here:

1. This investment represents an attractive opportunity for the organization to penetrate a new and profitable market
2. The demand in the new market is likely to increase at a compound rate of 25% p.a. for the rest of the decade
3. The new production facility will substantially reduce our costs so we will be able to undercut our nearest competitors
4. Client service will improve substantially

Good practice requires some hard numbers and good managers/evaluators will insist on quantification of this type of vague statement. In general, 'must do' investments are only exempt from financial or broader business analysis where they are driven by legal or regulatory requirements or, occasionally, by a need to replace a key legacy system. If the tax authorities require companies to produce a report in a given format, companies have no option but to comply. All other types of 'mandatory' investment are suspect! As transformate or strategic investments will have a longer time implication than efficiency or effectiveness investments, the simple ROI and payback methods are not adequate. The time value of money-based techniques such as discounted cash flow need to be used.

8.12 *Ex-post* investment evaluation

This is the most difficult aspect of cost benefit analysis and the choice of evaluation technique depends on the type of *ex-ante* analysis being used. An example of cost displacement *ex-post* evaluation may be seen in Table 8.7.

Table 8.7 A cost benefit analysis for a transformate proposal

Using IT to improve performance through more information	**All costs in 000s**				
Transformation project – 4 years	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Set-up costs					
Hardware	990				
Software	876				
Reorganization costs	700				
Initial training	450				
Commissioning	555				
Total initial costs	3571				
Annual ongoing IT costs of project					
Staff	340				
Maintenance	172				
General	38				
Amortization	900				
Total ongoing costs	1450				
Annual benefits					
Additional sales		2700	3510	4563	5932
Cost of sale		2750	2819	2889	2961
Net profit		−50	691	1674	2970
Tax		0	207	502	891
After tax profit		−50	484	1172	2079
Amortization		900	900	900	900
Net cash flow	−3571	850	1384	2072	2979
Cost of capital	15%				
Tax rate	30%				
Economic life of the project	4				
Net present value	1280				
Internal rate of return	28%				
Profitability Index	1.36				

Cost displacement cases might allow actual data to be captured from the accounting system and these figures can then be used for evaluation. The relevant actual data will be the difference between the old recorded values and the new recorded values. Bear in mind that good *ex-post* analysis is greatly facilitated by good *ex-ante* analysis. If the ground has been well prepared, it is usually possible to compare what actually happened with what was expected or planned. A common phenomenon in IT evaluation is to attempt to justify an investment retrospectively on different grounds than those in the original business case. Such shifting of goalposts should be treated with circumspection. It can happen that there are significant, unexpected benefits of an IT investment. It can also happen that these are claimed as a smoke-screen to cover the failure of the project to achieve its original goals.

8.13 Processes for business case accounting or financial analysis

Traditional cost benefit analysis is undertaken using discounted cash flow techniques involving estimates of the investment amount, the annual benefits and the cost of capital. All these variables are difficult to estimate. The cost of the organization's capital is frequently considered the most difficult variable to determine. The rate of interest the organization pays on its debt, or an arbitrarily chosen hurdle or discount rate, is sometimes used as a surrogate for the cost of capital. When using the marginal cost of borrowing as the discount rate, the implicit assumption is that the funds for the investment will be borrowed. If this is not so, then the validity of the evaluation will depend on how close the actual cost of capital is to the borrowing rate.

IT systems evaluation can be undertaken in several different ways using a variety of measures and at least two different processes. The two processes discussed here are the *deterministic* approach using single point estimates for the input values and generating a single estimate for the result, and the *stochastic* approach which uses ranges as input and generates a range of results. The stochastic method is sometimes referred to as *simulation* or *risk analysis* and is discussed in Chapter 9.

Deterministic analysis assumes a world or situation where the exact value of input variables can be known. Once the values of these inputs are entered, a unique result, determined by the logic of the algorithms and the data, is calculated. Because *ex-ante* investment analysis exclusively uses estimates of future values for the investment amount in the form of the ongoing costs and the benefits, it is frequently said that as soon as the single point values are determined, the input and output will be wrong. However, as Box once said, all models are wrong, but some are useful. Deterministic modelling is generally used to test the sensitivity of outcomes to changes in key input variables via 'what-if?' type analyses.

8.14 Deterministic analysis

Table 8.8 is the input form of a deterministic model for capital investment appraisal in a spreadsheet. All the data are single point estimates.

Table 8.8 Input form for a deterministic model

Capital investment appraisal system						
A deterministic model		**Cash out**	**Cash in**			
IT investment – cash out		350 000				
Net IT benefits:	Year 1		60 000			
	Year 2		95 000			
	Year 3		120 000			
	Year 4		180 000			
	Year 5		200 000			
Fixed cost of capital or interest rate		20.00%				
		Y1	**Y2**	**Y3**	**Y4**	**Y5**
Inflation adjusted interest rates		25%	29%	30%	35%	40%

Discounting is normally applied to cash flows as opposed to 'book' figures such as depreciation, accruals or income. The use of cash flow techniques therefore requires that all figures used actually represent cash dispensed or received by the organization. Figures that include non-cash items are excluded. Table 8.9 is an investment report based on the input in Table 8.8, which shows a number of different investment measures including payback, NPV, PI, IRR, etc.[1]

An important feature of this spreadsheet model is the use of variable costs of capital or discount rates. These discount rates can be used to reflect either anticipated rates of inflation, or more generally, to account for an increasing risk profile. The further into the future the estimated benefit the greater the degree of uncertainty or risk, and therefore the higher the discount or interest rate associated with the investment. The high interest rate has the effect of reducing the future value of the benefit.

The results in Table 8.9 are, of course, highly dependent upon the assumptions made concerning the cost of capital, the investment amount and the cash flows.

[1] These investment ratios are formally defined in Appendix C.

Table 8.9 Results produced by the deterministic model

Investment reports on IT system	
Payback in years and months	3 years 5 months
Rate of return (%)	37.43%
NPV at a fixed discount rate (FDR)	2598
Profitability index (PI) − FDR	1.01
Internal rate of return (IRR)	20.28%
Variable discount rates	
NPV at variable discount rates (VDR)	−71 754
PI − VDR	0.79
Discounted payback FDR in years and months	4 years 11 months

As these future estimates are always uncertain it is important to perform a what-if analysis on these assumptions. Table 8.10 is sometimes referred to as a what-if table and is built into the functionality of most if not all spreadsheets. It indicates the way in which the NPV and the PI vary in relationship to the cost of capital.

Table 8.10 Effect of changing fixed cost of capital on the NPV and PI

FDR	NPV	PI
10%	120 342	1.34
12%	92 597	1.26
14%	67 176	1.19
16%	43 839	1.13
18%	22 375	1.06
20%	2598	1.01
22%	−15 656	0.96
24%	−32 533	0.91
26%	−48 162	0.86
28%	−62 658	0.82
30%	−76 124	0.78

Table 8.11 shows the combined effect of differing investment amounts and different fixed costs of capital on the NPV of the project.

Looking at this table it can be seen, for example, that with an investment of 300 000 and a cost of capital of 22% the resulting NPV will be £34 344.

Table 8.11 Effect of varying the fixed cost of capital and the investment amount on the NPV

FDR	Investment amount				
2 598	200 000	250 000	300 000	350 000	400 000
10%	270 342	220 342	170 342	120 342	70 342
12%	242 597	192 597	142 597	92 597	42 597
14%	217 176	167 176	117 176	67 176	17 176
16%	193 839	143 839	93 839	43 839	−6161
18%	172 375	122 375	72 375	22 375	−27 625
20%	152 598	102 598	52 598	2598	−47 402
22%	134 344	84 344	34 344	−15 656	−65 656
24%	117 467	67 467	17 467	−32 533	−82 533
26%	101 838	51 838	1838	−48 162	−98 162
28%	87 342	37 342	−12 658	−62 658	−112 658
30%	73 876	23 876	−26 124	−76 124	−126 124

The use of the what-if tables can provide considerable insight as to how the project outcome can vary if the input factors change.

8.15 Summary

There are a number of different approaches to business case accounting or cost benefit analysis which range from single point estimate techniques to rather sophisticated risk or stochastic analysis. In developing an IT investment business case it is important to choose the appropriate level of sophistication and not to spend an excessive amount of time on the financial numbers. It is also important not to become bogged down in minor detail. Financial models should focus on the major variables and not chase spurious accuracy.

In some cases, where the amounts are small, it may not be necessary to perform any business case accounting or cost benefit analysis at all.

Business case accounting is only at best a part of the IT investment business case and as such needs to be seen as a supporting tool to the main justification of the IT investment proposal.

9

Risk analysis

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The computer press is littered with examples of information technology fiascos or near disasters. An example is the computer aided dispatch system introduced into the London Ambulance Service in 1992. The £1.5 million system was brought into full use at 07:00 hours on 26 October and almost immediately began to 'lose' ambulances. During that and the next day less than 20% of ambulances reached their destinations within 15 minutes of being summoned, a very poor performance when compared with the 65% arriving within 15 minutes the previous May and the target set by the Government of 95%. The service reverted to semi-computerized methods during the afternoon of 27 October and then right back to manual methods on 4 November when the system locked up altogether and could not be re-booted successfully. (South West Thames Regional Health Authority, 1993)

Joyce Fortune and Geoff Peters,
Learning from Failure: The Systems Approach (1995)

9.1 Introduction

Risk analysis attempts to accommodate the inherent variability in the input estimates and produces a result that more closely reflects the level of uncertainty frequently experienced in the real world.

In situations where uncertainty is small, deterministic models can provide suitable solutions. It is more likely that uncertainty in the input variables, evidenced by their variability, is relatively high and therefore this should to be taken into consideration.

Specifying a probability distribution for each of the input variables – such as investment, cash flows and cost of capital – can capture this uncertainty. There are many candidate probability distributions that can be usefully employed for this purpose. Some of the more useful distributions are likely to be the uniform, the triangular and the beta.

Operation of the above uses the Monte Carlo method. This involves generating a range[1] of outcomes for the input variables, e.g. investment, described by some specified probability distribution, and then evaluating the behaviour of an

[1] Peter Drucker, in describing the use of ranges in accounting, has recalled the following anecdote: 'When I started work in 1927 with a very old and prosperous cotton exporter in Hamburg, most businesses did not have double entry book-keeping. It was introduced at the organisation by the chief book-keeper. The boss never accepted it. He said: "If I want to know where we stand, I stay behind on Saturday and count the petty cash. That's real. The rest is allocations." He had a point. When I went to London to work for a small investment bank, I was taught by my boss, who was a very old shrewd

associated output variable, e.g. internal rate of return. The Monte Carlo method can also be used to establish how robust and sensitive the outcomes are with respect to the assumptions concerning the input variable(s).

For more on the properties of a number of probability distributions, and guidance on how to generate random samples from these distributions, see Johnson and Kotz (1970) and Gonin and Money (1989). Also within all major spreadsheets there is a facility to create these types of distributions.

The risk of an investment is the potential of input/output variables to fluctuate from their original estimates. As in the vast majority of cases, input/output variables do fluctuate, and risk analysis accommodates this by allowing ranges, rather than single point estimates, to be used. It is generally much easier to confidently state that an investment will be between 200 000 and 300 000 than it will be 250 000.

There are a variety of techniques available to assist management and other risk assessors in evaluating the extent and the size of the risk inherent in a particular investment. There are at least three generic approaches to identifying and assessing risk. These are:

- Group brainstorming
- Expert judgement
- Assumption analysis

Group brainstorming uses group interaction to identify the variables that carry the most exposure to variability. Once the variables have been identified, the group then attempts to quantify the limits of the variability as well as the probability associated with the range of possible inputs and outputs. Brainstorming groups may meet several times before the estimates of the variables are finalized.

Expert judgement uses experienced individuals who are aware of the factors causing the investment potential to vary. This is the quickest and easiest way of identifying risk, but considerable care must be given to choosing the expert.

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banker, always to begin with cash flow. He argued it was the only thing that even the smartest accountant couldn't fudge. Proper accounting on these lines only came in after the Second World War, with the flow of funds statement. The next step could be a comparable statement of the investment flow and productivity of knowledge. I've toyed with that, but I didn't work it up. I'm not saying I could. There are problems in putting numerical value on it. I think it would be the first statement to use ranges, not precise figures. I believe that if accounting hadn't been invented 700 years ago – if we had waited until the 18th century – most of our accounts would show ranges. We now know how to handle plus-or-minus probabilities. The accountant's figure for receivables is basically a mid-point between guesses.' (Drucker, *Financial Times*, 10 April 1999).

Assumption analysis requires the detailed questioning of each assumption. This analysis requires each assumption to be modified in such a way that those circumstances that are disadvantageous to the investment will be evaluated. The effects of the changes in assumptions are then used as part of the range of variable specification.

A useful tool in assessing different types of risk is the influence diagram. An influence diagram is a perceptual map showing concepts or issues to illustrate how different aspects of a proposed investment may interact with each other, causing variability in the input/output estimates.

9.1.1 Influence diagrams

An influence diagram allows all the related concepts and issues to be mapped showing the interconnections between them. Such conceptual mapping can be used to quickly identify areas of high variability, which are those with a high number of interconnections. This technique is especially useful for facilitating creative thinking in the search for the identification and quantification of risk. Figure 9.1 shows an influence diagram illustrating nine possible factors that directly or indirectly affect sales volumes.

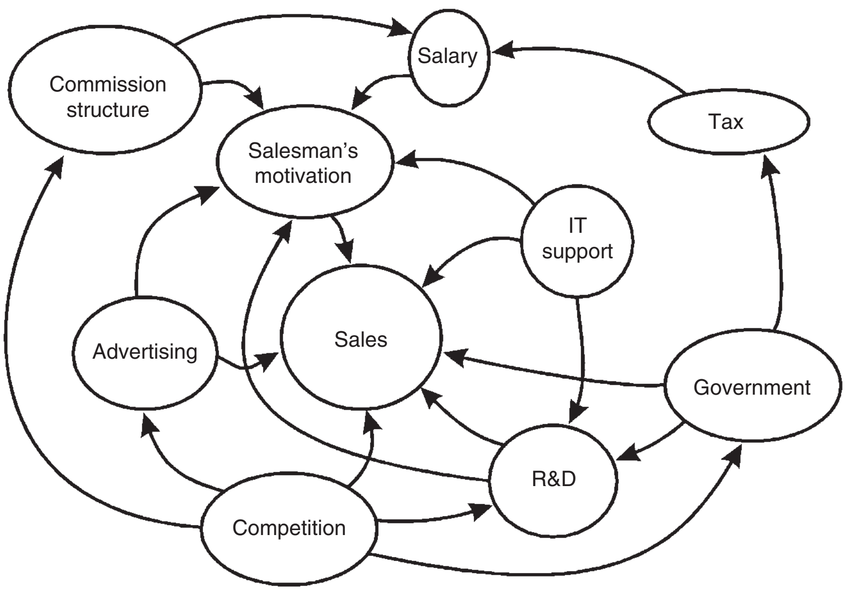

Figure 9.1 An influence diagram

After the conceptual map has been developed it is then necessary to debate the size of the potential fluctuations in the variables. Bringing together a group of experienced managers and discussing the likely value of each factor can achieve this. At the conclusion of such a debate, maximum and minimum values should be established for sales, costs, prices, assets, cash flows, etc.

9.2 Using spreadsheets for risk analysis

The spreadsheet is a useful tool for performing financial risk analysis for IS development projects. Figure 9.2 shows the results of a capital investment appraisal model. This is the same model that was used in Chapter 8 to illustrate deterministic business case accounting.

The model in Figure 9.2 has been developed using deterministic logic. This means that single point estimates have been made for all the input values from which the output is calculated.

	A	B	C	D	E	F	G
1	**Capital Investment Appraisal System**						
2	**A deterministic model**						
3		**Cash-Out**	**Cash-In**	**Net Cash Movement each year**			
4	**IT Investment - Cash Out**	350,000			-350000		
5	**Net IT Benefits** Year 1		66106		66106		
6	Year 2		99902		99902		
7	Year 3		120901		120901		
8	Year 4		194590		194590		
9	Year 5		249671		249671		
10	**Fixed Cost of Capital or Interest Rate**		25%				
11							
12			Y1	Y2	Y3	Y4	Y5
13	**Forecast inflation rates**		22.00%	30.00%	37.00%	40.00%	42.00%
14							
15	**Investment Reports on IT System**						
16	Payback in years & months		3	years	4	months	
17	Rate of return(%)		41.78%				
18	N P V Fixed Discount Rate (FDR)		-9760				
19	Profitability Index FDR (PI)		0.97				
20	Internal Rate of Return (IRR)		23.91%				
21	**Variable Discount Rates**						
22	N P V Variable Discount Rates (VDR)		-55414				
23	Profitability Index VDR (PI)		0.84				
24	Discounted Payback FDR in years and months		5	years	1	months	

Figure 9.2 A capital investment appraisal spreadsheet model

Risk management, by its very nature, suggests that the single point estimate approach that is normally used in evaluating information system investments is not adequate. The single point estimate, or deterministic approach, assumes that all cost and benefit estimates are known with certainty. Clearly this is seldom ever the case in reality. When risk management is being applied this lack of accuracy is admitted and cost estimates and revenue estimates are expressed, not as single points but as ranges of values (Nugus 2006).

Figure 9.3 considers an investment for which the actual amount to be invested, the precise benefits to be derived and the interest rates are not known. It is known (or at least thought) that the investment amount will be between £350 000 and £400 000. Similarly the IT benefits for years 1 to 5 have also been entered into the spreadsheet as ranges, for example in year 1 the minimum benefit is estimated at £65 000 and the maximum value of the benefit is stated at £75 000. Similarly, the exact rate of interest is not known, but it is estimated at between 20% and 30% per annum.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Input form for Risk Analysis**												
2				Minimum	Maximum								
3	**IT Investment - Cash Out**			350000	400000								
4													
5	**Net IT Benefits**	Year 1		65000	75000								
6		Year 2		100000	110000								
7		Year 3		125000	135000								
8		Year 4		185000	205000								
9		Year 5		205000	255000								
10													
11	**Fixed Cost of Capital**			20.00%	30.00%								
12													
13	**Inflation adjusted cost of capital**			Y1 Min	Y1 Max	Y2 Min	Y2 Max	Y3 Min	Y3 Max	Y4 Min	Y4 Max	Y5 Min	Y5 Max
14				20%	25%	30%	35%	35%	40%	40%	45%	45%	50%
15													
16													
17	**Select variable to report**				NPV (FDR)								
18	**with an X in the appropriate box**			X	IRR								
19					NPV (VDR)								
20													
21			N.B. You must mark ONLY ONE box with an upper case X										

Figure 9.3 Risk analysis input form

By recalculating the spreadsheet thousands or even tens of thousands of times using values between the specified maximum and minimum, different outcomes will be obtained. Due to the uncertainty of exactly what the actual costs and benefits will be it is important to recalculate the model a large number of times. By so doing, a large number of different combinations of costs and benefits are selected. It is then by analysing the large number of different outcomes that an understanding of the probable results of the investment can be seen (Nugus 2006).

Table 9.1 is a results scenario for the internal rate of return using the input data in Figure 9.3 and Figure 9.4 shows the results graphically.

Table 9.1 Summary results for risk analysis on IRR

Summary statistics for	IRR
Mean	0.204
Standard deviation	0.016
Range	0.078
Minimum	0.163
Maximum	0.241
No. of recalculations	2000

The data used in Figure 9.3 to produce the results in Table 9.1 and Figure 9.4 would be regarded as being of relatively low risk.[2] The reason for this is that the most likely outcome is a return of 20% with a standard deviation of 1.6%.

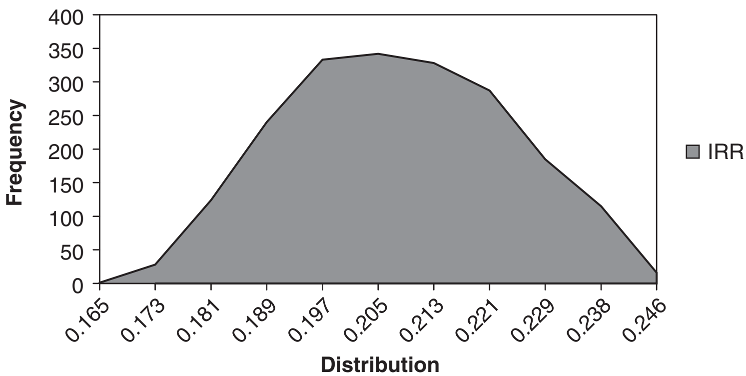

Figure 9.4 Graphical representation of risk analysis results for IRR

This means that even if all the most unfavourable estimates occur, i.e. maximum investment costs, lowest benefits and highest cost of capital, the investment is still expected to produce an IRR of 16%. On the positive side, if the investment is kept low and the highest benefits are achieved, then the investment could produce a return as high as 24%.

[2] This view of risk is of course contingent upon the rate being at least as big as the organization's standard hurdle rate.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Input form for Risk Analysis												
2				Minimum	Maximum								
3	IT Investment - Cash Out			450000	600000								
5	Net IT Benefits	Year 1		60000	80000								
6		Year 2		85000	115000								
7		Year 3		120000	140000								
8		Year 4		170000	210000								
9		Year 5		200000	260000								
11	Fixed Cost of Capital			15.00%	40.00%								
13	Inflation adjusted cost of capital			Y1 Min	Y1 Max	Y2 Min	Y2 Max	Y3 Min	Y3 Max	Y4 Min	Y4 Max	Y5 Min	Y5 Max
14				20%	25%	30%	35%	35%	40%	40%	45%	45%	50%
17	Select variable to report			X	NPV (FDR)								
18	with an X in the appropriate box				IRR								
19					NPV (VDR)								
21			N.B. You must mark ONLY ONE box with an upper case X										

Figure 9.5 Different set of input data

A different set of input data can of course produce quite a different scenario. Figure 9.5 shows a different set of data and Table 9.2 and Figure 9.6 show the result of the risk analysis using the NPV as the outcome variable.

Table 9.2 Summary results of risk analysis on NPV

Summary statistics for	NPV (FDR)
Mean	−197 123
Standard deviation	74 201
Range	364 181
Minimum	−359 200
Maximum	4981
No. of recalculations	2000

The example used to produce the results shown in Table 9.2 and Figure 9.6 would be regarded as a relatively high risk. The most likely outcome of this investment is an NPV of around −197 000, which of course is unsatisfactory and would suggest that it is inappropriate to proceed with the investment under these terms. In fact the worst scenario is an NPV of −359 200. It is possible, with a favourable discount rate and good annual net benefits, for this investment to return a positive NPV of 4981. This potential variability is the risk.

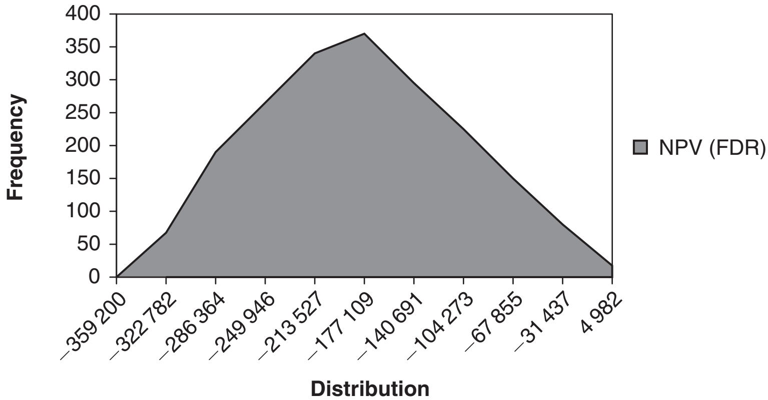

Figure 9.6 Graphical representation of risk analysis results on NPV

9.3 Worked examples

The following is a worked example of financial risk analysis in the IS risk management process. It describes an organization where there is a considerable degree of uncertainty about both the costs and the benefits that will be derived from the IS investment.

Continental Products Limited were considering the acquisition of a new information system. After considerable discussion the IS staff produced the following cost estimates for hardware, software and commissioning:

1. The hardware costs will be between 400K and 900K
2. The software costs are estimated at between 350K and 500K
3. The commissioning costs will be between 200K and 300K

It was thought that there was an equal probability that the actual costs would be anywhere between the highest and the lowest estimates. Thus the probability distribution is said to be uniform or rectangular. A similar set of assumptions was employed to establish the ongoing costs and the benefits to be derived from the information system.

The four columns in Table 9.3 reflect the possible values for the three cost variables. The *Lowest* and the *Highest* columns are self-explanatory. The *Average-ML* (where ML is the *most likely*) column is the mid-point between the lowest and highest values. The *Risk data* column is calculated with the spreadsheet RAND() function and generates a random number between the lowest and highest values.

The operations director at Continental was especially concerned about how long it would take for the benefits to appear. It was at his insistence the stakeholders

Table 9.3 Cost estimates using the deterministic and stochastic measures

Capital investment appraisal for Continental Products Ltd				
	Costs in 000s			
	Lowest	**Highest**	**Average-ML**	**Risk data**
Hardware	400	900	650	706
Software	350	500	425	406
Commissioning	200	300	250	238
Total	950	1700	1325	1350

agreed that there would be no benefits in the first year and that there might not be any benefits even in the second year. The stakeholders debated the benefits issue for several days before finally agreeing to the following estimates of benefits:

1. In the first year after implementation the organization believes that there is little likelihood of the benefit exceeding the ongoing costs. Thus, the net benefit is estimated at zero.
2. For the second year the system is expected to produce up to 100K of benefits, although there are some members of staff who believe that the system will only produce net positive benefits in the third year.
3. In year 3 the benefits will be between 450K and 650K and in year 4 they will be between 850K and 100K.
4. In year 5 the benefits are to be fixed at 1500K.
5. The organization's cost of capital is at present 25% and it is believed that over the next five years it will fluctuate between 20% and 30%.
6. The stakeholders were not able to agree on the economic life of the project. Everyone agreed that the system would still be operational in five years' time, but certain members believed that an IT investment should be fully amortized in no more than three years. Other stakeholders suggested that a seven year approach should be taken, as there was little likelihood of any real benefits in the first or second year.
7. The stakeholders agreed that the NPV should be the primary measure by which the investment will be judged. They all unanimously wanted to know what the IRR and also the discounted payback would be.

Table 9.4 has been created in a similar way to Table 9.3, but reflects the possible values for the benefits over the five years and Table 9.5 shows the estimated cost of capital.

Table 9.4 Five year benefit estimates using deterministic and stochastic measures

	Benefits in 000s			
	Lowest	**Highest**	**Average-ML**	**Risk data**
Year 1	0	0	0	0
Year 2	100	100	100	100
Year 3	450	650	550	467
Year 4	850	1100	975	923
Year 5	1500	1500	1500	1500

Table 9.5 Cost of capital estimates using deterministic and stochastic measures

	Cost of capital			
	Lowest	**Highest**	**Average-ML**	**Risk data**
	20%	30%	25%	27%

The capital investment appraisal analysis in Table 9.6 shows four sets of calculations.

Scenario 1 in Table 9.6 represents the possible outcome if the average or most likely numbers are achieved. In terms of the NPV these calculations show a result that does not earn an adequate return to justify proceeding with the investment. One way of interpreting this is that the cost of capital the organization needs to earn is higher than the IRR that it appears the investment can generate.

Scenario 2 represents the possible outcome if the worst numbers are achieved, i.e. the highest cost and the lowest benefits and the highest cost of capital. In terms of the NPV these calculations show a very poor result, which clearly does not earn an adequate return to justify proceeding with the investment.

Scenario 3 represents the possible outcome if the best numbers are achieved, i.e. the lowest cost and the highest benefits and the lowest cost of capital. In terms of the NPV these calculations show a good result, which does earn an adequate return to justify proceeding with the investment.

Scenario 4 is a risk analysis, showing the possible outcome using randomly generated numbers between the best and worst case scenarios. In terms of the NPV these calculations show a good result, which does earn an adequate return to justify proceeding with the investment. This data can be used to perform a

Table 9.6 Estimates of the performance of the investment using most likely, best and worst projections as well as risk analysis

Capital investment appraisal for Continental Products Ltd						
Scenario 1						
Cash flows	YR0	YR1	YR2	YR3	YR4	YR5
(Most likely)	−1325	0	100	550	975	1500
Cum. cash flow	−1325	−1325	−1225	−675	300	1800
Year number	0	1	2	3	4	5
NPV	−88					
IRR	23%					
Payback in year	4					
Scenario 2	YR0	YR1	YR2	YR3	YR4	YR5
(Worst scenario)	−1700	0	100	450	850	1500
Cum. cash flow	−1700	−1700	−1600	−1150	−300	1200
Year number	0	1	2	3	4	5
NPV	−4259					
IRR	13%					
Payback	>5 years					
Scenario 3	YR0	YR1	YR2	YR3	YR4	YR5
(Best scenario)	−950	0	100	650	1100	1500
Cum. cash flow	−950	−950	−850	−200	900	2400
Year number	0	1	2	3	4	5
NPV	628					
IRR	36%					
Payback in year	4					
Scenario 4	YR0	YR1	YR2	YR3	YR4	YR5
(Risk analysis)	−1350	0	100	467	923	1500
Cum. cash flow	−1350	−1350	−1250	−783	139	1639
Year number	0	1	2	3	4	5
NPV	−31.86					
IRR	21%					
Payback in year	4					

simulation based on 5000 reiterations; the summary statistics for which are shown in Table 9.7.

The result of this analysis is likely to be regarded as unsatisfactory as the most likely outcome is an NPV of −82. This can be clearly seen in the graph in Figure 9.7.

Table 9.7 The statistical results of the risk simulation

Summary statistics for	NPV
Mean	−82
Standard error	3
Median	−86
Standard deviation	199
Sample variance	39 580
Range	1099
Minimum	−620
Maximum	479
Sum	−408 897
Count	5000

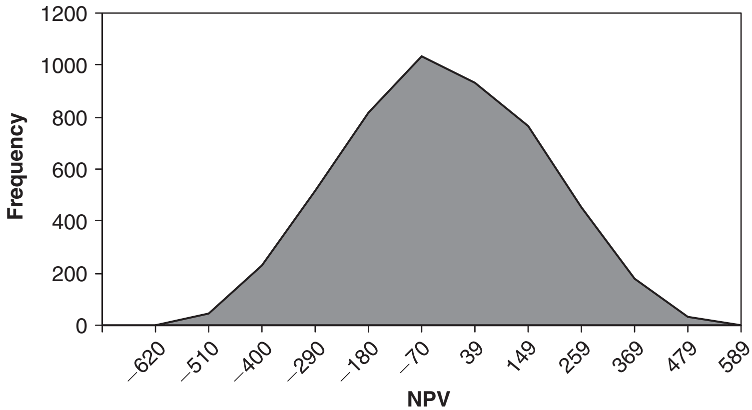

Figure 9.7 The graphical results of the risk simulation

9.3.1 Re-examining the input assumptions

At this stage, from a risk management perspective the task is to return to the original estimates and to attempt to question each of the values. The aim is to see if there is a way of reducing the costs and increasing the benefits in absolute terms, as well as looking for opportunities to reduce the potential variability in the estimates.

After further discussion with the stakeholders, the IS staff produced the following revised cost estimates for hardware, software and commissioning. It is believed that it will be possible to reduce the investment cost without materially affecting the benefit stream that is being left with the original estimated numbers. Thus the following estimates are now relevant for the investment:

1. The hardware cost will now be between 250K and 500K
2. The software costs are now estimated at between 150K and 250K
3. The commissioning costs will be unchanged between 200K and 300K

These revised cost estimates are shown in Table 9.8.

Table 9.8 The revised range of cost estimates

Capital investment appraisal for Continental Products Ltd				
	Costs in 000s			
	Lowest	Highest	Average-ML	Risk data
Hardware	250	500	375	352
Software	150	250	200	152
Commissioning	200	300	250	216
Total	600	1050	825	720

Using these assumptions the capital investment appraisal analysis can be performed again, where the NPV, the IRR and the payback are all recalculated. As can be seen from Table 9.9 the IS investment opportunity now looks more attractive.

It is important to note that the estimates of cost and benefit should not be lightly changed. If the stakeholders cannot find a reasonable cause for expecting to be able to reduce the cost, or increase the benefit, or reduce the variability in these estimates, then they should not be changed. Producing better figures for the sake of the financial analysis is simply a method of self-delusion.

The most likely, the best scenario and the risk analysis scenario all show improvement. Scenario 2, which is the worst-case scenario, still shows a potential loss or negative NPV. Thus the IS project manager needs to pay careful attention to not operating near the parameters described by these circumstances. In general if any of the three positive scenarios can be achieved then the project will have been worthwhile.

Running the simulation again using the revised data produces the summary statistics in Table 9.10, which further illustrates the improved projection for the IS investment, as does the graph displayed in Figure 9.8.

In addition to the estimates of the returns that will be achieved looking better in the second set of calculations, these figures also show a significant reduction in

Table 9.9 The revised range of investment statistics

Capital investment appraisal for Continental Products Ltd						
Scenario 1						
Cash flows	YR0	YR1	YR2	YR3	YR4	YR5
(Most likely)	−825	0	100	550	975	1500
Cum. cash flow	−825	−825	−725	−175	800	2300
Year number	0	1	2	3	4	5
NPV	411					
IRR	38%					
Payback in year	4					
Scenario 2	YR0	YR1	YR2	YR3	YR4	YR5
(Worst scenario)	−1050	0	100	450	850	1500
Cum. cash flow	−1050	−1050	−950	−500	350	1850
Year number	0	1	2	3	4	5
NPV	−2026					
IRR	27%					
Payback	>5 years					
Scenario 3	YR0	YR1	YR2	YR3	YR4	YR5
(Best scenario)	−600	0	100	650	1100	1500
Cum. cash flow	−600	−600	−500	150	1250	2750
Year number	0	1	2	3	4	5
NPV	978					
IRR	53%					
Payback in year	3					
Scenario 4	YR0	YR1	YR2	YR3	YR4	YR5
(Risk analysis)	−729	0	100	506	944	1500
Cum. cash flow	−728	−728	−628	−122	821	2321
Year number	0	1	2	3	4	5
NPV	625					
IRR	41%					
Payback in year	3					

the risk profile faced by the IS development. This reduction in risk can be seen by looking at the relative range of numbers across the X axis of the graphs in Figures 9.7 and 9.8, as well as sometimes by observing the relative shapes of the curves. In this respect the rule is that the narrower the curve the lower the risk. In addition the standard deviation, which is regarded as an important measure of risk, is 199 and 148 in the two cases. Thus the second set of projections shows lower risk.

Table 9.10 The statistical results of the risk simulation using the revised data

Summary statistics for	NPV
Mean	420
Standard error	2
Median	419
Standard deviation	148
Sample variance	22 019
Range	887
Minimum	−12
Maximum	876
Sum	2 101 617
Count	5000

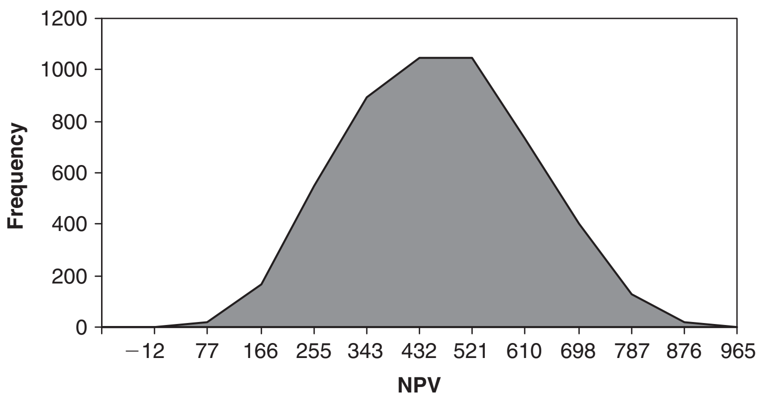

Figure 9.8 Graphical results of the risk simulation using the revised data

9.4 Financial risk review process

The process of stating assumptions and examining their financial implications by using stochastic type analysis as described in this chapter is very important for the better understanding of the costs and the benefits associated with an IS investment. It is important to remember the words of Wittgenstein (1980) who said, 'Nothing is so difficult as not deceiving oneself.'

The numbers are only as good as the intentions and actions they represent, and a project with a great business case can fail just as quickly as one without any cost benefit analysis at all.

9.5 Summary

In the past it was difficult and expensive to perform sophisticated financial risk analysis whereas today it is inexpensive and relatively easy. Furthermore, historically there was very little understanding of how to use the output from financial risk analysis. Today there is a much greater awareness of how to use the result of this type of thinking.

Thus in some respects this question could now be considered to be obsolete or at least on the verge of obsolescence.

On the other hand, there are many who would argue that information technology is so clearly a basic requirement for business that it is unnecessary to perform regular cost benefit analysis at all, never mind sophisticated financial risk analysis. Such an argument implies that IS are as essential to the organization as an adequate telephone system.

Yet again, investment in IS developments still does not represent trivial amounts of money to most organizations and, therefore, should not be compared to telephones. In reality, unless some planning and estimating are done, management will never know how it is performing. And, therefore, even though the estimation and/or prediction of IS performance is imperfect, it is essential to perform these calculations to obtain some sort of indication of what might be expected. Whatever method or metric is chosen it must be realized that it is likely to be no more than a subjective assessment with a low level of objectivity.

As a tool to aid the understanding of the project and its costs and benefits as well as a means of supporting IS project risk management the use of financial risk analysis is certainly a most useful device and it is simple enough that it should be used extensively. There are excellent software products available on the market today that will produce risk analysis. These are easy to use and inexpensive to purchase.

10

Evaluation of the IT function

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Only two of the thirteen companies that participated in the study agree that their IS departments are critical to corporate success. The remaining eleven companies all see their IS department as a necessary, but burdensome, cost pit.

Mary Lacity and Rudy Hirschheim, *Information Systems Outsourcing, Myths, Metaphors and Realities* (1995)

Exploiting the informated environment means opening the information base of the organization to members at every level, assuring that each has the knowledge, skills and authority to engage with the information productively.

Shoshana Zuboff, *The Emperor's New Workplace* (1995)

10.1 A holistic approach to IT function evaluation

The IT function of an organization is involved in the development, implementation and maintenance of numerous systems. These systems aim to meet needs at all levels within the organization. In evaluating the success or effectiveness of the IT department it is normally necessary to evaluate the performance of the individual systems, and then use the aggregate of the performances on the individual systems as an overall measure of the success or effectiveness of the IT department. Especially in organizations where there is a high degree of decentralization of the IT function, the evaluation is not focused so much on the IT department but rather on the users of the information systems.

For the organization's IT function to be managed successfully, management will need to have appropriate instruments whereby it can measure the effectiveness of IT within the organization. In fact, recent surveys reveal that general management consider measurement of IT effectiveness a key issue. Unfortunately, there is little agreement on how to measure effectiveness.

The measurement problem is exacerbated by the many ways in which effectiveness may be viewed. For example, an IT department can be considered effective when it:

- Is meeting its objectives
- Operates within its budgets
- Delivers on time
- Is a major catalyst in directing the firm's use of IT
- Ensures that the firm is using IT competitively
- Has a clearly understood role in the organization
- Is generally perceived to be an ally
- Is at least as internally efficient as the industry average

- Can deliver systems for no greater cost than they can be purchased in the open market
- Is perceived by top management to be value for money and users believe that IT is being deployed in a way which supports their pursuit of excellence

There is one thing on which there is agreement, success is not necessarily reflected in the level of investment in IT.

Despite the obvious difficulty in measuring the effectiveness of the IT function, the fact that it is competing for resources with other functions, such as marketing, finance, production, etc., means it is essential that there are credible ways of identifying not only the benefits of the IT function, both 'hard' and 'soft', but also a means of measuring them.

10.2 Goal-centred vs systems' resources

There are basically two general views with respect to measuring IT effectiveness. These are the goal-centred view and the systems' resource view (Hamilton and Chervany 1981a and b). In the goal-centred view we focus on the outcomes of the IT function. We determine the task objectives of the system and then establish the criteria for measuring whether these objectives have been achieved. In the systems' resource view we focus on the process or functional aspects of the system. In this case effectiveness is measured against such things as user job satisfaction, communication between IT staff and users, and quality of service.

Where the firm's task objectives or system resources are relatively obvious, and where intangible benefits play a relatively small role, direct physical measurements may be used to assess the effectiveness of the system. Where complex situations are involved, simple techniques are no longer appropriate and perceptions become a critical part of the process for measuring the overall effectiveness of an information system.

In this chapter some significant contributions to the problem of measuring the effectiveness of management information systems (MIS) are reviewed. User information satisfaction (UIS) is recognized as an important indicator (surrogate) of MIS effectiveness. It is on this approach to the measurement problem that we now concentrate, and in particular on perceptual measures of UIS. This involves incorporating user feelings, beliefs, opinions and attitudes towards IT into the evaluation procedure.

In the context of IS effectiveness, it is generally believed that if users declare themselves to be satisfied with the system then the system may be said to be effective. Clearly, such satisfaction measurement is at best an indirect and relative measure, which must be used with considerable care. In some organizations users could be happy with inadequate systems. Trends are the most important aspect.

10.3 Tangible vs intangible benefits

Thirty or so years ago the evaluation of the IT function was relatively straightforward. At this time computers were used to automate well-understood, well-structured office systems, thereby increasing efficiency through cost savings. These systems were used to perform time consuming accounting, stock control and wages tasks by operational staff. Traditional cost benefit and work study methods for calculating the effectiveness of the IT function were adequate. The techniques used to perform cost benefit analysis included *cut-off period, pay-back period, discounted cash flow (DCF) and return on investment (ROI).*

Since then, new technology, particularly the advent of the microcomputer, has resulted in information technologies having progressed from the basic cost reduction and control type applications to the provision of decision support at the strategic level (Money *et al.* 1988). The influence of new technologies is, therefore, increasingly being felt at top management level.

This upward penetration of new information technologies raises issues that previously did not exist. In evaluating IS effectiveness we have to consider both the MIS and the environment within which it operates. Thus, broader organization-wide issues have to be considered, and this includes behavioural aspects. A consequence is that there is a certain 'invisibility' associated with the contributions of the information systems to the effectiveness of the organization as a whole. This invisibility is usually expressed by reference to intangible benefits. The traditional cost benefit approaches to evaluating effectiveness are now generally regarded as inadequate, especially when a holistic view of the firm is required.

More recent approaches account for the intangible benefits that tend to be overlooked by traditional cost benefit analysis (see Chapter 7). These approaches incorporate user perceptions on a number of criteria relating to IS, into an overall measure of satisfaction with it. These include perceptions on numerous variables related to such things as input procedures, output procedures, computer processing capabilities, speed of response, quality of service, IS staff quality, availability of training, quality of documentation and organizational factors such as top management involvement and user participation. These issues considered holistically represent a framework that may be used to measure effectiveness.

10.4 User information satisfaction (UIS)

User satisfaction is generally considered to result from a comparison of user expectations (or needs) of the IS with the perceived performance (or capability) of the IS on a number of different facets of the IS. This is considered to be a holistic approach to systems effectiveness as it addresses the whole IS function rather than individual systems.

More specifically, overall attitude to the IS function can be considered to be influenced by the size and direction of the discrepancies (or gaps) between expectations and performance. A positive (negative) gap results when perceived performance exceeds (is below) expectation. A large ‘positive’ gap can be interpreted as indicating that IS resources are being wasted, whereas a large ‘negative’ gap indicates a need for improved performance.

A variant to the above approach is to use the correlation between expectations and performance scores as a measure of ‘fit’. The correlations provide a means for assessing the overall effectiveness of the IS function, where high positive correlations can be taken to imply ‘consensus’ of views.

Of the many published papers on UIS two will be discussed in more detail below, namely, the Miller and Doyle (1987), and the Kim (1990) papers. Both these studies propose conceptual models to explain UIS, thereby adding credence to the instruments developed from them. These models have their roots in the theory of organizational and consumer behaviour. This is easy to comprehend if one accepts that the IS function impacts on the whole organization and is aimed at satisfying the user (i.e. customer) who can be both internal as well as external to the organization.

10.5 A gap approach to measurement

10.5.1 The Kim model

A feature of Kim’s model is that UIS is considered to be influenced not only by post-implementation experience with the IS but also by pre-implementation expectations of the IS. The latter is captured through the user’s initial expectations of the IS.

In this approach, UIS is measured by the discrepancy between the user's perception score of the IS performance and the user's expectation score of the IS. Further, the model describes how UIS is influenced by the discrepancies that arise during the developmental and service delivery processes. The developmental stage comprises two substages, namely, the determination of the IS requirements and the design and installation of the IS. These various stages give rise to three gaps that influence the UIS. These gaps may in turn be influenced by various organizational factors. Examples include: user participation in defining the IS requirements; top management support which may take the form of increased investment in IS, thereby influencing the gap between the design specifications and the quality of the IS installed; and the extent of user training which is likely to impact on the gap between the actual quality of the IS installed and what the user perceives the quality to be through use of the system. There may also be other organizational factors which directly impact on the IS, rather than indirectly through the gaps. The Kim model is represented diagrammatically in Figure 10.1.

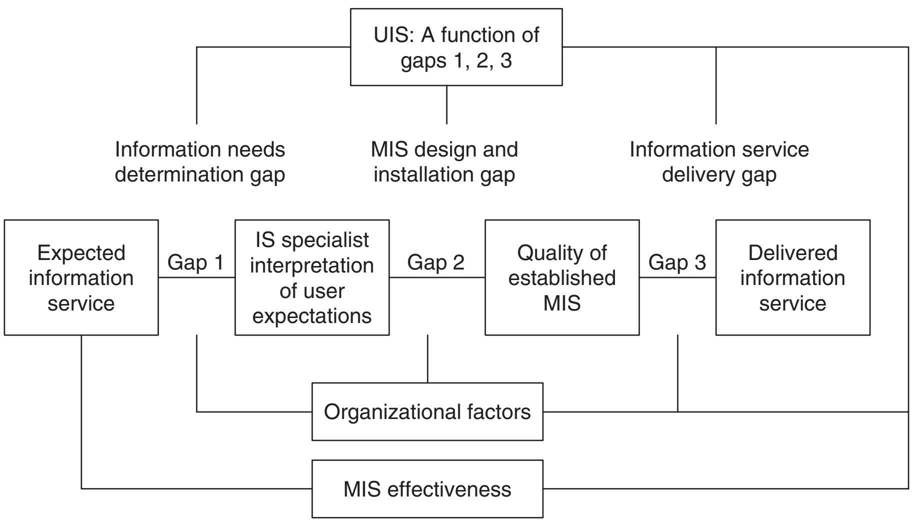

Figure 10.1 A UIS model (after Kim, 1990)

Interpretation of the gaps

Gap 1 This is the discrepancy between the users' expectations of the IS and the systems designers' interpretations of these expectations.

Gap 2 This is the discrepancy between the IS specialist's interpretation of the users' needs and the quality of what is actually installed for the user.

Gap 3 This is the discrepancy between the quality of what is actually installed and what the user experiences when interacting with the MIS.

Incorporation of organization factors

The model postulates that the three gaps can be affected by organizational factors. For example, Gap 1 could be influenced in a positive way by encouraging user participation in the design stage. This involves determining the information requirements desired from the MIS. On the other hand, top management support for MIS, exhibited through, say, the provision of enough resources, should be positively correlated with Gap 2. Finally, the provision of proper training should be positively correlated with Gap 3.

Formulating and fitting the model

UIS is measured as the discrepancy between user expectations and the perceptions of the MIS. Furthermore, the model assumes that overall UIS can be explained by Gaps 1 to 3 and also organizational factors. More formally:

$$\text{UIS} = f(\text{Gap1}, \text{Gap2}, \text{Gap3}, \text{Organizational Factors})$$

To operationalize the model, it will be necessary in the first instance to develop instruments to measure the three gaps. This should be possible by applying the methodologies used by researchers when modelling consumer satisfaction with quality of service, where consumer satisfaction is expressed as a function of a number of gaps (Parasuraman *et al.* 1985, 1988; Brown and Swartz 1989). The approach most used to conceptualize and determine the dimensions for the evaluation of IS effectiveness is the multivariate statistical analysis technique of factor analysis (see section 10.6). Once these instruments are available it should be possible, through the use of correlation and regression analysis, to determine which organizational factors affect these gaps. Also, the extent and nature of the influence of the gaps and the identified organizational factors on overall UIS can be determined through the use of such statistical methods.

10.5.2 The Miller–Doyle approach

Of the many instruments proposed for measuring, through perception, user satisfaction with information systems, the one due to Miller and Doyle is described here (Miller and Doyle 1987). It is, in spirit, similar to the conceptual model described above. The instrument has been extensively used in many different firms, in many different sectors, and the results provide convincing evidence of the instrument's reliability and validity.

Description of the instrument

The instrument is designed to measure the perceived effectiveness of the overall IS function and involves the use of a questionnaire. The questionnaire comprises five parts, A to E.

Part A consists of 34 questions which measure the extent to which certain facets of the IS are perceived to be important in ensuring the organization's IS will be effective and successful. The attitudes are rated on a semantic differential scale of 1 (irrelevant) to 7 (very critical). Part B consists of four questions on the future needs for IS; Part C consists of the same 34 questions as Part A but in this case the respondent is asked to rate the 34 questions with respect to the actual performance achieved within their organization. Again a seven point scale is used but in this case the levels of perceived importance go from 1 (very poor) to 7 (excellent); Part D consists of four questions relating to the organization's performance in developing new systems; Part E consists of four questions which capture certain demographic data. There is also a question which asks for a rating of the organization's overall IS performance on a scale of 1 (complete failure) to 7 (very successful).

The importance ratings in Parts A and B capture perceptions on the business needs, while the performance ratings in Parts C and D capture perceptions of the organization's IS capabilities.

A factor analysis of the 38 performance ratings revealed that there were seven dimensions of user satisfaction underlying the responses to these 38 questions. These are:

- Functioning of existing transaction/reporting systems
- Linkage to strategic processes of the firm
- Amount and quality of user involvement
- Responsiveness to new systems needs
- Ability to respond to end-user computing needs
- IS staff quality
- Reliability of services

See Appendix F for an abridged list of the original 38 questions. The full questionnaire is given in Miller and Doyle (1987). Also see section 10.10 for a description of the factor analysis method.

Interpreting the results

The mean of the performance responses to each of the 38 questions can be taken as a measure of the perceived performance on each of the 38 facets.

Overall user attitude to the IS function is measured by a composite score derived from the user performance mean ratings on the 38 questions, by calculating their mean value. This gives the user an overall assessment of the organization's IS capabilities.

The fit between importance and performance ratings can be measured by the square of the correlations between these scales, and/or by the discrepancies (gaps) between these scales. Miller and Doyle recommend the use of correlation as the preferred measure of success of the MIS.

Importance and performance ratings are obtained from both IS specialists and users. This results in six correlation measures of fit. These are shown in Table 10.1.

Table 10.1 Measures of fit

Measure of fit	IS specialist		User		Significance of R^2 implies:
	Imp.	Perf.	Imp.	Perf.	
1	X	X			IS staff satisfaction
2	X		X		Agreement on what is important for the business
3	X			X	IS provides capabilities that are highly rated by users
4		X	X		IS staff aware of organizational needs and are meeting these
5		X		X	Agreement on how IS is performing
6			X	X	User satisfaction

These correlations between the 38 items mean importance and mean performance scores provide a quick and reliable method for assessing the overall effectiveness of the IS function. High positive correlations imply a consensus of views. Firms in which the IS function is successful tend to demonstrate high squared correlations for, in particular, measures 1, 3 and 6.

Further analysis is possible. The instrument can be used to assess the IS function on each of the seven critical areas for success. Also, an analysis of responses on individual items can provide useful information. For example, a count of item non-responses can identify those items on which respondents can provide an opinion, and those for which they have difficulty in expressing an opinion. The variability in responses, as measured by the standard deviation, can also provide useful information. Should the standard deviation of both the importance and performance ratings be greater for IS specialists than users? This may imply that users are less able to discriminate in their responses to the questionnaire than the specialists. This in turn may suggest a need for education in IS. There are many other possibilities of very basic, but worthwhile, analyses of the responses to this questionnaire.

Use of the approach described does make it possible to quickly obtain a reliable and valid assessment of the IS function and thereby identify those areas where effort is required to improve the chances of success. The questionnaire does appear to offer significant advantages over the traditional approaches of cost benefit and economic analysis.

10.6 A gap model applied to an office automation system

The effectiveness of a computer network system of a business school is investigated. The focus is on users of the system who include academics, secretarial and administration staff, and MBA students.

The study involved the use of a self-completion questionnaire, which is shown in Figure 10.2. The questionnaire comprised four sections. The first section captured background information relating to the individual's position in the Business School, years of work/study experience, years of work experience with a PC, and finally years of work experience with a PC network. This is followed by three parts labelled A, B and C. Parts A and B use the same set of 24 questions, where these questions capture information on various facets of the system.

Part A measures the extent to which the attributes are perceived to be important to the effectiveness of the system. Expectation was measured on a four point scale from 1 – irrelevant to 4 – critical.

Part B uses the same items but now the respondent was asked to rate the performance of the Information Systems Department on a four point scale from 1 – very poor to 4 – excellent.

Part C involves a general question about the individual's overall satisfaction with the computer network system.

There were 86 questionnaires available for analysis. Of these 76 were completed by the MBA students. The analysis that follows was performed on the MBA responses.

Measurement of IS effectiveness in a business school

The following questionnaire has been designed to help assess the effectiveness of the computer network system used by academics, secretarial and administration staff as well as students in your business school.

The questionnaire is divided into three parts. Parts A and B use the same set of 24 questions. Part C is an open-ended question. Your answers to the questions in Part A refer to the system's attributes that you believe are important to the ***effectiveness*** of the system. Your answers to the second set of 24 questions in Part B refer to how the information systems department of the business school actually ***performs*** in terms of these systems attributes. Finally, in Part C we would welcome any comments that you would like to make concerning your own experience with the computer network and/or with the information systems department. The questionnaire uses a four point scale.

First set of 24 questions	Second set of 24 questions
Critical	Excellent
Important	Good
Not important	Poor
Irrelevant	Very poor

For example, you might think that ease of access to computer facilities is critical, and therefore your rating in the first set of questions will be:

Irrelevant	Not important	Important	Critical ✓

If you feel that the performance of the information systems department in providing these facilities is good, this will mean your rating in the second set of questions will be:

Very poor	Poor	Good ✓	Excellent

The questionnaire should not take more than 15–20 minutes to complete. All information supplied by respondents will be treated with the utmost confidence.

Please supply the following information about your position in the business school:
Are you academic, secretarial/administrative or student? ....
How many years have you been working with a PC? ....
How many years experience have you had working with a computer network? ....

Thank you very much for your assistance in this study. Please return your completed questionnaire to the administrator:

IT Effectiveness Assessment Services

Figure 10.2 User satisfaction questionnaire (Continued/)

PART A – Importance

Please respond by ticking the option which corresponds to your opinion of the ***importance*** of the following 24 attributes in ensuring the effectiveness of your system.

1	Ease of access for users to computing facilities. Irrelevant ________ Not important ________ Important ________ Critical ________
2	Up-to-dateness of hardware. Irrelevant ________ Not important ________ Important ________ Critical ________
3	Up-to-dateness of software. Irrelevant ________ Not important ________ Important ________ Critical ________
4	Access to external databases through the system. Irrelevant ________ Not important ________ Important ________ Critical ________
5	A low percentage of hardware and software downtime. Irrelevant ________ Not important ________ Important ________ Critical ________
6	A high degree of technical competence from systems support staff. Irrelevant ________ Not important ________ Important ________ Critical ________
7	User confidence in the systems. Irrelevant ________ Not important ________ Important ________ Critical ________
8	The degree of personal control people have over their systems. Irrelevant ________ Not important ________ Important ________ Critical ________
9	System's responsiveness to changing user needs. Irrelevant ________ Not important ________ Important ________ Critical ________
10	Data security and privacy. Irrelevant ________ Not important ________ Important ________ Critical ________
11	System's response time. Irrelevant ________ Not important ________ Important ________ Critical ________
12	Extent of user training. Irrelevant ________ Not important ________ Important ________ Critical ________
13	Fast response time from support staff to remedy problems. Irrelevant ________ Not important ________ Important ________ Critical ________
14	Participation in the planning of system requirements. Irrelevant ________ Not important ________ Important ________ Critical ________
15	Flexibility of the system to produce professional reports. Irrelevant ________ Not important ________ Important ________ Critical ________

Figure 10.2 (/Continued)

16	Positive attitude from IS staff to users. Irrelevant ________ Not important ________ Important ________ Critical ________
17	User's understanding of the systems. Irrelevant ________ Not important ________ Important ________ Critical ________
18	Overall cost effectiveness of the information systems. Irrelevant ________ Not important ________ Important ________ Critical ________
19	Ability of the systems to improve my personal productivity. Irrelevant ________ Not important ________ Important ________ Critical ________
20	Ability of the systems to enhance the learning experience of students. Irrelevant ________ Not important ________ Important ________ Critical ________
21	Standardization of hardware. Irrelevant ________ Not important ________ Important ________ Critical ________
22	Documentation to support training. Irrelevant ________ Not important ________ Important ________ Critical ________
23	Help with database development. Irrelevant ________ Not important ________ Important ________ Critical ________
24	Ability to conduct computer conferencing with colleagues. Irrelevant ________ Not important ________ Important ________ Critical ________

PART B – Actual performance

Please respond by ticking the option which corresponds to your opinion of the actual ***performance*** of the information systems department in terms of the following 24 attributes.

1	Ease of access for users to computing facilities. Very poor ________ Poor ________ Good ________ Excellent ________
2	Up-to-dateness of hardware. Very poor ________ Poor ________ Good ________ Excellent ________
3	Up-to-dateness of software. Very poor ________ Poor ________ Good ________ Excellent ________
4	Access to external databases through the system. Very poor ________ Poor ________ Good ________ Excellent ________
5	A low percentage of hardware and software downtime. Very poor ________ Poor ________ Good ________ Excellent ________
6	A high degree of technical competence from systems support staff. Very poor ________ Poor ________ Good ________ Excellent ________

Figure 10.2 (/Continued)

7	User confidence in the systems. Very poor ________ Poor ________ Good ________ Excellent ________
8	The degree of personal control people have over their systems. Very poor ________ Poor ________ Good ________ Excellent ________
9	System's responsiveness to changing user needs. Very poor ________ Poor ________ Good ________ Excellent ________
10	Data security and privacy. Very poor ________ Poor ________ Good ________ Excellent ________
11	System's response time. Very poor ________ Poor ________ Good ________ Excellent ________
12	Extent of user training. Very poor ________ Poor ________ Good ________ Excellent ________
13	Fast response time from support staff to remedy problems. Very poor ________ Poor ________ Good ________ Excellent ________
14	Participation in the planning of system requirements. Very poor ________ Poor ________ Good ________ Excellent ________
15	Flexibility of the system to produce professional reports. Very poor ________ Poor ________ Good ________ Excellent ________
16	Positive attitude from IS staff to users. Very poor ________ Poor ________ Good ________ Excellent ________
17	User's understanding of the systems. Very poor ________ Poor ________ Good ________ Excellent ________
18	Overall cost effectiveness of the information systems. Very poor ________ Poor ________ Good ________ Excellent ________
19	Ability of the systems to improve my personal productivity. Very poor ________ Poor ________ Good ________ Excellent ________
20	Ability of the systems to enhance the learning experience of students. Very poor ________ Poor ________ Good ________ Excellent ________
21	Standardization of hardware. Very poor ________ Poor ________ Good ________ Excellent ________
22	Documentation to support training. Very poor ________ Poor ________ Good ________ Excellent ________

Figure 10.2 (/Continued)

23	Help with database development. Very poor ________ Poor ________ Good ________ Excellent ________
24	Ability to conduct computer conferencing with colleagues. Very poor ________ Poor ________ Good ________ Excellent ________

PART C – Overall opinion

Please rate your overall opinion of the computer network system.

Very poor ________ Poor ________ Good ________ Excellent ________

Please supply any further comments you wish concerning the performance of the IT&S Division

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Figure 10.2 (/Continued)

10.7 Basic results

A basic analysis of the expectation and performance perceptions was initially performed. Averages and standard deviations for the expectation and performance scores appear in Table 10.2. Also in Table 10.2, for each of the questions, are the mean perceptual gap scores, as well as their standard deviations, where the gap is determined by subtracting the expectation score from the performance score. In the last column of Table 10.2 are the correlations between the gap scores and the overall satisfaction scores.

10.8 Some implications arising from the analysis

1. System's response time is ranked second in terms of expectation but nineteenth on performance.
2. Ability to conduct computer conferencing with colleagues and help with database or model development was ranked low on both expectation and performance.
3. Overall cost effectiveness of information systems, standardization of hardware, and data security and privacy received relatively low rankings on expectation, but relatively high rankings on performance.

Table 10.2 **Basic analysis of perceptions**

Att. No.	Attributes	Expectation			Performance			Perceptual		Gap correlation with satisfaction
		Rank	Mean	SD	Rank	Mean	SD	Gap	SD	
6	High degree of technical competence from support staff	1	3.45	0.60	2	2.82	0.53	−0.63	0.73	0.0232
11	System's response time	2	3.42	0.50	19	2.20	0.83	−1.22	1.05	0.5738***
5	Low percentage of hardware and software downtime	3	3.39	0.54	10	2.49	0.60	−0.90	0.90	0.4307***
1	Ease of access for users to computing facilities	4	3.37	0.65	5	2.75	0.59	−0.62	0.92	0.2154*
13	Fast response from support staff to remedy problems	5	3.34	0.53	11	2.47	0.62	−0.87	0.85	0.0524
3	Up-to-dateness of software	6	3.33	0.53	1	3.01	0.53	−0.32	0.77	0.3794**
20	Ability of the system to enhance learning experience	7	3.32	0.59	8	2.66	0.64	−0.66	0.81	0.3328**
15	Flexibility of the system to produce professional reports	8	3.22	0.69	17	2.22	0.72	−1.00	1.06	0.2330*
7	User confidence in systems	9	3.20	0.59	11	2.47	0.60	−0.73	0.79	0.3112*
19	Ability of the system to improve personal productivity	10	3.18	0.53	9	2.62	0.59	−0.56	0.81	0.4160***
16	Positive attitude of IS staff to users	11	3.16	0.49	3	2.78	0.62	−0.38	0.77	0.0945
22	Documentation to support training	12	3.11	0.56	22	1.96	0.62	−1.15	0.95	0.3165**
9	Systems responsiveness to changing user's needs	13	3.05	0.49	11	2.47	0.64	−0.58	0.77	0.2947*
12	Extent of user training	14	3.04	0.72	20	2.14	0.69	−0.90	0.95	0.0795

(Continued/)

Table 10.2 (/Continued)

Att. No.	Attributes	Expectation			Performance			Perceptual		Gap correlation with satisfaction
		Rank	Mean	SD	Rank	Mean	SD	Gap	SD	
2	Up-to-dateness of hardware	15	3.01	0.53	14	2.46	0.72	−0.55	0.89	0.3056**
17	User's understanding of the system	16	3.01	0.62	16	2.36	0.56	−0.65	0.84	0.0563
8	Degree of personal control users have over their systems	17	2.95	0.56	15	2.37	0.65	−0.58	0.90	0.2528*
10	Data security and privacy	18	2.80	0.80	3	2.78	0.45	−0.02	0.89	−0.1314
4	Access to external databases through the system	19	2.78	0.62	18	2.21	0.55	−0.57	0.79	−0.0127
23	Help with database development	20	2.72	0.69	21	2.12	0.65	−0.60	0.90	0.2050*
21	Standardization of hardware	21	2.63	0.69	6	2.74	0.50	+0.11	0.81	0.0625
14	Participation in planning of system requirements	22	2.47	0.66	22	1.96	0.64	−0.49	0.81	0.0033
18	Cost effectiveness of IS	23	2.46	0.74	7	2.72	0.51	+0.26	0.96	0.4160***
24	Conduct computer conferencing with colleagues	24	2.11	0.67	24	1.93	0.57	−0.17	0.77	0.3204**

* implies correlation is significant at the 5% level, ** implies correlation is significant at the 1% level, *** implies correlation is significant at the 0.1% level

4. The correlation between the ranked expectation and performance item means is 0.39, which is not significant at the 5% level. This implies a lack of consensus between the perceived needs for the system to be effective and the perceived ability of the IT department to meet these needs.
5. The general evaluation of performance across all attributes was poor. Up-to-dateness of software with a mean score of 3.01, being best on performance.
6. The gaps for 15 of the 24 statements about the system are positively and significantly correlated with the overall satisfaction score, and therefore can be considered to be potentially 'good' indicators of user satisfaction. Since the gap is determined by subtracting the expectation score from the performance score, the positive correlation implies that the greater the gap, in a positive sense, the more the user satisfaction.

To visualize the gaps between the expectation and the performance scores, a *snake diagram* may be drawn. The snake diagram shown in Figure 10.3 highlights the score for both the performance and expectation questions on the same axis.

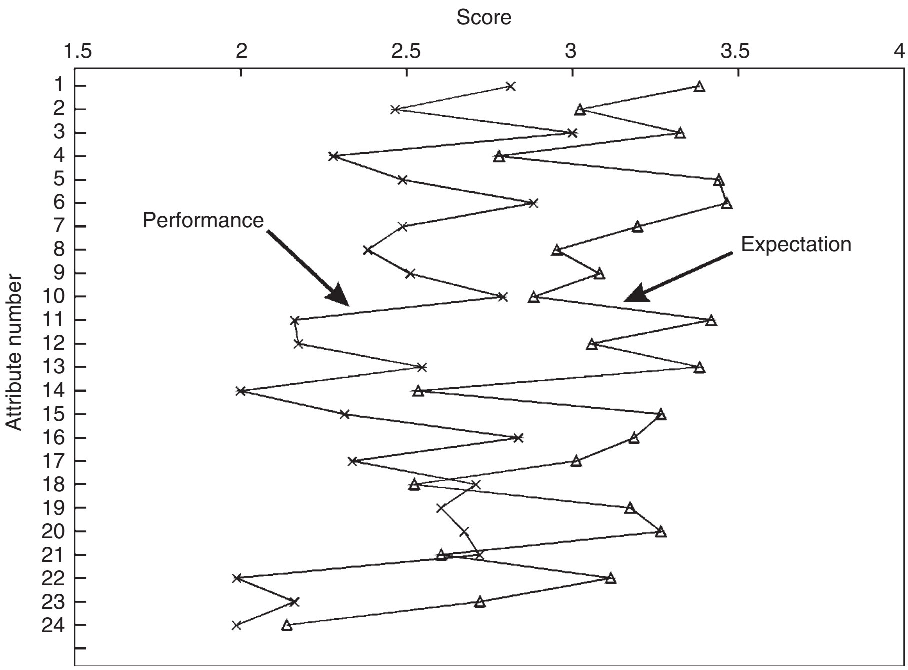

Figure 10.3 A snake diagram

Figure 10.4 is a modified snake showing the two sets of scores as well as a graph of the gaps.

In this figure, the line indicating the zero value is most important. Attributes that display a gap greater than zero, i.e. positive gaps, are those on which the firm is committing more resources than are perhaps required. Attributes that display a negative gap are those where the performance is less than the expectation and therefore in these respects the information systems department is underperforming. Where the gap is actually zero, or in other words no gap, there is an exact match between users' expectations and performance.

From Figure 10.4 it can be seen that in this case only three attributes scored close to a zero gap, while the majority show negative gaps.

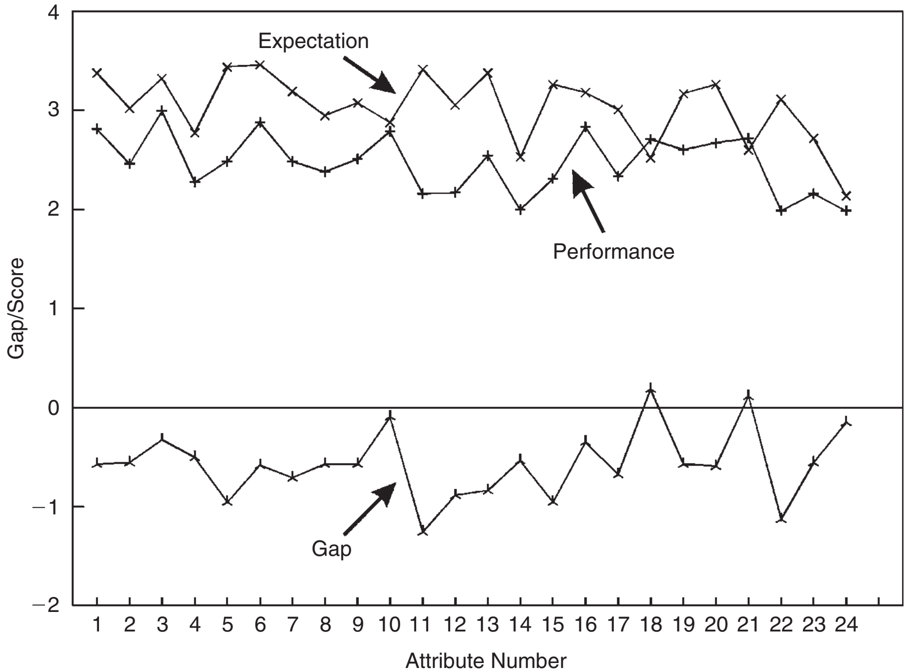

Figure 10.4 A modified snake diagram

10.9 Performance analysis

The next step in the analysis was to perform further evaluation of the performance scores. This involved calculating standard errors for each attribute. The simple average performance scores show only one of the attributes, namely, 'up-to-dateness of software' performing at an above average score of 3.01. In order to establish whether these attributes could possibly fall into the category 'good', hypothesis testing was performed. This was done by calculating, using the *t*-distribution, the 97.5th percentile and using this value as the critical value in deciding whether the performance is significantly above the mid-point of '2.5'. The critical value is calculated by adding to the mean performance score for the attribute two standard errors. Should the calculated mean value exceed 3 then the attribute is considered to be 'good', otherwise it is considered to be 'poor'.

This corresponds to carrying out a one-tailed *t*-test on the mean at a 2.5% level of significance. Should the calculated upper limit exceed 3 then the attribute can be considered to be 'good' otherwise 'poor'. This result is displayed in the last two columns of Table 10.3.

Table 10.3 Evaluation of performance scores using standard errors

Attributes	Performance		Upper Limit	Indicator
	Mean	Std Error	Mean + 2SE	
6 High degree of technical competence from support staff	2.82	0.061	2.94	Poor
11 System's response time	2.20	0.096	2.39	Poor
5 Low percentage of hardware and software downtime	2.49	0.069	2.63	Poor
1 Ease of access for users to computing facilities	2.75	0.068	2.89	Poor
13 Fast response from support staff to remedy problems	2.47	0.071	2.61	Poor
3 Up-to-dateness of software	3.01	0.061	3.13	Good
20 Ability of the system to enhance the learning experience of students	2.66	0.074	2.81	Poor
15 Flexibility of the system to produce professional reports	2.22	0.083	2.37	Poor
7 User confidence in systems	2.47	0.069	2.61	Poor
19 Ability of the system to improve personal productivity	2.62	0.067	2.75	Poor
16 Positive attitude of IS staff to users	2.78	0.072	2.92	Poor
22 Documentation to support training	1.96	0.071	2.10	Poor
9 Systems responsiveness to changing users needs	2.47	0.074	2.62	Poor
12 Extent of user training	2.14	0.079	2.30	Poor
2 Up-to-dateness of hardware	2.46	0.083	2.63	Poor
17 User's understanding of the system	2.36	0.064	2.49	Poor
8 Degree of personal control users have over their systems	2.37	0.075	2.52	Poor

(*Continued/*)

Table 10.3 (/Continued)

Attributes	Performance		Upper Limit	Indicator
	Mean	Std Error	Mean + 2SE	
10 Data security and privacy	2.78	0.052	2.88	Poor
4 Access to external databases through the system	2.21	0.063	2.34	Poor
23 Help with database development	2.12	0.075	2.27	Poor
21 Standardization of hardware	2.74	0.057	2.85	Poor
14 Participation in planning of systems requirements	1.96	0.074	2.11	Poor
18 Cost effectiveness of IS	2.72	0.058	2.84	Poor
24 Conduct computer conferencing with colleagues	1.93	0.066	2.06	Poor

The performance scores can also be analysed graphically. The average performance scores on an attribute by attribute basis, as well as the overall evaluation score ('Please rate your overall opinion of the network system') and the all-data or all-attributes average are displayed graphically in Figure 10.5.

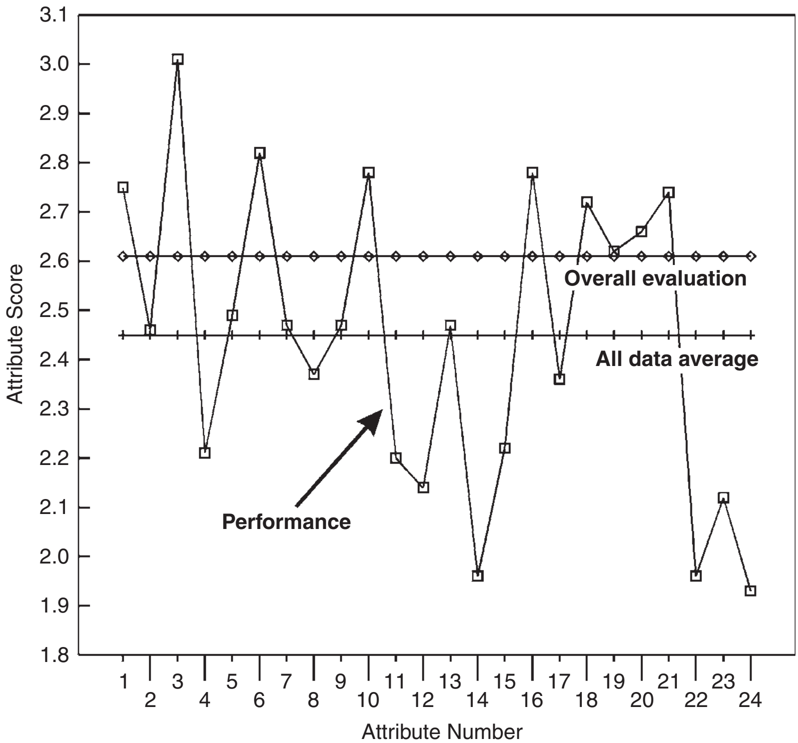

Figure 10.5 Performance analysis

The overall evaluation score is the average result of the question asked in Part C of the questionnaire. The all-data average is the arithmetic mean of all the attribute performance scores for all the questionnaires.

An interesting feature of Figure 10.5 is that the mean overall evaluation score of 2.61 is higher than the all-data average of the performance scores, which is 2.45. In fact the mean overall evaluation is statistically significantly higher at the 5% level.

This gap is very important and suggests that the user community, although scoring the performance of the individual attributes quite poorly, gives the service as a whole a significantly higher score.

This might be regarded as a forgiveness factor. It could be that the students although being aware that most aspects of the service were bad still felt that the ISD were doing as well as can be expected considering the level of resourcing and investment going into the system.

10.10 Factor analysis

Factor analysis is a mathematical procedure that can assist the researcher in conceptualizing a problem.

According to Kerlinger (1969) it is a method for determining the number and nature of the underlying dimensions (or factors) among large numbers of measures of the concept being evaluated. Factor analysis is a technique used to locate and identify fundamental properties underlying the results of tests or measurements and which cannot be measured directly (a factor is a hypothetical entity that is assumed to underlie the results of the tests). It is therefore a technique that can be used to provide a parsimonious description of a complex multi-faceted intangible concept such as UIS.

Factor analysis is available on many statistical software packages. In this study it was performed using the SPSS/PC+software package. In using factor analysis there are traditionally four steps to be performed with the computer results which are:

1. Consult the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy. The rule for the use of this statistic is that if the KMO is less than 0.50 there is no value in proceeding with the technique. The greater the value of the KMO the more effective the factor analysis is likely to be.
2. Examine the eigen values. Only factors with an eigen value of greater than 1 are used in the analysis.

3. Study the rotated factor matrix. Examine each factor one at a time, looking for the input variables that influence the factor, which have a loading of 0.5 or more.
4. Attempt to combine the meaning of the variables identified in 3 above into a super-variable that will explain the combined effect of these individual variables, and will become the invisible factor the analysis attempts to isolate.

See Appendix D for a more detailed description of factor analysis.

10.10.1 Factor identification

In order to gain a better understanding of the scores, a factor analysis was performed on both the expectation and performance data. The underlying factors were determined through the principal component procedure of the SPSS/PC software package. Each of the set of expectation statements and performance statements were analysed by using the principal components procedure for extraction of the factors followed by a varimax rotation. The resulting factor matrices are displayed in

Table 10.4 Factor analysis of student expectation scores

Attrib. no.		Factor loading	Gap correlation with satisfaction
Factor 1: Ease of use (14.2% of variance)			
A23	Help with model/database development	0.7466	0.2154*
A16	Positive attitude of information systems staff to users	0.6173	0.0945
A21	Standardization of hardware	0.6043	0.0625
A22	Documentation to support training	0.5507	0.3165**
Factor 2: Modernness (9.8% of variance)			
A3	Up-to-dateness of software	0.8067	0.3794**
A2	Up-to-dateness of hardware	0.6489	0.3056**
Factor 3: System's control (8.0% of variance)			
A18	Overall cost effectiveness of information systems	0.7746	0.0678
A10	Data security and privacy	0.7092	−0.1314
A14	Participation in the planning of the system requirements	0.6083	0.0033
Factor 4: Technical competence available (6.7% of variance)			
A12	Extent of user training	0.7621	0.0795
A17	User understanding of the system	0.6800	0.0563
A6	A high degree of technical competence	0.5403	0.0232

* implies correlation is significant at the 5% level, ** implies correlation is significant at the 1% level, *** implies correlation is significant at the 0.1% level

Table 10.5 Factor analysis of student perceptions of performance

Attrib. no.		Factor loading	Gap correlation with satisfaction
Factor 1: Effective benefits (28.4% of variance)			
B19	Ability of the system to improve personal productivity	0.8430	0.4160***
B20	Ability of the system to enhance the learning experience of students	0.7003	0.3328**
B11	System response time	0.5745	0.5738***
B7	User confidence in systems	0.5174	0.3112**
B12	Extent of user training	0.5118	0.0795
Factor 2: Modernness (7.8% of variance)			
B9	System's responsiveness to changing user needs	0.7357	0.2947*
B8	Degree of control users have over their systems	0.6647	0.2528*
B2	Up-to-dateness of hardware	0.6141	0.3056*
B21	Standardization of hardware	0.6091	0.0625
Factor 3: System access (7.3% of variance)			
B15	Flexibility of the system to produce professional reports	0.7172	0.2330*
B17	Users' understanding of the system	0.6995	0.0563
B22	Documentation to support training	0.5339	0.3165**
B5	A low percentage of hardware and software downtime	0.5115	0.4307***
Factor 4: Quality of service (6.4% of variance)			
B16	Positive attitude of IS staff to users	0.7665	0.0945
B13	Fast response time from support	0.6588	0.0524

* implies correlation is significant at the 5% level, ** implies correlation is significant at the 1% level, *** implies correlation is significant at the 0.1% level

Tables 10.4 and 10.5. Only those statements with a factor loading of 0.5 or more are listed in the tables.

10.10.2 Expectation scores

Eight factors with eigen values greater than 1 were extracted from the expectation data, accounting for 62.2% of the overall variance. Only the first four of these were interpretable. It could be that perceptions of what is important are not clear in the respondents' minds.

Ease of use emerged as the factor explaining most of the variance. Modernness of the system, system control, and technical competence available, in order of variance explained, were the remaining factors. These factors and the attributes loading on them are given in Table 10.4. The KMO measure for these scores was 0.543.

Only four of the 12 gap scores are significantly correlated with overall satisfaction. This implies that the dimensions identified by the factor analysis of expectation scores are likely to be weak measures of user satisfaction with the system.

10.10.3 Performance scores

Four factors with eigen values greater than 1 were extracted from the performance data, accounting for 49.9% of the total variance. Effective benefits realization emerged as the factor explaining most of the variance. Modernness of the system, system access and quality of service were the remaining factors. These factors and the statements loading on them are given in Table 10.5. The KMO for these scores was 0.7439.

Only three of the 13 gap scores relating to statements loading on the first three factors are uncorrelated with the overall satisfaction scores. Thus, the performance factors are potentially 'good' measures of satisfaction with the system. The fourth dimension, namely, perception of the quality of the IS staff, is a weak measure of user satisfaction with the system, since for both statements loading on this factor, the gap scores are uncorrelated with overall user satisfaction.

In contrast to the analysis of the expectation data, the respondents appear to have a much clearer view of the performance of the IT department and thus the performance dimensions are likely to be more reliable measures of user satisfaction than those derived from the expectation data.

10.10.4 Regression analysis: explanation of overall satisfaction scores

Regression analysis was performed with a view to establishing which variables were important in explaining the overall satisfaction scores. The initial explanatory variable pool consisted of: the summated gap scores for each of the four perceptual performance factors, as well as the two factual variables; years of experience working with a PC; and years of experience working with a PC network. Subsequent theoretical considerations led to a revision of the pool.

The quality of service factor shown in Table 10.5 was excluded from the analysis, as the gaps for variables loading on this factor were not correlated with the overall satisfaction scores. Also, for each of the first three factors (effective benefits, modernness and system access), those variables loading on the factor, but not correlating with overall satisfaction, were excluded from the summated gap scores. The exclusion of these variables did not change the interpretation of the factors.

In the first instance, a full regression analysis was performed using the SPSS/PC+ regression program. In this regression, the overall satisfaction scores were regressed on the *summed gap scores* for the *modified* perceptual factors, i.e. effective benefits, modernness and system access, as well as the two factual variables; years of experience working with a PC; and years of experience working with a PC network. The results of this regression are reported in Table 10.6.

Table 10.6 Results of full regression analysis

	Correlation with overall opinion	Regression coefficient	Beta weight	Significance
Gap variables				
Effective benefits	0.548***	0.1021	0.4597	0.0001
Modernness	0.366**	0.0340	0.1246	0.2389
System access	0.492***	0.0486	0.1797	0.1082
Non-gap variables				
PC experience	−0.058	−0.0036	−0.0176	0.8751
Network experience	−0.127	−0.0365	−0.1190	0.2874

** Correlation is significant at the 1% level, *** Correlation is significant at the 0.1% level
Multiple correlation $R_{\text{Full}} = 0.6478$
Coefficient of determination $R^2_{\text{Full}} = 0.4196$
$F = 10.12$, Significance = 0.0000

The results of the full regression reveal a significant regression ($F = 10.2$, significance = 0.0000) with a multiple correlation R of 0.6478. The multiple correlation R indicates the extent of the correlation between the overall satisfaction scores and all the explanatory variables collectively. The interpretation of the R^2 value of 0.4196 is that the explanatory variables collectively explain 41.96% of the variation in the overall satisfaction scores. The relative impact of each explanatory variable can be inferred from the so-called beta weights, which are standardized regression coefficients. The beta weights are used in preference to the ordinary regression coefficients, as they are independent of the unit of measurement for the variable itself. In the fitted model, effective benefits with a highly significant beta weight of 0.4597 is the factor that has by far most impact on the overall opinion score. The impact of effective benefits can be considered to have approximately 2.5 times as much impact as system access, which has a beta weight of 0.1797.

It is interesting to note from the second column of Table 10.6 that while all three gap variables are significantly and positively correlated with overall satisfaction, both the PC and PC network experience variables are not significantly correlated with overall satisfaction. It is of additional interest to note that, although not significant, the correlations in the sample between overall satisfaction and both the PC and PC network experience variables are negative. It is just possible, therefore, that overall satisfaction can be inversely related to these experience variables, which would imply that the more experienced users are more difficult to satisfy.

The regression model was recomputed using the stepwise regression procedure and the results are presented in Table 10.7.

Table 10.7 Results of stepwise regression analysis

	Correlation with overall opinion	Regression coefficient	Beta weight	Significance
Gap variables				
Effective benefits	0.598***	0.1089	0.4890	0.0000
Modernness	0.366**	–	–	–
System access	0.492***	0.0586	0.2167	0.1082
Non-gap variables				
PC experience	−0.058	–	–	–
Network experience	−0.127	–	–	–

** Correlation is significant at the 1% level, *** Correlation is significant at the 0.1% level
Multiple correlation $R_{\text{Full}} = 0.6264$
Coefficient of determination $R^2_{\text{Full}} = 0.3924$
$F = 23.5721$, Significance $= 0.0000$

The stepwise regression retains only two of the original five variables included in the full regression model. Despite this, the two models are very similar in terms of fit. ($R^2_{\text{Full}} = 0.4196$ versus $R^2_{\text{Stepwise}} = 0.3924$).

The results of the stepwise regression reveal that effective benefits and system access are significant in explaining the overall satisfaction scores. Also, a comparison of the beta weights suggests that effective benefits have about 2.25 times more impact on overall satisfaction than system access. The full regression and stepwise regression beta weights are essentially the same.

10.11 Summary of findings

The gaps on the two perceptual performance factors, namely effective benefits and system access, are significant in assessing overall satisfaction with the network. The gap on effective benefits is approximately twice as important as system access in terms of its impact on overall satisfaction. Previous PC and PC network experience do not impact significantly on overall satisfaction with the network system.

The fitted model in this case only explains about 40% of the variability in the overall satisfaction scores. Thus, there are other factors, not identified in the study, which impact on overall satisfaction. This in turn suggests that the evaluation of an office automation/network system is far more complex, involving more than just the two dimensions identified.

10.12 Analysing qualitative information

In an attempt to find out more precisely the nature of problems with the systems and service, the user satisfaction survey usually includes an open ended question inviting the respondent to comment on the effectiveness of their organization's systems (see Part C of Figure 10.2).

A collation of these comments and criticisms can run into many pages of text, which clearly will pose problems to the analyst. Not only do we wish to extract the key problems but also desire a deeper understanding of the nature of the problems to be brought to the attention of management. The authors have found the application of two well-established methods, namely, that of content analysis and correspondence analysis, to be very successful in facilitating this process.

A description of these techniques together with application follows. The study described was carried out at a business school different from that of section 10.6.

This study was conducted at a UK business school during March and April 1991. Self-completion questionnaires were distributed to users of the system in an attempt to measure user satisfaction with the network, the information system staff, and other information systems services offered. There were six different groups of users.

The questionnaire used was similar to that of Figure 10.2. Of the 220 questionnaires distributed 108 were returned, of which 95 were completed and of these 57 contained comments and criticisms resulting in over 12 pages of text requiring analysis. For a full discussion of the study and a copy of the questionnaire the reader is referred to Remenyi and Money (1993).

10.12.1 Content analysis

Content analysis is a simple but laborious process of examining the transcript or text with the objective of categorizing its content. This is achieved by identifying keywords, themes, or some other content category as the unit for analysis, and then counting the number of occurrences of the category. In this study the unit used in the analysis was themes such as printer problems, poor systems access, etc. A more detailed discussion of content analysis can be found in Berelson (1980).

The result of the content analysis for this study is a one-way frequency table as shown in Table 10.8. This table shows the number of occasions a particular comment or criticism was made.

Table 10.8 Summary of respondents' remarks

No.	Comment	Frequency	Abbreviation
1	Unhelpfulness of ISD staff	14	UHS
2	Slow response to requests for assistance	12	SRA
3	Printer problems	12	PRP
4	Outdated equipment	10	OUE
5	Systems not easy to use	10	NEU
6	Incompatibility of hardware and software	9	IHS
7	Poor access to systems	9	PAS
8	Insufficient funding of ISD	6	IFI
9	Lack of standards	6	LOS
10	Poor quality of training available	6	PQT
11	ISD staff priorities are wrong	4	IPW
12	Promises not kept	2	PNK
13	Accounting too complex	2	APC
14	Too many errors in software	2	EIS
15	Poor linkage to accounting system	2	PLA
16	ISD is technically excellent	1	ITE
17	ISD is totally and hopelessly incompetent	1	ITT
18	Some improvements in ISD recently	1	SII
19	ISD service is far better than other business schools	1	IBO
20	ISD service is far worse than other business schools	1	IWO

The comments in Table 10.8 have been coded with a three-letter abbreviation, which is used in the following reports and graphs.

The one-way frequency analysis provides no real surprises. In terms of other similar work conducted by the authors it is worth noting that there is a high number of respondents claiming that the ISD staff are unhelpful. There were relatively few contradictory comments although comments 16 and 17 as well as comments 19 and 20 are very good examples of how different some opinions can be.

The contingency table, or two-way frequency table as it is sometimes called in Table 10.9, shows the frequency with which the content categories occur by user group.

Table 10.9 Frequency table of user remarks

Abbreviations		User job codes						Frequency
		1	2	3	4	5	6	
1	UHS	7	2	0	5	0	0	14
2	SRA	6	3	0	3	0	0	12
3	PRP	5	5	0	1	0	1	12
4	OUE	3	0	1	2	1	3	10
5	NEU	4	1	0	3	1	1	10
6	IHS	0	4	0	3	2	0	9
7	PAS	2	1	0	2	1	2	8
8	IFI	1	2	2	1	0	0	6
9	LOS	2	2	1	1	0	0	6
10	PQT	2	0	0	3	1	0	6
11	PNK	1	1	0	3	0	0	5
12	IPW	2	1	0	0	0	0	3
13	APC	0	2	0	0	0	0	2
14	TES	0	2	0	0	0	0	2
15	PLA	0	2	0	0	0	0	2
16	ITE	0	0	1	0	0	0	1
17	ITI	1	0	0	0	0	0	1
18	SII	0	0	1	0	0	0	1
19	IBO	0	1	0	0	0	0	1
20	IWO	1	0	0	0	0	0	1

The frequency table forms the basic input for the correspondence analysis described in the next section.

Although a simple listing of these comments and the criticisms is quite useful on its own, to explore further the information potential of the above content analysis it is necessary to use another technique – correspondence analysis.

10.12.2 Correspondence analysis

Correspondence analysis was developed in France, being the brainchild of Benzecri (1969). Popularization of this technique to the 'English speaking' world can be largely attributed to Greenacre (1984). It is an exploratory data analysis technique that provides a simultaneous graphical representation of the rows and columns of a two-way contingency table thereby possibly helping the analyst to gain an understanding of the nature of the associations among the rows and columns. The display in two dimensions is known as a perceptual map.

According to Greenacre:

> Correspondence analysis is a technique for displaying the rows and columns of a data matrix (primarily, a two-way contingency table) as points in dual low-dimensional vector spaces. (Greenacre 1984, p. 54)

The only constraint on the cell entries in the contingency table is that they be non-negative. The data matrix actually used was the contingency table, Table 10.9, showing the occurrence of comments and criticisms offered by different user groups.

In the table the columns represent the job codes for different user groups. Thus 1 is academics, 2 is Sec/Admin, 3 is ISD Staff, 4 is Research Associates, 5 MBA Students and 6 is Executive Course Member. The rows represent the different issues mentioned such as UHS represents unhelpful staff and SRA represents slow response to request for assistance.

The primary output of the correspondence analysis is a map identifying the row and column attributes as points in a space of two or more dimensions. This graphical display or perceptual map represents the relative positions or grouping of the various concepts listed in the contingency table. Those rows (issues), which have similar profiles, are plotted close together, and columns (user groups) with similar profiles are plotted close together. It is the objective of correspondence analysis to present the results in as simple a form as possible.

The decision concerning the number of dimensions that will suffice to represent the contingency table is made on the basis of the amount of variation, or inertia as it is sometimes called, that the retained dimensions explain. There is no hard and fast rule concerning what is a sufficient amount of explained variation.

For this study the first two dimensions accounted for 63% of the inertia. Because of the difficulties in representing three-dimensional space it was decided that two dimensions were sufficient. The resulting perceptual maps show the relative positions of the different concepts and different participating informants.

The axes are purely numerical scales that are produced to show relative distance from the centroid in a graphical way. These axes may be thought of as two artificial variables synthesized from the original data set that give the maximum explanation of the differences and the similarities between the originally observed values. It is up to the analyst using the correspondence analysis to actually attribute meaning to these axes.

From Figure 10.6 it is possible to see that some of the comments and criticisms may be conveniently grouped together. For example, by projecting each of the user remark category points onto the vertical axis and studying the order in which they are positioned on this axis it will be noticed that the issues UHS, SRA, PNK, IHS, PRP and PQT are all below the horizontal axis. All these issues are related to people. The issues OUE, IFI, PAS, LOS and NEU are above the horizontal axis. These issues may be thought of as funding matters.

Issues that are grouped together on the perceptual map are said to be associated or similar. The association of such variables may be thought of as a type of correlation in that the association shows that there exists a relationship between these variables. The perceptual map does not indicate the type of relationship. The specification of the nature of the relationship depends on the environment being described by the correspondence analysis.

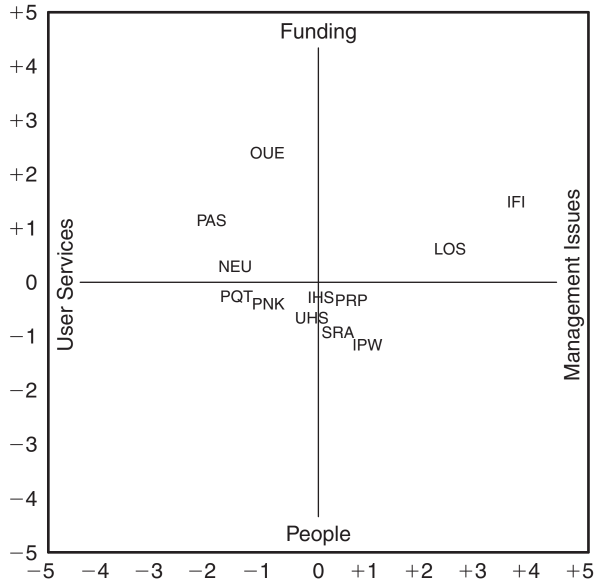

Figure 10.6 Perceptual map showing concepts

The positions or projections of the issues on the horizontal axis suggest that they are lined up with user services such as PAS (poor access to system), NEU (not easy to use), PQT (poor quality training) and OUE (out of date equipment) on the left and the more management related issues such as LOS (lack of standard) and IFI (insufficient funds) on the right.

It is not surprising that the concepts described as service issues, when projected onto the horizontal axis, lie in close proximity to one another. The groups of respondents that fall close to this area on the graph could be described as having a service focus. In fact they constitute a cluster, and the main theme of this cluster is lack of service. Clearly this is the most pressing problem facing the ISD.

In the same way as the issues have been grouped, so the participating respondents may be grouped. Figure 10.7 shows the grouping of the respondents.

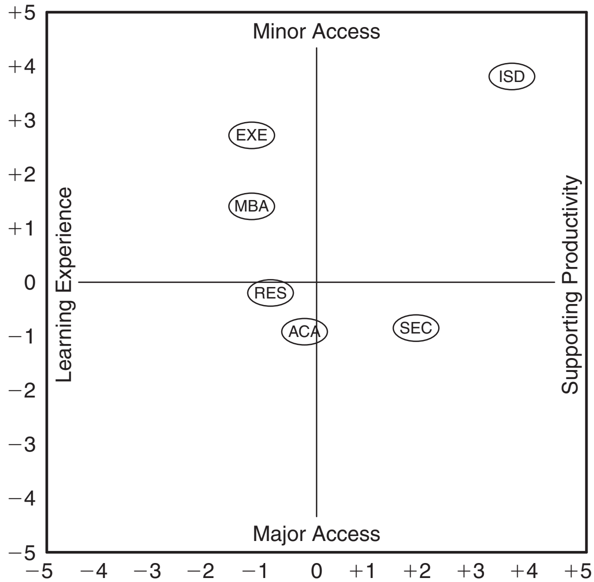

Figure 10.7 Perceptual map showing user groups

The plot for the respondent groupings reveals a horizontal axis with one pole appearing to be ‘learning experience’ and the other ‘supporting productivity’. The vertical axis appears to be a scale from ‘major access’ to ‘minor access’.

It may be seen that five of the groups lie in an arc around the origin of the axes. This shows that although they have different views they also have much in common. There is one group that lies quite distant from the rest. This is the ISD, and the perceptual map confirms that their views are quite out of line with the rest of the business school.

Finally, Figure 10.8 shows the issues and the respondent groups superimposed on the same set of axes. This perceptual map gives a clear indication of which groups have which problems with the system.

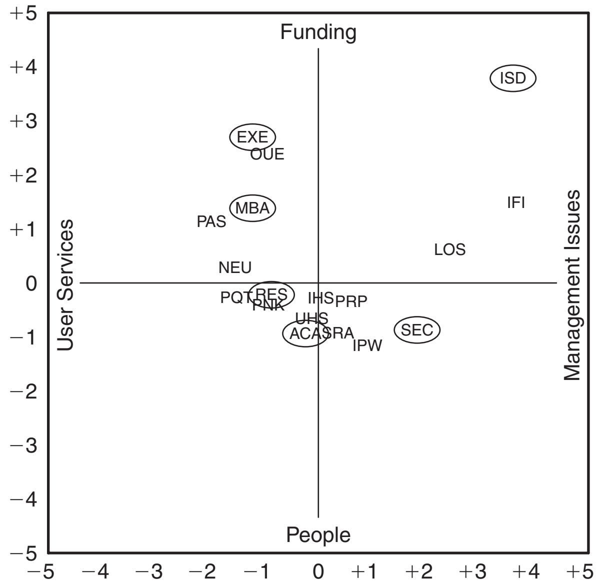

Figure 10.8 Perceptual map showing respondents and user groups on the same axes

The research associates and academics are positioned close to one another and therefore have fairly similar concerns. The main concerns for the research associates appear to be poor quality training, promises not kept, unhelpful staff, equipment not easy to use and incompatible hardware and software. The academics are primarily concerned with issues such as unhelpful staff, promises not kept, slow responses, printer problems and ISD staff priorities are wrong.

The administration/secretarial staff shares with academics concerns with regard to ISD staff priorities being wrong as well as slow response.

The MBA and Open Executive course members have similar profiles with poor access to the system being of most concern to the MBAs and outdated equipment being of major concern to the executives. This is not surprising, as the equipment in the business school is somewhat dated.

As mentioned above, the ISD appear to have views markedly out of line with the five other user groups. Their main concerns are associated with insufficient funds and lack of standards, which are operational and technical issues, normally associated with their work.

From the joint map (rows and columns superimposed) a study of the horizontal axis reveals that the executives, MBAs and research associates are more concerned with user services, while the secretarial and ISD staff is more concerned with management issues. The academic staff is positioned at the centroid, thus apparently concerned equally with user services and management issues.

A study of the vertical axis reveals that the ISD and executives, and to a lesser extent the MBAs, focus more on funding, while the research associates, academics and secretarial staff tend to focus on people issues.

In summary the findings of the correspondence analysis suggests that the problem is a lack of service concerning a group of seven key issues:

1. Unhelpfulness of ISD staff
2. Slow response to requests for assistance
3. Printer problems
4. Outdated equipment
5. Systems not easy to use
6. Incompatibility of hardware and software
7. Poor access to systems

The correspondence analysis reveals the views of the ISD staff are out of line with the rest of the user community at the business school. Whereas the various user groups are concerned about issues such as Unhelpfulness of ISD staff, Slow response to requests for help, Outdated equipment, Poor printers, etc., the ISD perceive the business school's information systems problems to be lack of funds and lack of standards. This lack of congruence is one of the most important difficulties facing the management of the business school.

10.13 A multiple gap approach to measuring UIS

A multiple gap approach to measuring UIS has been investigated by the authors. This original research is designed to find ways and means of offering assistance to those seeking to obtain a penetrating insight into how systems are viewed at various stages of their production, implementation and use, and how this has an impact on UIS. Multiple gap analysis is a useful instrument in this respect.

In a study presently in progress at the college, three measures of a system's benefit profiles are being studied. The first measure related to how the system's original architects perceived the potential benefits. The information relating to potential benefits is extracted from the original specification of requirements documentation. Sixteen different benefit types were defined by the firm. These include the system's ability to:

1. Reduce overall costs
2. Displace costs
3. Avoid costs
4. Provide opportunity for revenue growth
5. Provide improved management information
6. Provide improved staff productivity
7. Provide capacity for increased volume
8. Reduce error
9. Provide a competitive advantage
10. Catch up with competition
11. Provide improved management control
12. Provide improved management productivity
13. Provide improved staff morale
14. Provide improved corporate image
15. Provide improved customer service
16. Provide improved client/supplier relationships

During the development of the original specification of requirements, the authors of the document were required to state the relevance of each benefit type to the system by rating the benefit on a four point scale. This is a measure of the importance or need that the firm has for each of the benefit types. A questionnaire used for this data collection is shown in Figure 10.9.

The second measure of benefits was obtained by requesting that the project manager and other members of his or her team, on completion of the system's development, answer the same set of questions relating to the 16 different benefit types. This data provides a second view of the potential benefits by obtaining an opinion as to what extent the project manager believes the system, as it has been developed, can actually achieve the stated benefits. This is a measure of the expectations of the IS professionals who have developed the system. Figure 10.10 shows the questionnaire required for the capture of this data.

Unlike the first questionnaire, which is administered either by the researcher studying the actual specification of requirements, or by discussion with only one informant, i.e. the project manager, the second and third questionnaires can be

THE MEASUREMENT OF INFORMATION SYSTEMS BENEFITS	
Answer the questions by ticking the option which corresponds to your opinion of the importance of the following types of benefit which may be achieved by the proposed system.	
1	The system's ability to reduce overall costs. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ____________________ ____________________
2	The system's ability to displace costs. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ____________________ ____________________
3	The system's ability to avoid costs. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ____________________ ____________________
4	The system's ability to provide opportunity for revenue growth. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ____________________ ____________________
5	The system's ability to provide improved management information. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ____________________ ____________________
6	The system's ability to provide improved staff productivity. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ____________________ ____________________
7	The system's ability to provide capacity for increased volume. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ____________________ ____________________
8	The system's ability to reduce error. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ____________________ ____________________

Figure 10.9 Questionnaire used in conjunction with the specification of requirements

9	The system's ability to provide competitive advantage. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ______________________________ ______________________________
10	The system's ability to catch up with competition. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ______________________________ ______________________________
11	The system's ability to provide improved management control. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ______________________________ ______________________________
12	The system's ability to provide improved management productivity. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ______________________________ ______________________________
13	The system's ability to provide improved staff morale. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ______________________________ ______________________________
14	The system's ability to provide an improved corporate image. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ______________________________ ______________________________
15	The system's ability to provide improved customer service. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ______________________________ ______________________________
16	The system's ability to provide improved client/seller relationships. Irrelevant _______ Not important _______ Important _______ Critical _______ If you answered either IMPORTANT or CRITICAL, please give details: ______________________________ ______________________________

administered to many users. As a result, when there are multiple users involved, summary statistics have to be calculated.

THE MEASUREMENT OF INFORMATION SYSTEMS BENEFITS	
Answer the questions by ticking the option which corresponds to your opinion of the probability that the following benefits will be achieved by the proposed system.	
1	The system's ability to reduce overall costs. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details: ________________________________ ________________________________
2	The system's ability to displace costs. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details: ________________________________ ________________________________
3	The system's ability to avoid costs. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details: ________________________________ ________________________________
4	The system's ability to provide opportunity for revenue growth. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details: ________________________________ ________________________________
5	The system's ability to provide improved management information. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details: ________________________________ ________________________________
6	The system's ability to provide improved staff productivity. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details: ________________________________ ________________________________
7	The system's ability to provide capacity for increased volume. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details:

Figure 10.10 Questionnaire used by systems development project managers

8	The system's ability to reduce error. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details:
9	The system's ability to provide competitive advantage. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details:
10	The system's ability to catch up with competition. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details:
11	The system's ability to provide improved management control. Unlikely _______ Possibly _______ Probably _______ Certainly _____ If you answered either PROBABLY or CERTAINLY, please give details:
12	The system's ability to provide improved management productivity. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details:
13	The system's ability to provide improved staff morale. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details:
14	The system's ability to provide an improved corporate image. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details:
15	The system's ability to provide improved customer service. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details:

Figure 10.10

16	The system's ability to provide improved client/seller relationships. Unlikely _______ Possibly _______ Probably _______ Certainly _______ If you answered either PROBABLY or CERTAINLY, please give details: ____ ____

Figure 10.10 (/Continued)

The third measure of benefits was obtained by requesting that the users complete a questionnaire that attempts to collect data on the actual performance of the system. This questionnaire is shown in Figure 10.11.

THE MEASUREMENT OF INFORMATION SYSTEMS BENEFITS Answer the questions by ticking the option which corresponds to your opinion of the performance of the system.	
1	The system's ability to reduce overall costs. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ____ ____
2	The system's ability to displace costs. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ____ ____
3	The system's ability to avoid costs. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ____ ____
4	The system's ability to provide opportunity for revenue growth. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ____ ____
5	The system's ability to provide improved management information. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ____ ____

Figure 10.11 Questionnaire used by ultimate users of systems

6	The system's ability to provide improved staff productivity. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ______________________________ ______________________________
7	The system's ability to provide capacity for increased volume. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ______________________________ ______________________________
8	The system's ability to reduce error. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ______________________________ ______________________________
9	The system's ability to provide competitive advantage. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ______________________________ ______________________________
10	The system's ability to catch up with competition. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ______________________________ ______________________________
11	The system's ability to provide improved management control. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ______________________________ ______________________________
12	The system's ability to provide improved management productivity. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ______________________________ ______________________________
13	The system's ability to provide improved staff morale. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: ______________________________ ______________________________
14	The system's ability to provide an improved corporate image. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details:

Figure 10.11 (/Continued)

	__________ __________
15	The system's ability to provide improved customer service. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: __________ __________
16	The system's ability to provide improved client/seller relationships. Very poor ________ Poor ________ Good ________ Excellent ________ If you answered either GOOD or EXCELLENT, please give details: __________ __________

Figure 10.11 (/Continued)

As there are three data sets collected, described in Figure 10.12, there is a potential for three distinct sets of gaps. The three different data sets collected are

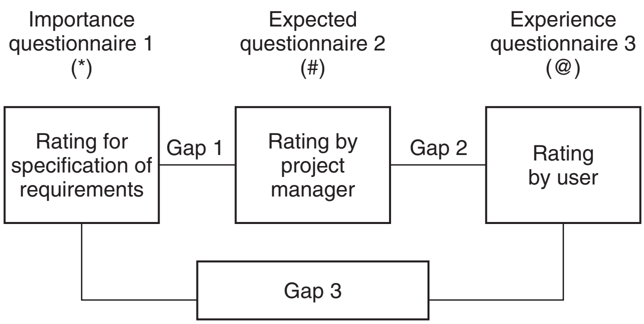

Figure 10.12 Gap analysis concepts

shown in Figure 10.13, and Figure 10.14 shows how the relative values from the different questionnaires could be presented.

In Figure 10.14 importance scores are indicated by *, while expectation scores are shown as # and experience scores are expressed as @.

Concerning the first gap, GAP_1, if $(* - \#) > 0$ then the system's developers are claiming to have underachieved in terms of what the original system's architects believed was possible. If $(* - \#) < 0$ then the system's developers are claiming to have overachieved in terms of what the original system's architects believed was possible. If $(* - \#) = 0$ then there is a concurrence of opinion between the system's architects and the system's developers.

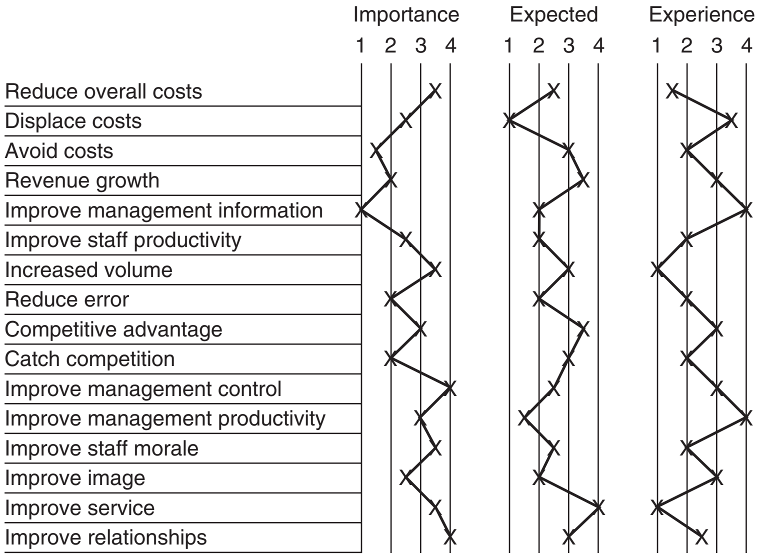

Figure 10.13 Results showing three different data sets

	1	2	3	4
Ability to reduce overall costs	@	#	*	
Ability to displace costs	#	*	@	
Ability to avoid costs	*	@	#	

* Importance scores
\# Expectation scores
@ Experience scores

Figure 10.14 Presentation of results

Concerning the second gap, GAP_2, if $(\# - @) > 0$ then the system's users are claiming that the benefits delivered have underperformed in terms of what the system's development project manager believed was possible. If $(\# - @) < 0$ then the system's users are claiming that the system has overperformed in terms of what the system's development project manager believed was possible. If $(\# - @) = 0$ then there is a concurrence of opinion between the system's architects and the system's users.

Concerning the third gap, GAP_3, if $(* - @) > 0$ then the system's users are claiming that the benefits delivered have underperformed in terms of what the original system's architects believed was possible. If $(* - @) < 0$ then the system's users are claiming that the system has overperformed in terms of what the original system's architects believed was possible. If (* − @) = 0 then there is a concurrence of opinion between the system's architects and the system's users.

A positive GAP_1, i.e. gaps between the original system's architects and the system's development project manager, may be interpreted as an underachievement in the firm's delivery process. This underdelivery may be attributed to over-enthusiasm or the lack of expected resources, or the fact that the system was not fully understood at the outset. A negative GAP_1 may be attributed to the reverse.

A positive GAP_2, i.e. gaps between the system's development project manager and the users, may be interpreted as an underachievement in the firm's systems realization process. This underachievement may be attributed to the lack of training, the lack of systems documentation or the fact that the system was not fully understood or to all three such causes. A negative GAP_2 may be attributed to the reverse.

A positive GAP_3, i.e. gaps between the original system's architects and the system's users, may be interpreted as an indication of user dissatisfaction, or as an indication of the lack of effectiveness of the firm's IT. Attributing this to specific causes may be difficult and thus GAP_1 and GAP_2 may be an invaluable guide in this respect. A negative GAP_3 may be attributed to the reverse. This gap analysis may identify complex relationships within the firm between users and systems people.

It is possible for there to be a positive or negative GAP_3 while GAP_1 and GAP_2 have different signs. For example, it is possible that there is general user dissatisfaction with the system as shown by the positive GAP_3 and by a positive GAP_2 but there may be simultaneously a negative GAP_1. Such a situation would indicate a position where there were major misunderstandings between the system's professionals and the users. On the other hand there may be a very positive user view while the architects and the system's development project manager rated the system less favourably. Both these situations suggest the need for extensive training of IS professionals and users.

The same type of analysis conducted on the results of the one gap, as has been described earlier in this chapter, may be performed on the two/three gap approach. Snake diagrams may also be drawn which are invaluable in interpreting the results. Factor analysis may also be used to explore underlying relationships in the data. As may be seen from the questionnaires shown in Figures 10.9 to 10.11 this research calls for descriptive explanations from all three types of informants. These explanations may also provide most valuable insights for management.

This type of study is longitudinal in nature. Therefore it will take at least a year or two between the time the first data set is obtained until final analysis may be conducted. The insight this technique can provide will be worth the effort and the wait.

10.14 Using a questionnaire approach to measure IT effectiveness

The following is a step-by-step guide to using a survey approach to the measurement of IT effectiveness.

Obtain authorization for the measurement exercise
This is best obtained from the highest possible level in the firm and should also have the approval of the IS director.

Establish a focus group
A focus group consists of a number of IS and user executives who define the issues to be included.

Construct the questionnaire
Use information obtained from the focus group to develop the measuring instrument.

Conduct a pilot survey
Produce a questionnaire and complete on a face-to-face basis with five to ten prospective respondents.

Use feedback from the pilot to refine the questionnaire
The pilot survey will show those areas of the questionnaire that need enhancing and those areas that are extraneous.

Select a sample
Choose an appropriate sample that is representative of the organization as a whole. It should include users from all levels of the management hierarchy.

Dispatch questionnaires
A fixed date for the return of questionnaires is essential, and respondents should be made aware of this fact.

Collect questionnaires
Depending on the distribution of the sample, the questionnaires can either be collected or returned by the respondents.

Analyse results
Collate and analyse the results. This can be time consuming, but is essential if valuable information is to be generated.

Present report
The results of the questionnaire should be summarized in a written report, using as little technical jargon as possible.

10.15 Summary

There is a growing trend towards the utilization of user satisfaction measurements as a surrogate for information systems effectiveness. This is a holistic approach which enables the firm to obtain an overview of the effectiveness of the IS function. Gap analysis is a popular way of conducting these studies and it is not difficult to construct an appropriate questionnaire. The analysis of the statistics that these techniques produce is not trivial and requires the assistance of a statistician.

The questionnaire in Appendix F represents the latest approach to collecting data on user satisfaction. It is also supplied on the CD ROM accompanying this book.

11

Ranking and scoring

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We propose that the real benefits of information technology results from a change in the business.

M. Parker and R. Benson, 'Information Economics: An Introduction' (1987)

11.1 Introduction

An approach that an organization may wish to undertake in assessing the potential of an IT system is to perform an overview evaluation using a simple ranking and scoring technique. The procedure involves rating a system or a group of systems against a series of general evaluation criteria. This approach is quite similar to what Parker *et al.* (1988) refer to as 'information economics'. The evaluation criteria involve issues such as industry attractiveness, internal value chain, industry value chain, offensive or defensive thrusts, etc. Other issues not directly related to strategic concerns, but which affect equally important dimensions of a system may also be included.

11.2 Five steps to evaluation

There are five steps involved in an overview evaluation:

1. Select the criteria
2. Associate weights to each criterion
3. Score systems in terms of how they satisfy the criteria
4. Calculate a system's rating by multiplying each score by the weight and then summing to a total
5. Select the system with the greatest total score

The key issues of ranking and scoring addressed here are:

- Strategic value
- Critical value
- Operational value
- Architectural value
- Investment value
- Risk assessment

11.2.1 Strategic value

The strategic value refers to the system's potential to create for the organization a competitive advantage. This may be done in many ways, including effecting one or more of the five industry forces as described by Porter (1985). Competitive advantage may also be derived by improving the organization's own value chain internally, or by changing the industry value chain. Strategic value may be derived from an offensive thrust or by a defensive reaction to other players in the market.

11.2.2 Critical value

The critical value of a system refers to its ability to improve the effectiveness with which the organization competes. The attributes of the systems listed under this category will not *per se* deliver a new competitive advantage, but will generally improve the amount of basic advantage already available to the organization.

11.2.3 Operational value

Operational value embraces both systems that relate to efficiency issues, as well as issues that are fundamental to the organization's continued existence. These are not strictly strategic, although they are of vital importance to the organization and are, therefore, considered at the same time as the strategic issues.

11.2.4 Architectural value

Architectural value considers major infrastructural systems without which the information systems department probably could not function at all.

11.2.5 Investment value

Investment value refers to a measure of the financial benefit that a system delivers to the organization.

11.2.6 Risk assessment

Risk assessment represents both conceptual and practical problems. Although it is relatively easy to define risk it is difficult to actually assess its impact on a particular information system or project. The risk of a project is the potential for the actual values of the input and output variables to fluctuate from their original estimates. For example, although the list price of a new mainframe might be £250 000, by the time the organization pays the invoice for it, the amount may be greater or less due to a price change or exchange rate fluctuation, or even a pre-installation upgrade. As original estimates may vary upward or downward, the measure of risk should reflect both the project's positive and negative potential. As most managers are averse to risk, risk is often only seen as a negative aspect of a system. The result of this is that risky investments tend to have their benefits understated and their costs overstated. Thus, risk is treated as a cost, resulting in a reduced estimated value of the system. In general, this is not a satisfactory way of handling risk as it does not reflect the upside potential inherent in the risk, which is as intrinsic to the concept as the downside. Entrepreneurial managers may well wish to emphasize the upside potential of the investment, making their judgement on that evaluation rather than on the negative downside evaluation.

11.3 A spreadsheet system for overview evaluation

A spreadsheet can be useful in assisting the evaluation of the strategic potential of IT investment using this ranking and scoring technique.

The primary function of the spreadsheet is to offer a checklist of issues that should be considered during an IT investment evaluation process. The secondary purpose of the spreadsheet is to calculate a total score, which represents the perceived value of the systems under review. The calculations involved are trivial, but the purpose of the spreadsheet is to offer a systematic approach to the ranking and scoring process.

The first task in using this system is to select the evaluation criteria that are most relevant in the organization's particular circumstances. The criteria listed in Figure 11.1 are typical issues of concern, but of course they could change from organization to organization and with the type of information system being considered.

The second step is to allocate weights to each of these criteria or factors on a scale of 1 to 10. The objective of this is to effectively spell out the relative importance of the factors to the organization. The final step is to score the system or systems under review on a scale of 1 to 5 for each of the criteria chosen.

Figure 11.1 shows the options from which the evaluation criteria are made and ten evaluation criteria have been selected.

Each of the ten criteria chosen from the list of 23 is then weighted on a scale of 1 to 10 and a weighted decision variable table is created that can be used as a checklist with which to compare competing information systems. Each competing system is then individually scored against the weighted decision variables using a scale of 1 to 5. For each competing system the weight of the decision variable is multiplied by the score, and these values are then summed.

IS selection system					
Indicate the **10** most relevant factors with an x.					
Strategic value		*Operational value*		*Risk assessment*	
Industry attractiveness		Administration improvement		New technology	x
Internal value chain	x	Legislative requirements		New application	x
Industry value chain	x			Application size	x
Offensive	x	*Architectural value*		Market damage	x
Defensive	x	Operating system			
		Comms. infrastructure			
Critical value		Languages			
Expense control					
Asset reduction		*Investment value*			
Equipment utilization		Payback	x		
Sales increase		NPV/PI	x		
Production enhancement		IRR			
Waste minimization					

Figure 11.1 Selecting the decision variables

Table 11.1 shows the selected criteria, together with their weighted importance and the results of the evaluation for three different information systems.

Table 11.1 shows all the chosen decision variables as well as the weights, scores and results for each of the systems being analysed.

Table 11.1 Weighted criteria with scores for three competing information systems

Selected criteria	**Weighting**	**System 1**		**System 2**		**System 3**	
		Score	**Value**	**Score**	**Value**	**Score**	**Value**
Internal value chain	8	5	40	4	32	2	16
Industry value chain	9	4	36	4	36	5	45
Offensive	10	3	30	4	40	5	50
Defensive	7	2	14	4	28	2	14
Payback	9	5	45	4	36	5	45
NPV/PI	9	4	36	4	36	5	45
New technology	−8	3	−24	2	−16	1	−8
New application	−5	3	−15	2	−10	2	−10
Application size	−7	2	−14	5	−35	2	−14
Market damage	−6	5	−30	5	−30	0	0
			118		117		183

Note that the negative scores for the risk assessment criteria in Table 11.1 reflect the risk aversion expressed by most managers. An entrepreneurial manager's view of the risk inherent in the investment opportunity could be expressed as a positive score.

Looking at the results in Table 11.1, it would seem that System 3 best fits the requirements based on the selected criteria. A risk positive approach to the risk criteria could lead to quite a different system being indicated as the most appropriate selection.

The interpretation of results from a system such as the one illustrated here is not trivial, and neither is it necessarily obvious from these values which investment will be preferred.

11.4 Summary

In this chapter, one approach to using a ranking and scoring technique has been described. Such techniques are quite popular and are therefore used extensively in business. The variables used and the weighting and scoring ranges employed may vary enormously. Readers are, therefore, invited to choose their own variables and use their preferred weighting and scoring measures.

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12

Value for money and health checks

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If two people stand at the same place and gaze in the same direction, we must, under pain of solipsism, conclude that they receive closely similar stimuli. But people do not see stimuli; our knowledge of them is highly theoretical and abstract. Instead they have sensations, and we are under no compulsion to suppose that the sensations of our two viewers are the same . . . Among the few things that we know about it with assurance are: that very different stimuli can produce the same sensations; that the same stimulus can produce very different sensations; and, finally, that the route from stimuli to sensation is in part conditioned by education.

T. S. Kuhn, *The Structure of Scientific Revolutions* (1967)

12.1 Efficiency and effectiveness studies

A subject that is different, but relatively close to measuring IT benefits, is that of conducting value for money (VFM) and health check review (HCR) studies of the information systems department. These are very large subjects in their own right, and this chapter provides a brief overview of the area.

The aim of a value for money study is to establish whether the ISD is functioning efficiently, and whether the amount being spent on the department is proportionate to the service level being obtained. Questions such as 'Is the IS management making the most of the funds invested?', or 'Can the organization obtain the same service cheaper?' are asked. A value for money study may also ask if different ways of managing the ISD could be applied, so that a better level of service will be obtained for the same expenditure. Thus value for money studies often attempt to identify opportunities for improvements and areas for general cost saving. Furthermore, pending resource requirements are often addressed in a value for money study to see if there is any way of minimizing, or simply reducing, this expenditure. In fact, a value for money study can address any of the operative issues faced by the ISD.

Some value for money studies extend beyond considerations of the efficiency of the ISD to also look at the effectiveness of the information systems function. Such studies are usually much more extensive than the relatively straightforward efficiency reviews. Effectiveness studies are sometimes referred to as health check reviews and focus on strategic issues as well as operational issues. Therefore, an HCR requires a much broader view of the organization and the role that the ISD plays.

12.2 A value for money study

It is important to establish that a value for money study is not simply an audit. The term audit has a very negative connotation and can produce very unusual behaviour in those members of staff who feel threatened by an external inspection. A value for money study is aimed as much at highlighting areas of excellence, as identifying those areas requiring remedial action. The study includes a discussion of the many different ways in which an ISD may be improved, and the selection of the most practical and cost-effective way of so doing with relation to the organization in question.

The deliverables of a value for money study *inter alia* include:

1. A balanced report presented as objectively as possible highlighting the strengths and weaknesses of the ISD
2. A better idea of how to use the resources available to the ISD
3. A clearer idea of what the ISD budget can actually buy
4. A more motivated ISD management team who, as a result of participating in the study, have been highly involved in assessing their own work and that of their colleagues
5. A top management team who are likely to better understand the challenges faced by their ISD
6. A list of action points

VFM studies may be conducted either internally, i.e. by the organization's own staff, or by external consultants.

There are a number of different approaches to value for money studies adopted by the large consultancies offering their own proprietary methodologies. Organizations who wish to conduct their own VFM studies should establish their own structured methodology before commencing.

If it is decided to use outside consultants to perform a VFM study, this must be approached in such a way that ISD personnel do not feel threatened. Failure to achieve this will lead to misinformation and inaccurate information being supplied. The most successful approach seems to be to use small teams involving both external consultants and selected internal personnel.

12.3 Setting up a value for money study

Once the study team has been selected, the first step is a meeting to agree the objectives and the scope of the study in direct relation to the organization. Furthermore, the resources available for the study and the timescales must be clarified, and the deliverables defined. A team leader should also be appointed at this initial meeting. This should be someone from within the organization who will be responsible for coordinating the work of the study with the other team members.

In defining the objectives, four main questions feature:

1. Is the ISD providing value for money?
2. Are pending resource requirements for the ISD reasonable?
3. What opportunities exist for cost savings, improved efficiency and effectiveness?
4. What is the ISD doing especially well and how can this excellence be extended?

The precise scope of the study categories will vary extensively depending on the organization, but there are 12 identifiable areas that can be considered when setting up a study:

1. Hardware
2. Software
3. Staffing
4. Service levels
5. Security
6. Technical support
7. User support
8. Costs and charges
9. Application systems development
10. Networks
11. Integration with the rest of the organization
12. The information systems plan

The resources available for the study in terms of access to people, documentation, equipment, etc. must be clarified. In addition, the overall timescale for the study must be clearly identified. A traditional approach to performing value for money studies is for the study team to examine documentation, interview personnel and generally to observe the function of the ISD. Progress meetings will be necessary to review the ongoing progress of the study and to discuss the results to date. A time limit should be set for completing personnel interviews, reviewing documentation and other procedures, and progress meetings should also be scheduled from the outset. This enables a date to be put on the submission of the final report.

In the setting-up stage of the study, the required presentation approach for the deliverables should be agreed. This should include a succinct management report of the findings and recommendations of the study. The first part of the VFM report should provide an assessment of the current situation, whereas the second part of the report will focus on an action plan indicating how the performance of the IS function may be improved. Where necessary, appendices may be attached showing results of the analysis used to support findings and recommendations. In addition, an action plan should be provided with definitive practical suggestions for improved cost effectiveness and department efficiency.

12.4 Detailed planning of the study

The operational issues listed in the scope of the study incorporated most of the areas that an ISD might be involved with. This list will vary to some extent from organization to organization, and the study must be structured to meet the specific needs of the organization.

The following subsections indicate the type of information that the study team should aim to derive within each of the scope categories. In every case, having collected and analysed the information, an indication as to how well the ISD function is operating in that area should be reported, together with suggestions for improved cost effectiveness and efficiency. By the end of the study a pattern should develop which will show the broad areas where most improvement can be gained.

12.4.1 Hardware and software

It is important to determine exactly what hardware and software exists, and what is in use, in the organization. This will, in most cases, involve personal computers on the desks of end-users, as well as the equipment under the direct control of the data processing department. The range of hardware configurations and versions of software in use should be established. In many cases this is a non-trivial task and the establishment of a hardware and software asset register is a key component in any VFM study. Other aspects of the hardware and software inventory include what software is installed on machines, but not actually used by the user? What is the future plan for hardware and software growth? What is already on order, and what capacity planning techniques are employed? How effective is the data processing function?

If possible, existing statistics should be reviewed, and an indication as to the relevance and application of current configurations with relation to workload should be established. Performance monitoring tools may already be in use, and if so, data from these should be analysed to suggest the value for money currently being obtained. Other monitoring and modelling procedures might be suggested by the study, which could enhance cost effectiveness.

The areas of hardware and software maintenance should be addressed. How much of this is outsourced and how much is performed internally? The study should examine the approach currently employed by the organization and comment on the cost effectiveness of this approach.

12.4.2 Staffing

A headcount of ISD staff should be taken, as well as an organization chart for the department. ISD staff placed in user departments must also be counted. Manpower planning procedures should be examined in relation to the current workload. It may also be useful to perform a study of the current working practices and conditions. This will involve reviewing rates of pay, leave entitlement, as well as training commitments. In so doing, 'good practice' may be identified and recommendations provided as to how these may be implemented. The question of analyst, programmer and operator productivity must also be addressed, as well as the staff involved in data entry, data validation and information distribution. Key performance indicators should be identified for use in comparability studies in order that future objectives may be set and improvements be monitored.

12.4.3 Service levels

This involves looking at the current agreements and commitments that the ISD has to clients in terms of turnaround times, response times, availability, etc. If a service or help desk exists, its efficiency in terms of staffing and response time should be examined. What tools for recording problems and solutions are used? It may be appropriate to suggest the creation of such a service if it has not already been established. As even quite small organizations can benefit enormously from the introduction of sound service level agreements, this area is frequently given considerable attention.

12.4.4 Security

The study should examine all levels of computer related security, including physical access as well as controls over input, processing and output procedures.

How computer security fits in with the general security of the organization should be examined, and where the responsibility for security lies will be important. Physical access covers both controls over access to the premises, as well as to machines, software and data. Special attention to the control of operating software should be given. What, if any, written procedures are there, and what happens in actual practice? How does the organization intend to minimize attacks from hackers and viruses? Potential problem areas should be highlighted. If the company has a disaster recovery plan, this should be reviewed and the methodology used compared to others. The cost effectiveness of this and alternative approaches can then be assessed.

12.4.5 Technical support

The present practices and procedures should be reviewed. This will include looking at how hardware and software upgrades are handled, what standardization is in place and how this can be improved. The commitment to training from the ISD should be examined as efficiency can be greatly enhanced if users are properly trained in the applications they should be using.

12.4.6 User support

How much support do users feel they get from ISD and how approachable do they feel ISD personnel are? Are requests dealt with promptly and sympathetically? Consider establishing departmental 'gurus' to filter trivial problems away from ISD.

12.4.7 Costs and charges

The costs incurred in the IT area by the organization should be assessed and areas for potential savings highlighted. It is important that IT services are charged for. This implies that all IS users should have a budget and a certain degree of discretion as to how to spend it. Charging formulae should be evaluated together with algorithms for efficiency and fairness.

12.4.8 Application systems development

Examine the standards and methodologies currently in use for systems development and ongoing maintenance. Are CASE tools or other development aids being used? Evaluate the efficiency and effectiveness of these procedures. Compare the perceptions of the systems as seen by the users, user management and development staff. Derive a satisfaction quotient.

12.4.9 Networks

Examine the current design and configuration of online networks in terms of cost effectiveness and efficiency. Determine whether alternative approaches such as PC networks could be applied, whether networks have enough capacity and are performing to an efficient level. What is the loading and the downtime of the network and can this be improved? How many users are currently connected and can this be increased? If the organization has not established a policy to network PCs, this is a potential area for dramatic cost improvements as software, data and peripherals can be shared and accessed more readily.

12.4.10 Integration with the rest of the organization

The study should clearly establish the relationship of the ISD to the rest of the organization. A review of the history of the department, its workload growth, reorganizations, management changes, etc. is useful. Who is responsible for communicating with other departments within the organization as well as with clients and suppliers? What is the reporting hierarchy within the ISD and to the rest of the organization?

12.4.11 The information systems plan

If the organization has undertaken the development of a strategic information systems plan (SISP), this will provide important information for the VFM study. The plan should be examined to see how many of the recommendations therein are in practice, and how successful they are. Has the information systems plan been linked to the overall corporate plan of the organization? What monitoring of the plan has taken place and what results have been attained?

12.5 Analysing the results

The performance of the ISD in each of the categories may be assessed on a scale of perhaps four points. Such a scale would have the categories: excellent, good, poor and very poor, where 4 is excellent, 3 is good, 2 is poor and 1 is very poor. The scores could be derived by averaging views obtained at interviews, or by collecting data using a questionnaire. Table 12.1 shows the results of a study showing a relatively high VFM, and Table 12.2 represents the results of a study showing a low VFM.

Table 12.1 Results of a high VFM study

Hardware	3.2
Software	3.4
Staff	3.6
Service	2.8
Technical support	2.9
User support	1.9
Costs	3.9
Applications	2.9
Networks	3.5
Security	2.1
Integration	2.8
IS planning	2.8

Table 12.2 Results of a low VFM study

Hardware	2.4
Software	2.3
Staff	2.9
Service	0.9
Technical support	2.2
User support	1.5
Costs	0.9
Applications	2.8
Networks	3.5
Security	2.1
Integration	2.2
IS planning	1.8

The results of the scores may be presented in a number of different ways. One method of presentation, is that of a wheel diagram. In Figure 12.1 this concept has been adopted to accommodate the 12 scope categories using the ratings

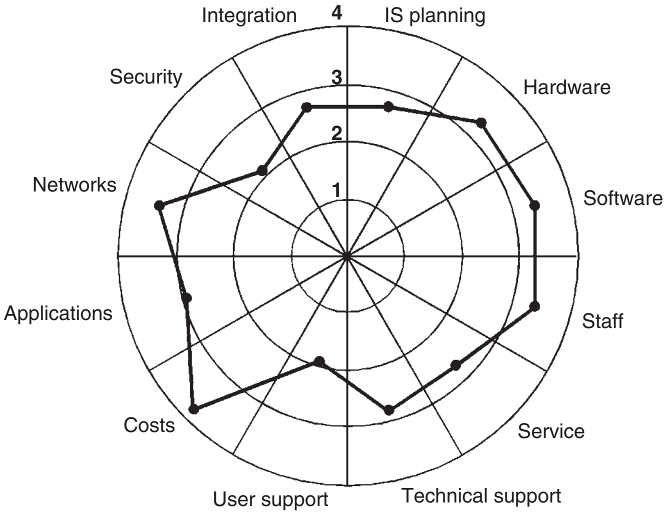

Figure 12.1 Wheel diagram showing high VFM

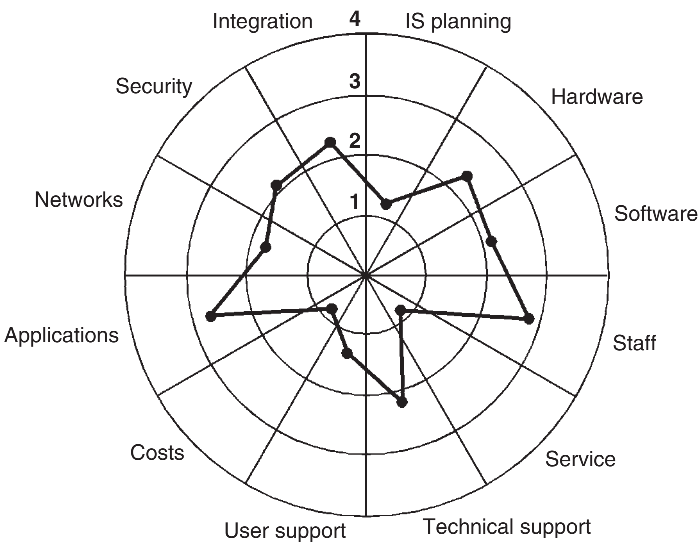

Figure 12.2 Wheel diagram showing low VFM

shown in Table 12.1. Figure 12.2 uses the data from Table 12.2. The area of the polygon produced by joining the scores is a reflection of the VFM the organization receives. If the area is large the VFM is considerable, whereas if the area is small the VFM is low.

12.6 A list of action points

A VFM study must indicate how the performance of the ISD may be improved and this should be expressed through a list of action points. These may address such issues as:

- Increasing/decreasing the staff complement
- Replacing hardware/software
- Initiating training programmes
- Implementing additional security procedures
- Initiating strategic information systems planning
- Controlling end-user computing

The amount of detail that will be supplied with the action points will depend upon the terms of reference for the study. In some cases, the detail may be minimal, whereas in others the action points may be very specific.

12.7 A health check review (HCR) study

Most of the topics discussed so far have been looked at from the point of view of assessing the level of efficiency in the ISD. Thus, the main focus has been on operational issues. In some cases, it can be useful to the organization to measure the value for money they are getting from an effectiveness viewpoint. In this case, a more strategic view of the IS function is required.

Research has been conducted by the National Computing Centre (NCC) in a number of large UK establishments, with the aim of discovering how effective IT is in their organizations and how this can be improved. They defined effectiveness as the contribution made by the IS function to the organization's objectives and the organization's performance. Some aspects of the NCC study are described here to indicate how extensive an HCR study may be.

12.8 NCC HCR study

The main aim of the study was to define and measure what is meant by IT effectiveness. This was addressed by considering the following three key questions:

- What are the most important elements in effectiveness?
- How should each be defined?
- On what scale can each be measured?

The study was highly participative, comprising reviews, seminars, research projects, chief executives' conference, as well as regular reports of the findings. Participants in the study decided for themselves the subjects to be covered in seminars and briefings, arising from the findings of the reviews.

In order to approach these issues in some kind of structured way, the study prepared a pilot review of the IS function. Feedback from the pilot produced a second-generation set of questions, which formed the basis of a review procedure that could be applied and compared to each of the participating organizations.

The resulting review procedure was based around the following 12 elements of effectiveness, which were grouped under three headings of IT Policy, IT Contribution and IT Delivery. Each of the 12 elements had a definition and a list of issues to be discussed with each organization during the review process.

IT Policy

- Corporate IT strategy
- IT planning and management
- IT investment
- IT budgeting

IT Contribution

- Customer relations
- Supply of IT services
- Evaluation of existing systems

IT Delivery

- Technology strategy
- Development planning
- Operations planning
- Human resources strategy
- Quality strategy

From an independent assessment by a consultant, a qualitative scale of measurement was produced, consisting of five statements reflecting the level of sophistication, where A represented Advanced Practice and E represented Unsophisticated Practice. Ratings B to D represented points in between. The researchers emphasize that these results should not be taken purely at face value, seeing A as good and E as bad, but rather as a basis for discussion and refinement of the process.

An enhanced wheel or web diagram could then be produced giving a profile of each participant's response to the 12 elements. Figure 12.3 is an example of such a diagram. It does not reflect a particular participant in the study but rather an average for a group.

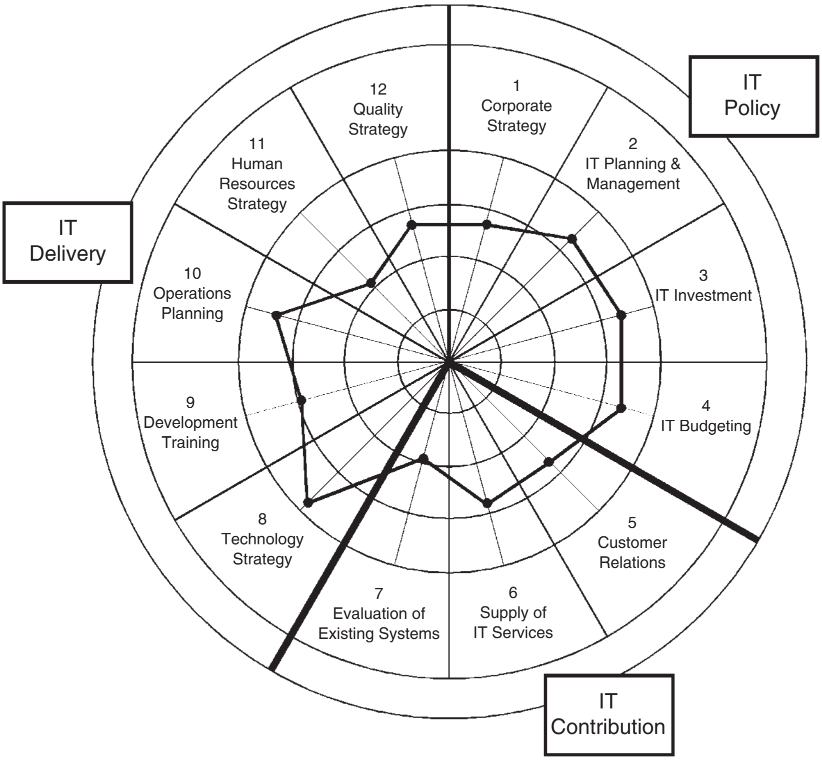

Figure 12.3 Wheel diagram showing 12 review elements

Although the individual results for each organization were confidential, Table 12.3 shows an example of the type of statements associated with the ratings.

Table 12.3 Details of corporate IT strategy

Most advanced performance found:	IT and corporate strategies are closely integrated with effective feedback achievements.
Median performance:	Corporate and IT strategies are related but not integrated.
Least advanced performance:	Corporate and IT strategies are loosely linked.

The results of the reviews produced a number of significant points:

1. A set of definitions and measurements were produced which could be used to test effectiveness. Participants in the study saw how they measured on a number of key issues alongside other partners. The following quotations are typical:

   In our relationships with our customers, our practice is among the most advanced in the Joint Venture.

   We thought we were doing a sound job on development planning, but most of the Partners are further advanced than us.

   None of the Partners really has a handle on quality strategy; we are not alone.

   The identification and presentation of best practice in information management has given us a standard to aim at.

2. A series of recommendations for each of the participants was produced. These provide an objective base for internal discussions on how the effectiveness of the IS function can be improved.
3. The reviews highlighted differences between participants' individual preoccupations and the current fashions. For example, fashionable IT issues included: using IT as a strategic weapon, user friendliness and open systems. None of the participants considered these as a preoccupation.
4. Most organizations were still in the infrastructure phase, by which is meant automating clerical and routine operations, creating a communications network and establishing a base of routine transaction data. The IS department is forming a platform of understanding, confidence and comfort for users and, more importantly, for top management and line management. Superstructure refers to the adventurous, risk-taking, act-of-faith type of IS. Without substantial success on the infrastructure side, superstructure cannot be properly addressed.
5. The reviews showed that best practice is culture dependent. In a high-tech environment, where the top management are interested and involved in IS, performance expectations are different to those organizations where top management are more involved in other issues.

The key issues for continued study as seen by the participants themselves were stated as:

- Effectiveness as top management see it
- Developing the definition and measurement of effectiveness
- Linking IS and corporate strategies

- Sharpening and promulgating IS policies
- Human resources
- Quality

12.9 Summary

Value for money analysis is a key issue. Studies should be conducted on a regular basis, perhaps every two or three years. Using, at least partially, external consultants is recommended in order to retain a level of objectivity. The results of a VFM study should be presented to top management in order that findings can be incorporated into the ongoing development of the ISD. VFM analyses are operational in nature and if strategic issues are to be included, then an HCR is required. These studies are much more comprehensive.

13

Designing IT surveys for benefit measurement

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All we can expect from one another is new and interesting information. We cannot expect answers. Solutions, as quantum reality teaches, are a temporary event, specific to a context, developed through the relationships of persons and circumstances.

Margaret Wheatley, *Leadership and the New Science* (1992)

13.1 Introduction

In order to measure IT effectiveness, most firms will need to administer a survey to staff, suppliers and customers/end-users. To do this, considerable knowledge and skill relating to survey design, sample choice, etc., is required. If handled correctly, a survey can provide detailed information about systems effectiveness, but conducted poorly, the survey may be useless and a complete waste of time and money.

It is not possible to describe a single, concise way in which to conduct a survey using questionnaires. There are many different approaches to a survey, and the appropriateness of the approach is entirely dependent on the particular circumstances being addressed. Furthermore, survey design is still regarded as more of an art than a science. Unfortunately, much of what has been written about survey design has been in the form of admonishments. The focus has been predominantly on what not to do rather than on those things that will help.

It is generally agreed that each study using questionnaires is unique. Therefore, every study requires that a questionnaire be specifically designed to fit the study's peculiar needs.

In designing a survey there are three main issues to consider. These are:

1. The survey method
2. The sampling scheme
3. Questionnaire design

Each of these components interacts with the others. In the following sections each will be discussed separately and the links that exist should become evident.

13.2 What is a survey?

A survey is a procedure for collecting information from individuals. The information sought can range from general background information such as age, income, size of the firm, the major areas of work of the firm and the location of the firm, to that relating to beliefs, feelings, attitudes, lifestyles and intentions, etc. Methods for obtaining such information usually fall into two categories, namely self-completion and interview administered. Self-completion methods include mail surveys, computerized surveys and so-called on-board or in-company surveys. Interview administered surveys include personal interviews, telephone and in-company/on-board surveys.

Each method possesses advantages and disadvantages. They do, however, all depend on the basic assumption that individuals subjected to questioning will be both willing and able to give truthful answers to the questions posed.

13.3 Approaches to data collection

13.3.1 Mail surveys

This method involves mailing the questionnaire to predetermined respondents with a covering letter. This form of survey is only necessary if there are many information system users and they are spread widely around the country or world.

Arguments for this method are that it allows a large sample, with wide locational coverage, to be easily obtained at a relatively low cost. Furthermore, it allows respondents to complete the form at their own pace and also ensures that they are free from being influenced by the interviewer. Generally speaking, these samples are easy to select.

Arguments against this method include the need for a very simple questionnaire, possible biased responses and the low response rate. Many suggestions for improving the response rate have been put forward. A good covering letter, follow-up questionnaire or reminder can boost response and so can the offering of incentives. Also, the problem of bias can be addressed through interviewing a small sample of non-respondents, or by comparing early returns with the returns from the follow-up questionnaire. The comparison is usually made on characteristics considered important to the study.

Typical response rates for this type of survey range from 1% to 60%.

13.3.2 In-company/on-board surveys

These surveys are carried out, for example, on board aircraft, in classrooms or in-company. In the information systems users' environment it may be possible to approach a group of IS users in the canteen, or perhaps a departmental head could be asked to bring his or her staff together for 25 minutes to fill out a questionnaire.

Arguments for this approach include that it provides a quick and cheap way of obtaining a large sample. This is because there is a captive audience. These surveys can be either interviewer or self-administered.

Arguments against this approach are that it invariably only includes users and that there may only be limited time available.

Typical response rates for this method range from 35% to 75%.

13.3.3 Telephone surveys

This method is a low cost form of personal interviewing which can be used to obtain information quickly. With a small number of users this is a fairly practical way of being able to collect data. Of course, if the users are spread around the country, Europe, or the world, telephone costs can be very substantial and, therefore, a major consideration against this approach.

Arguments for this method are that it is a good compromise in that it combines personal contact with cheapness and wide coverage; it provides information quicker than face-to-face interviewing and mail questionnaires; and it is easy to supervise the interviewing process, thereby reducing interview error.

Arguments against this method are that the telephone interview must be short; that it could be biased since it is limited to listed telephone owners; and that it could be expensive. A way in which this bias is overcome is through digit dialling. One such scheme is the so-called Plus-One sampling where a single, randomly selected number is added to each of a randomly selected sample of telephone numbers chosen from the telephone directory.

Typical response rates for this method range from 35% to 75%.

13.3.4 Personal interviews

This method requires a face-to-face conversation between the interviewer and the respondent. This approach is widely used in marketing research.

In the information systems users' environment, personal interviews are frequently used, especially to canvass the opinions of the decision makers. It is an expensive means of collecting data in terms of time and money and therefore cannot be used with large groups where telephone or mail surveys are probably more appropriate.

The main argument for this approach is that in a long interview it is possible to probe complex issues that can be carried out in a relaxed atmosphere, developed by the interviewer. This should ensure a good quality response.

Arguments against this approach include the high amounts of time and cost involved. There is also the possibility of interviewer bias, and the difficulty in targeting users.

There are many factors that can influence the response rate but typical response rates for this method are between 50% and 80%.

13.3.5 Computer surveys

Where firms have electronic mail already established, a survey can be conducted across the network. This allows for instant data collection and summarization. It is a relatively inexpensive method, easy to conduct and growing in popularity.

Arguments for this approach are that there is no need for printed questionnaires; interviewer bias is eliminated; checks can be built in so as to minimize response bias and optimize response consistency; and instantaneous analysis of the data is possible.

Arguments against this approach are that the design and programming of the questionnaire is likely to be a complex business involving considerable time and money up front; also respondents are restricted to e-mail users.

13.4 Sampling

All surveys require the selection of those individuals who are to provide the information. This set of individuals is called the sample. The sample comes from some much larger group of individuals or objects called the target population. The target population referred to as the *population* in the sequel is that group about which it is intended to make generalized statements based on the sample findings. The sample is ideally chosen so that no significant differences exist between the sample and the population in any important characteristics. In other words, the sample serves as a model for the population, and thus, from a statistical analysis of the sample data, it is possible to generalize to the whole population with a specified degree of confidence.

Sampling might be carried out in order to save expense (it would be impossibly expensive, as well as unnecessary, to carry out an opinion poll among the whole electorate). Using a sample also enables results to be obtained more rapidly.

Sampling has problems. It must be ensured that the sample is representative of the whole population, or the results will be biased and therefore will not be applicable to the whole population. For example, an opinion poll carried out by knocking on doors in the afternoon is likely to result in a lot of people who work during the day being missed. If interviews are conducted in the canteen at lunchtime, staff who do not go to lunch will be missed. Similarly, the findings from interviewing accounting practices of 20 or fewer partners, with respect to software usage, cannot be extrapolated to larger accounting practices. Whether a sample is considered representative or not is a subjective assessment by those carrying out the survey or those using the results of the survey.

Sampling also has problems of variability. Even if great care is taken to avoid bias, the sample will never be exactly like the population. If another sample were chosen in exactly the same way, it would be different. This places a limit on how accurate the sample can be, and therefore how accurately statements can be made about the population.

13.4.1 Choice of sampling frame

The sampling frame is a comprehensive list of individuals or objects from which the sample is to be drawn. For example, the membership list of a major association of data processing professionals or, perhaps, the membership list of the Institute of Chartered Accountants in England and Wales (ICAEW) could form the sampling frame. Other examples of sampling frames are the postal address file, the electoral register, the telephone directory and companies listed on the London Stock Exchange.

In practice, the findings of a simple up-to-date list are highly unlikely. Combining more than one list can possibly help improve matters.

13.4.2 Types of sample

Sampling techniques fall into two broad categories, namely non-probability samples and probability samples.

For a *non-probability sample* there is no way of estimating the probability of an individual having been included in the sample. Such a sample can occur when individuals are included in the sample on a 'first arrive first questioned basis' and as a consequence, it is not possible to ensure that the sample is representative. Examples of non-probability samples include *convenience samples, judgement samples* and *quota samples.*

In *probability sampling* each individual has a known, not necessarily equal, probability of being selected. Examples of probability sampling include *simple random sampling, systematic sampling, stratified sampling, cluster sampling* and *multi-stage sampling*. Probability samples can be rigorously analysed by means of statistical techniques, whereas for non-probability samples this is not possible.

13.4.3 Non-probability sampling

In non-probability sampling the subjective judgements of the researchers are used in selecting the sample. Clearly, this could result in the sample being biased. Non-probability samples are particularly useful in exploratory research. The more popular non-probability sampling methods are described below.

Convenience samples comprise those individuals that are most readily available to participate in the study. Such samples are extensively used in business school research, where the sample often comprises a group of MBA students or executives attending post-experience courses at the time the research is being undertaken.

Judgement samples, also called purposive samples, are samples where individuals are selected with a specific purpose in mind. The composition of such a sample is not made with the aim of it being representative of the population. Such samples comprise individuals considered to have the knowledge and information to provide useful ideas and insights. This approach is extensively used in the exploratory research stage and is invaluable in ensuring a 'good' final questionnaire.

Quota samples are selected so that there is proportional representation of various subgroups (or strata) of the target population. The selection of individuals to be included in the sample is done on a convenience basis. The interviewer is given information on the characteristics of those to be included in the sample, but the selection is left to the interviewer's judgement.

13.4.4 Probability samples

In obtaining a *probability sample*, use is made of some random procedure for the selection of the individuals or objects. This is done so as to remove the possibility of selection bias.

In *simple random sampling* each member of the population has an equal chance of being selected. Numbering individuals in the sampling frame and then selecting from these by some random procedure can achieve this. An example of such a sample is a questionnaire mailed to say 600 information systems executives chosen at random from a mailing list of 3000 executives.

A *systematic sample* is selected from the sampling frame of size N in the following manner. Having decided what size sample n is to be selected from the sampling frame, calculate:

$$\left[\frac{N}{n}\right] \text{ where [ ] denotes the largest integer } I \leq \frac{N}{n}$$

Now select a random number i, say, in the interval $1 \leqslant i \leqslant I$. The sample size n then consists of the ith, $(i + I)$th; $(i + 2I)$th, etc., up to the $(i + (n - 1)I)$th item from the sampling frame.

Should there be some pattern present in the sampling frame, then such samples will be biased. For example, a systematic sample from the daily sales of a supermarket could result in picking out sales figures for Saturdays only.

In *stratified sampling* the population is subdivided into homogeneous groups, called strata, prior to sampling. Random samples are then drawn from each of the strata and the aggregate of these forms the stratified sample. This can be done in one of two ways:

- The overall sample size n can comprise items such that the number of items from each stratum will be in proportion to the size of the stratum.
- The overall sample size can comprise items from each stratum where the number of items from each of the strata are determined according to the relative variability of the items within each of the strata.

The first approach is the one invariably used in practice.

In *cluster sampling*, the population is made up of groups, called clusters, where the clusters are naturally formed groups such as companies, or locational units.

A cluster sample from a large organization could be achieved by treating the various departments of a company as the clusters. A random sample of departments could then be chosen and all individuals in the departments sampled. In other words a census of the selected departments (clusters) is performed.

An extension of cluster sampling is *multi-stage sampling*. The simplest multi-stage sample involves random selection of the clusters in the first stage, followed by a random selection of items from each of the selected clusters. This is called two-staged sampling. More complex designs involve more than two stages. For example, in selecting a sample of accounting software users in accounting practices in England and Wales, a random sample of geographic areas may be made from the ICAEW membership list. Then, from within the areas, a number of accounting practices may be randomly selected, and finally, in the third stage, a random sample of software users is selected from each of the previously selected practices.

13.4.5 Size of sample

Determination of the sample size is a complex problem. Factors that need to be taken into consideration include: type of sample, variability in the population, time, costs, accuracy of estimates required and confidence with which generalizations to the population are made.

There exist formulae for computing sample size, which are based on sound scientific principles. These were briefly considered in section 13.4.4.

In practice, the sample sizes resulting from the application of the formulae are not slavishly adhered to and are frequently ignored. In fact, the sample size chosen tends to be one that fits in with company policy or is regarded as credible because it has been used by others conducting similar studies in the past. Such an approach is acceptable (Lehmann 1989).

13.4.6 Statistical determination of sample size

This section describes two situations encountered in practice, namely, how to determine the sample size for estimating a population mean to a specified margin of error, or accuracy, with a specified level of confidence; and how to determine the sample size needed to estimate a population proportion (or percentage) to a specified margin of error, or accuracy, within a specified level of confidence.

These formulae only apply for probability samples taken from a very large population where the sample will be less than 10% of the population. Sample size calculations for more complex designs can be found in Lehmann (1989).

13.4.7 Sample size to estimate the mean

Suppose you wish to estimate the true average of a system's response time. In order to estimate this, a random sample of response times is taken and the average of these used to estimate the system's actual mean response time. The question now addressed is, what size of sample is needed to be 95% confident that the sample mean will be within E units of the true mean, where the unit of measurement of E can be in, say, seconds or minutes? E is therefore the accuracy required from the estimate. The sample size is given by:

$$n = \frac{3.84\sigma^2}{E^2}$$

where σ is the population standard deviation of response times and 3.84 is the constant derived from the normal distribution ensuring a 95% confidence level. In practice σ is inevitably unknown and will have to be estimated. This can be done by using response times for a pilot sample of size n_p, say, in the sample standard deviation formula:

$$S = \sqrt{\frac{1}{n_p - 1}\sum (x_i - \bar{x})^2}$$

where x_i is the n_p pilot response time, and x is the numerical average of the sample response times.

A simpler approach, often used, is to estimate σ from the range of the pilot sample values. This is done according to the following formula:

$$S = \frac{\max(x_i) - \min(x_i)}{4} = \frac{\text{Range}(x_i)}{4}$$

Some texts recommend dividing the range by 6. This is likely to result in an underestimate of σ since pilots usually involve small samples. Of course a purely subjective estimate of σ is also possible.

Should it be required to estimate the mean to the same accuracy E as before, but now with a confidence level of 99%, then the sample size is given by:

$$n = \frac{6.66\sigma^2}{E^2}$$

where 6.66 is the constant derived from the normal distribution ensuring a 99% confidence level and σ can be estimated as described above.

13.4.8 Sample size to estimate a percentage

Suppose you wish to estimate the actual percentage, p, of your customers who purchase software from a competing company. Suppose further that you require to know what sample size is needed to be 95% confident that the estimate of p resulting from the sample will be within E% of the actual percentage, p:

$$n = \frac{3.84p(100 - p)}{E^2}$$

The caveat in this case is that p is not known, as it is the parameter being estimated. In practice the value of p used in the above formula can be estimated in a number of ways. It can be estimated subjectively, or from a pilot sample or taken to be 50%. The latter results in the most conservative sample size estimate.

For a 99% confidence level:

$$n = \frac{6.66p(100 - p)}{E^2}$$

where p can be estimated as described above.

13.4.9 Sample size correction factor

As previously stated the above formulae hold strictly only should the target population be infinite, and will provide good approximations should the calculated sample size n be small relative to the target population size N. By small we understand the sample size to be 10% or less of the population size. That is,

$$\frac{n}{N} \times 100 < 10\%$$

In situations where the sample size (n), as determined by the formulae above, exceeds 10% of the population size (N), n has to be adjusted downwards by applying a sample size correction factor (see Lehmann 1989, p. 301). In this case the required sample size n' is given by

$$n' = n \times \frac{N}{N + n - 1}$$

where $(N/(N + n - 1))$ is the sample size correction factor. Thus use of the sample size n' will provide the desired accuracy E.

The need for correction often arises in practice. For example, it is likely to occur should a firm decide to conduct an internal survey among staff using the computer network. In practice, all that needs to be done is to apply the sample size calculation under the infinite population size assumption and then should $((n/N) \times 100)$

be greater than 10% the calculated sample size n has to be multiplied by the sample size correction factor.

Another situation that arises is the need to calculate the accuracy E', say, associated with a specific confidence level given a sample size n'.

For estimating the percentage accuracy associated with 95% confidence and sample size n':

$$E' = \sqrt{\frac{3.84P(100-P)}{n'} \times \frac{N-n'}{N-1}}$$

and for estimating the accuracy of the mean associated with 95% confidence and sample size n':

$$E' = \sqrt{\frac{3.84\sigma^2}{n'} \times \frac{N-n'}{N-1}}$$

Examples of the application of these formulae can be found in Appendix E.

Sample size calculations for more complicated sampling schemes (e.g. stratified sampling) can be found in Lehmann (1989) and Churchill (1994).

13.5 Questionnaire design

A questionnaire is not just a list of questions to be answered. It has to be designed with specific objectives in mind and is essentially a scientific instrument for measurement of the population characteristics of interest.

In designing the questionnaire consideration must be given to such issues as (Churchill 1987):

- What does the firm want to achieve with the results of the questionnaire?
- What information is sought?
- What type of questionnaire will be used?
- How will the questionnaire be administered?
- The content of individual questions
- The type of response required to each question
- The number of questions to be used
- The manner in which the questions are to be sequenced
- After testing, by means of a pilot study, what revisions are needed?

Some of the above issues were dealt with in previous sections.

13.5.1 Prior to the main survey

The main survey makes use of a questionnaire comprising mainly structured pre-coded questions. The construction of the main questionnaire is generally preceded by some qualitative or exploratory research involving the use of such informal techniques as unstructured interviews, brainstorming and focus groups. These activities include group discussions addressing many open-ended questions. These activities combine not only to 'firm up' the study objectives, the method of data collection, and the definition of the target population, but also help identify appropriate questions to include in the survey and help ensure that the various concepts used in the survey are properly defined. A first draft of a questionnaire should then be tested by means of a pilot survey. Pilot surveys are used to test the structured pre-coded questions. It may include some open-ended questions.

13.5.2 Things that help

A good starting point is to have clear terms of reference and objectives for the study, and to have made a thorough study of past surveys similar to the one being undertaken. In designing the questionnaire, consideration should be given to composing a good letter of introduction, the offering of incentives such as a draw for a magnum of champagne, an attractive design, using no jargon, together with an easy to understand and relevant wording of the questions.

Also important is the sequencing of questions. This should be done so that the demographic and other potentially embarrassing questions are placed at the end of the questionnaire. Also, questions on the same topic should be kept together. The opening questions should be carefully designed so as to ensure the respondent's early cooperation, thereby increasing the chances of obtaining truthful and quality responses to all questions.

Pilot surveys are essential. Authors of questionnaires can never rely on knowing how clear a question is. This can only be established through pilot studies, which should be completed by a range of possible respondents, including those least familiar with completing questionnaires. Every single question should be examined on the basis of how the answer will lead to a better understanding of what is being studied.

Questions that do not contribute to the specific objectives of the study should be removed. Furthermore, more sophisticated surveys may involve complicated terminology and concepts that could mean different things to different people. In such cases precise definitions of these concepts must be provided.

Special attention should be given to the inclusion of demographic and usage questions so that adequate segmentation and cross tabulation can be performed. For example, of especial importance in ICT studies is knowledge of who are the extensive users, minimal users and clerical users.

13.5.3 Things to avoid

The design should ensure that the questionnaire is not unduly long. Mail questionnaires requiring more than 15 to 20 minutes to complete are likely to have a dramatic impact on the response rate. Further, the design should ensure that there is no vagueness in the questions posed, that there are no loaded or leading questions, no double-barrelled or double negative questions, no one-sided questions and not too many open-ended questions. Good quality responses to open-ended questions require the respondent to be articulate. Also, such questions are difficult to code for computer analysis. These two factors combine to produce problems in analysis and summarization. The questions should not be too complex or involve concepts that are likely not to be clearly understood. Where jargon has to be used it is essential to supply a detailed glossary. Should the questionnaire involve branching type questions, then the branching instructions must be clear so as to ensure that the respondent does not become confused.

13.5.4 Techniques for questioning

The manner in which questions are structured, ordered, presented and coded can affect the response rate and the quality of response, make accurate data capture easy and facilitate statistical analysis. Some of the ways in which this is done are set out below.

For more detailed discussions on this topic, the reader is referred to Churchill (1994), Dillon *et al.* (1987), Lehmann (1989) and Parasuraman (1991).

13.5.5 Sequencing of questions

It is generally agreed that the best way in which to order the questions is to place general questions first, specific questions next and attitudinal questions later. Hard questions should be placed fairly early interspersed with easy questions. Further, there is a need to ensure that the questions are structured in such a way that the respondent will find it easy to answer questions within a topic, and also not be burdened with questions that are irrelevant to him or her.

Funnel questions are used to sequence within a particular topic. For example, consider the sequence of questions:

Which of the following high-level languages do you use? (Please tick appropriate box)

Cobol ☐ Fortran ☐ APL ☐ C ☐ BASIC ☐

Which of the following high-level languages do you like most? (Please tick appropriate box)

Cobol ☐ Fortran ☐ APL ☐ C ☐ BASIC ☐

Which of the following high-level languages did you not use in the past seven days?
(Please tick appropriate box)

Cobol ☐ Fortran ☐ APL ☐ C ☐ BASIC ☐

In this type of question the respondent is guided from a general question to a specific question.

Filter questions are used to exclude the respondent from being asked questions that are irrelevant to him or her. For example, consider the question:

Do you ever use Cobol?
If YES: When did you last use Cobol?

Within last 10 days ☐ 11–14 days ☐ More than 14 days ago ☐

If NO: Why is that?

The above filter question also illustrates the use of what can be referred to as a specific time period question.

Specific time period questions are used to avoid memory problems with respondents. Consider the question:

How often do you use high-level programming languages? ☐

which is open ended and has no prompt, against:

When did you last use a high-level programming language? (Please tick appropriate category)

Within last 10 days ☐ 11–14 days ☐ More than 14 days ☐ Never ☐

13.5.6 Examples of pre-coded questions

Coding is the procedure for assigning numerical symbols to the categories or classes into which the responses are to be placed. This is usually decided when designing the questionnaire. For example:

Which of the following best describes your position in the management structure? (Please circle the appropriate number)

1 Upper
2 Upper middle
3 Middle
4 Lower middle
5 Lower

It is recommended that not more than six or seven categories be used. Also one must make sure that the categories fit, otherwise the respondent can become irritated.

13.5.7 Particular questions

The typology of data used in IS studies includes demographics, attitudes, beliefs, interests, preferences, product, software and systems usage, determinants of usage, perceived benefits and desired benefits. Below are examples of questions for some of these categories (see also Appendix F):

Demographic variables provide factual information about the individual or company and include information on:

- Industry in which the firm operates
- Number of IT staff employed in your firm
- Total investment in IT in the firm
- Degree of specialism of respondent (e.g. whether IS specialist or managerial user)

Socio-economic variables relate to the economic status of the individual or company. Examples of variables that reflect this include:

- Income
- Turnover
- Market share
- Profits
- Education
- Spend on IT training as percentage of annual income
- Position in the company
- Function within the firm

Attitudes relate to a latent state of mind, which in turn relates to feelings, which can subsequently influence behaviour. Attitude measurement is usually achieved by use of a five or seven point scale. For example:

(7) Strongly agree
(6) Agree
(5) Slightly agree
(4) Neither agree or disagree
(3) Slightly disagree
(2) Disagree
(1) Strongly disagree

Use of a scale with an odd number of points allows a neutral response. When using a five point scale leave out 'slightly'. Should it be desired to force the respondent to reveal his or her inclination, an even number of points is used. In the case of a five point scale leave out the 'neutral' category. Sometimes a four point scale is used. This can be achieved by leaving out the three central categories.

Example: *Attitudes*

To what extent do you agree that the following should be used by/introduced into your organization?

Use the scale:

(5) Strongly agree
(4) Agree
(3) Uncertain
(2) Disagree
(1) Strongly disagree

Q1 ☐ Computer assisted learning techniques
Q2 ☐ Public availability of financial information on public companies

Beliefs relate to an individual's subjective assessment, or opinion, of the likelihood of a statement holding.

Example: *Beliefs*

Indicate the strength of your opinion in terms of the use of your computer network if the following were available to you:

Use the scale:

(1) Very likely to use it
(2) Somewhat likely to use it
(3) Neither likely or unlikely to use it
(4) Somewhat unlikely to use it
(5) Very unlikely to use it

Q1 ☐ Access to the Internet through the system
Q2 ☐ Close collaboration with colleagues

What do you see as the main benefits of IT for your firm?

Use the scale:

(5) Very great benefit
(4) Great benefit
(3) Some benefit
(2) Little benefit
(1) No obvious benefit

Q1 ☐ Providing better management information
Q2 ☐ Improving access to external sources of information.

Incidentally, the above scale can be regarded as unbalanced in that the emphasis is placed on the extent of belief and is loaded towards the respondent indicating a degree of benefit. In the previous example the scale is regarded as balanced in that there are an equal number of negative and positive categories.

Usage of product/software/systems questions describe what is used, how it is used, the purpose of use, the benefit from use, the frequency of use, etc. Common variables include:

System used/planned to use
Usage rate of reports
Time between use
Satisfaction

Example: *Areas of use and amount of use*

Q1 In which areas do you use SIS (strategic information systems)?
(Please tick appropriate box)

☐ Sales and marketing systems

☐ Financial planning and mgmt systems

☐ Interorganizational systems

☐ Office automation

☐ Artificial intelligence-based systems

☐ Other (please specify)

Q2 How many hours per week do you use a workstation?

______ Hours

Q3 Of these hours what percentage (whole numbers) do you use the following?

_____ % Word processing

_____ % Spreadsheet

_____ % Database

_____ % E-mail

_____ % Time management

_____ % Other (please specify)

Example: *Benefit identification*

Q1 Can you cite an instance in which ICON can be directly credited with giving the firm a competitive advantage? (Please tick appropriate box)

☐ Yes
☐ No

If yes please give a brief description _______________

Example: *Satisfaction with software*

Q1 Look through the following list and state how satisfied you are with your firm's applications software in the following areas. Use the scale:

(1) Very dissatisfied
(2) Dissatisfied
(3) Not sure
(4) Satisfied
(5) Very satisfied

☐ Preparation of accounts
☐ Tax planning
☐ Stock control
☐ Payroll
☐ Novell network
☐ Other (please specify)

Determinants of use questions are included with the view to explaining behaviour relating to the use of products, software or information systems. Variables used include:

Knowledge and understanding of the system
Ease of use
Influence of others
Relevance of report contents

Information systems needs
Information systems capabilities

Example: IS *needs*

Evaluate how *important* you feel that each attribute is in ensuring that the overall computer-based system will be effective? Use the scale:

(1) Irrelevant
(2) Possibly useful
(3) Of some use
(4) Important
(5) Very critical

Q1 ☐ Availability and timeliness of report delivery
Q2 ☐ Communications between IS staff and managerial users.

Example: IS *capability*

Evaluate the degree of IS *performance* attained within your organization on the following scale:

(1) Very poor
(2) Poor
(3) Adequate
(4) Good
(5) Excellent

Q1 ☐ Availability and timeliness of report delivery
Q2 ☐ Communications between IS staff and managerial users.

13.6 Measurement scales

Section 13.5 revealed that the nature of data obtained from respondents is both qualitative and quantitative. Meaningful analysis requires that the responses be quantified.

There are four scales (or levels) of measurement that can be used. These are the nominal (or categorical), ordinal, interval and ratio measurement scales. Nominal and ordinal scales are often referred to as qualitative scales or non-metric scales. The interval and ratio scales are often referred to as quantitative scales or metric scales.

Nominal scales are used to identify the categories to which a respondent belongs. An example of such a scale can be found in Appendix G, question 1, where the response can be either yes or no. A nominal rating of '1' is assigned to a yes answer and a '0' to a no answer. A '1' therefore categorizes the respondent as 'having a formal procedure for identifying business opportunities or problems'.

In this case the numbers assigned are arbitrary and are no more than labels for the categories. Counting is the only analysis possible on such data.

Ordinal scales are used when the respondent is asked for responses in the form of a rank ordering. An example of the use of such a scale is:

Q1 Rank the following areas of benefit in the order you think that the proposed system will have the most impact on our organization.

(1) Efficiency (doing more things, doing things faster) ☐
(2) Effectiveness (doing the right thing) ☐
(3) Innovation (new ways of working) ☐
(4) Utilization (hours billed to client) ☐
(5) Job satisfaction (work environment) ☐

The ranks in this case provide information on the relative standing of the benefits when compared with the impact of the proposed system on the organization. For example, should efficiency be ranked '1' and effectiveness '2', then the system is considered to have a greater impact on efficiency than on effectiveness. How much more impact it will have cannot be inferred from such numbers. Therefore the difference in the ranks does not provide information on the actual extent of the impact. Such scales do allow for more sophisticated analysis than was possible for the nominal scale. For this data it is meaningful to compute such non-parametric statistics as the median, quartiles and rank correlations.

Interval scales possess the property that the difference between the numbers on the scale can be interpreted meaningfully. Examples of a scale that can be treated as an interval scale (Parasuraman 1991, p. 410) are to be found in Appendix F, parts B and C. For these questions the rating system is such that a score of 1 denotes strongly disagree and a score of 9 denotes strongly agree.

In this case, the difference between the ratings of two individuals on the same item gives an indication of the extent to which the two individuals agree or disagree on the item. In other words, the difference between the numbers of such a scale can be interpreted as an absolute measure of how far apart individuals are with respect to the item. For example, in this case the difference between a rating of '1' and a rating of '2' is equal to the difference between ratings of '3' and '4'. Also the difference, say, between '1' and '2' is half the difference between '1' and '3'. This thinking also applies between '4' and '5', '6' and '7', etc.

Interval scale data can be analysed by virtually the full range of statistical procedures. For this scale the calculation of means, standard deviations and Pearson correlation coefficients provides meaningful statistics.

Ratio scales are scales such that the numbers on the scale possess not only the properties of the nominal, ordinal and interval scales, but in addition, ratios of numbers on this scale have meaning.

This scale possesses the property that intervals between points on the scale are comparable. For example, the difference between an average workstation usage of 10 hours per week and 12 hours per week is the same as the difference between say 15 hours per week and 17 hours per week.

In addition, it is meaningful, for example, to compare an average usage of 15 hours per week with an average usage of 10 hours per week, by stating that the former usage of the workstation is 1.5 times that of the latter. For a ratio scale 'zero' has a physical meaning. In this case a response of zero is taken to mean that the individual does not use the workstation. Ratio data is the highest level of data and can be analysed by the full range of statistical techniques.

In practice, surveys generally make most use of data at the nominal, ordinal and interval level.

13.7 A guide to conducting a survey

The following is a step-by-step guide to conducting a survey of the use of IT in the firm.

Terms of reference

Accurately define the purposes of the survey. These should be stated as the survey's terms of reference.

Data collection

Establish how the data will be collected, i.e. personal interview, mail, telephone, etc.

Determine the sample size and the sample frame

Estimate the response rate that will produce the appropriate sample size.

Focus groups

Form a focus group in order to identify the key issues to be addressed by the survey. Focus groups may be from six to ten informants.

Produce questions

From the key issues develop a list of appropriate questions.

Questionnaire design

From the questions draft a questionnaire. This task includes the selection of an appropriate scale.

Conduct a pilot study

Perform a pilot study using the questionnaire to determine initial responses. The pilot study may encompass between six and ten individuals.

Revise the questionnaire

Using the results of the pilot study, revise the questionnaire so that it focuses more closely on the key issues.

Distribute questionnaire

Distribute the finalized questionnaire to the chosen sample. Each respondent should be notified of the date by which return of the completed questionnaire is required.

Collect results

The completed questionnaires should be collected. It may be possible to discard partially complete questionnaires in favour of complete ones, depending on the response rate achieved.

Code results

The results of the questionnaires should be coded appropriately, in order to make analysis and interpretation easier.

Analyse and interpret

The coded results should be analysed to determine the overall results of the survey. Careful analysis will reveal both whether the survey was successful as well as whether the IT systems are meeting the requirements of the respondents.

Two sample questionnaires are provided in Appendices F and G.

13.8 Summary

Survey design is very much an art and invariably results in economic considerations forcing the researchers to sacrifice what they ideally would require for what is practical in terms of the time and money available. It must be accepted that no survey will be found to be perfect. The key to a successful survey is the care taken in carrying out the time-consuming and costly upfront work. This includes tasks such as clearly defining the purpose and objectives of the study, the running of focus groups, analysing transcripts of the focus group meetings, conducting fairly open-ended interviews with appropriate persons, and the development and thorough pilot testing of the questionnaire. Also there is the need to ensure that the sample is representative and of credible size.

14

Evaluation and ABR project management

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You can manage an IS project just as well as you can manage a capital building project. Even if you're using the bleeding edge of technology, you can still succeed through careful planning, scheduling and monitoring.

T. Winter, cited in Scheier, R., *From Hard Hat to Hard Drive* (1995)

14.1 Introduction

IT projects can be successfully managed in much the same way as any other project. To do this the project management needs to carefully focus on the continuous evaluation of the project. In fact the measuring and management of IT costs and benefits needs to be an integral part of IT project management as well as the day-to-day management of an organization's computer-based systems. The purpose of this chapter is to explain how to set up evaluation as part of project management.

The process of management, and especially project management, is a repeated cycle of planning, resourcing, execution and control activities, which can be seen in Figure 14.1.

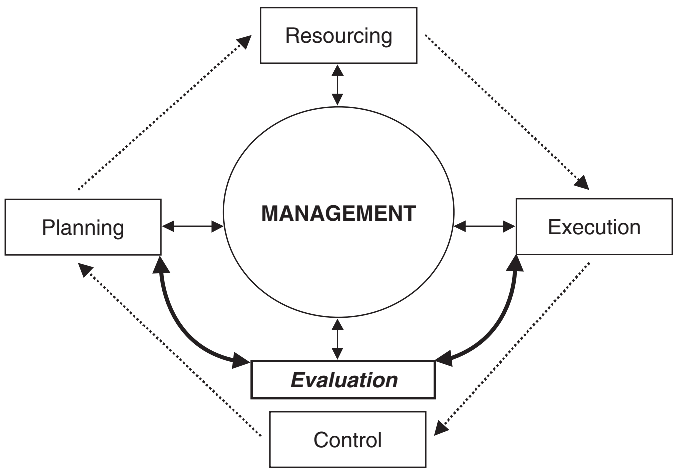

Figure 14.1 Evaluation as a central issue in the management process cycle

The control phase involves the evaluation of what has gone before and decision making to support the renewal of the planning and management exercise. The cycle of resourcing and execution is then repeated.

Central to evaluation is the process of measuring or assessing the merit or deficiencies of past performance.

The key practical issues of an evaluation process, especially from a project management point of view, are *when* is the evaluation to be done, *who* is to do the evaluation, and *how* is the evaluation to be done? This last issue involves deciding *what* characteristics of the information system are to be evaluated and which techniques are appropriate for the evaluation process.

14.2 The traditional approach

This section presents the traditional IT project management approach and underpins the fact that there have been developments as to how the IT evaluation process needs to be incorporated in IT project management.

The traditional IT project management approach was based on the concept that an IT project was purely a technical engineering type activity.[1] Figure 14.2, adapted

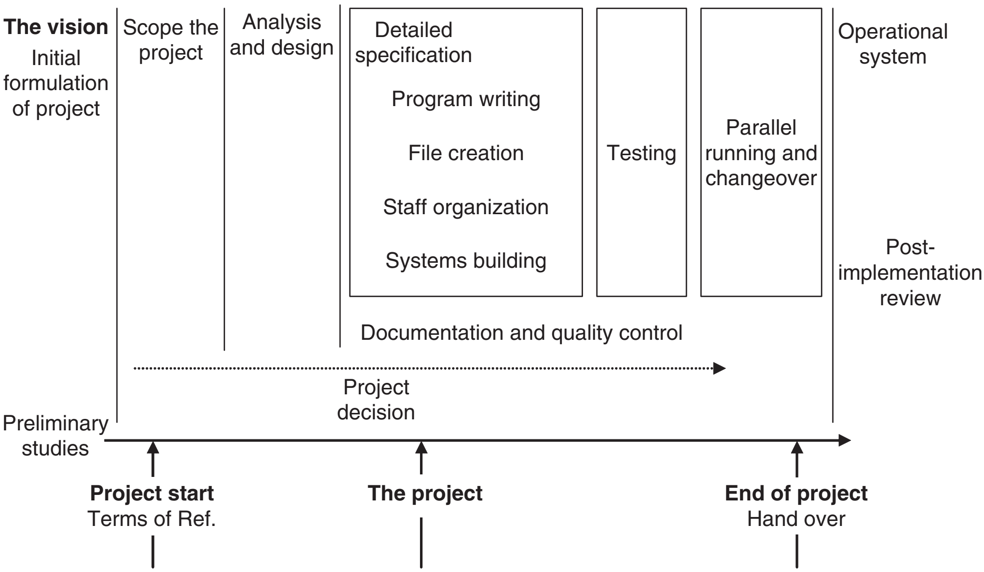

Figure 14.2 The stages of IT project development

[1] A participant attending an executive programme on IT management pointed out recently that IT was originally seen as much the same thing as civil engineering and that programmers were regarded by management much like bricklayers. Although this is perhaps a little exaggerated it certainly does capture the spirit of the traditional attitudes towards information systems development. With such an approach to programmers and programming it is hardly surprising that there have been so many failures.

from Zehnder (1990), illustrates the traditional project approach, which is sometimes referred to as the 'waterfall' approach.[2]

The issues of project management have been, and still are sometimes associated with delivering a number of completed and possibly integrated work packages (building blocks of the information system) on schedule. This involves managing the cost of delivering the information system within a budget and ensuring the quality of the build of the system components. The issues of evaluation for a project with this profile were the following:

- *When*: An initial evaluation was carried out at the feasibility stage when the project was scoped and the terms of reference for the project prepared. A second evaluation was carried out at the end of the design stage and a review was carried out after implementation. Then sometimes a post-implementation audit was conducted.[3]
- *Who*: At the feasibility stage, user management[4] was usually involved to support[5] the project leader in decision making.[6] The second evaluation involved the technical project team and sometimes the eventual users of the information system. The post-implementation review (if carried out at all) was an accounting type evaluation involving management and their accountants. Sometimes a user survey, evaluating their satisfaction with the system, was carried out (see user surveys: Chapters 10 and 13).
- *How and What*: The measurable characteristics for evaluation were the following:
  - Time: A schedule of activities was proposed and controlled. There are well-established and sophisticated techniques available for managing time in the context of project management.

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[2] It has been well known for some considerable time that projects seldom operate in as linear a fashion as the 'waterfall' approach or model suggests. Nonetheless it has been regarded as a useful description on the components of an IT project.

[3] Research on the issue of post-implementation audits suggests that perhaps as few as one third of projects are ever subjected to such a review.

[4] User management may sometimes have been just about the only other primary stakeholder represented here.

[5] The notion that the user manager would support the project leader actually puts the emphasis of the activities of these two stakeholders the wrong way around.

[6] Sound project management dictates that the feasibility study should be compiled with the direct support of a senior sponsor who should ensure that the process change underlying the information system clearly is beneficial to the organization.

- Cost: A budget was proposed and standard budgetary control techniques were used to evaluate and control tangible costs.
- Quality: Building quality software is sometimes still a problem even today, but there are techniques available used by software engineers to support quality assurance and control.[7]

The basic issues of evaluation outlined above are still an integral part of setting up and managing a project and should never be ignored as part of any IT project management programme.

14.3 Moving away from the traditional approach

In current business practice IT is now inextricably integrated into the fibre of an organization's functions. The effective use of IT underpins the business and the organization's ability to be successful in its operation. Over and above this, the environment in which an organization is operating is continually changing and so the organization needs be much more adaptable. This integration of IT and the climate of continual change have had a major impact on management thinking for IT projects.

Furthermore, there have been two key changes in the way IT projects and their management are perceived. First, by and large computer-based systems are not measured in terms of just the old ideas of quality of build, but in terms of the value of the system to realize business benefits for the organization.

Second, the development of computer-based systems is no longer viewed as an engineering project with development and build phases, a delivery point and then an extended period of use for the delivered application. The development of a computer-based system is viewed more in terms of the introduction and evolution of organizational processes. The system's development may be characterized as having a set-up phase and then the system evolves to meet the changing needs of the organization to deliver enhanced processes, which lead to improved efficiency and effectiveness, and thus produce business benefits for that organization. The

[7] The issue of quality today is more to do with whether the information system is fit for its purpose as opposed to the traditional view of quality being to do with minimizing the number of bugs that are present when the system is commissioned.

setting up of an evaluation process as part of project management needs to focus on the participation of the business people involved, on identifying the improved processes and on the continuous evaluation of the evolving system and its use. The evaluation activity of the management process involves setting up a group consisting of owners and managers and technical people who have a genuine stake in the future of the computer-based system and a concern for its success, to participate in the management process. The evaluation activity should be supported by information that evidences the performance of the system in terms of its support process changes, which make an improved contribution to the business's goals. The evaluation activity should be part of a continuing management activity over the useful life of the system and not just the project itself.

14.4 Active benefit realization

The process described in this chapter for setting up evaluation as part of IT management has been called active benefit realization (ABR) and is based on the approach proposed by Remenyi *et al*. (1997). This involves the integration of a continuous participative evaluation activity into the project management process.

The participation and delegation of some aspects the project control activity to the stakeholders, rather than focusing on technical issues, suggests a mindset shift. It requires more of a partnership and a co-evolution in systems building and a much broader focus on business processes rather than just technical project management issues. As the development and use of the systems progress, all the principal stakeholders appreciate the business problem more fully and understand the opportunities of the information system better. They will then guide the IS development towards a system that delivers real improvements. The ABR process complements the recognized and well-understood project management and financial management techniques that are necessary to satisfy top management sponsorship of an information system and are increasingly accepted as sound management practice for successfully delivering an information system.

14.5 The evaluation process

The ABR evaluation process for information systems development is illustrated in Figure 14.3. This figure shows that the evaluation needs to accommodate the

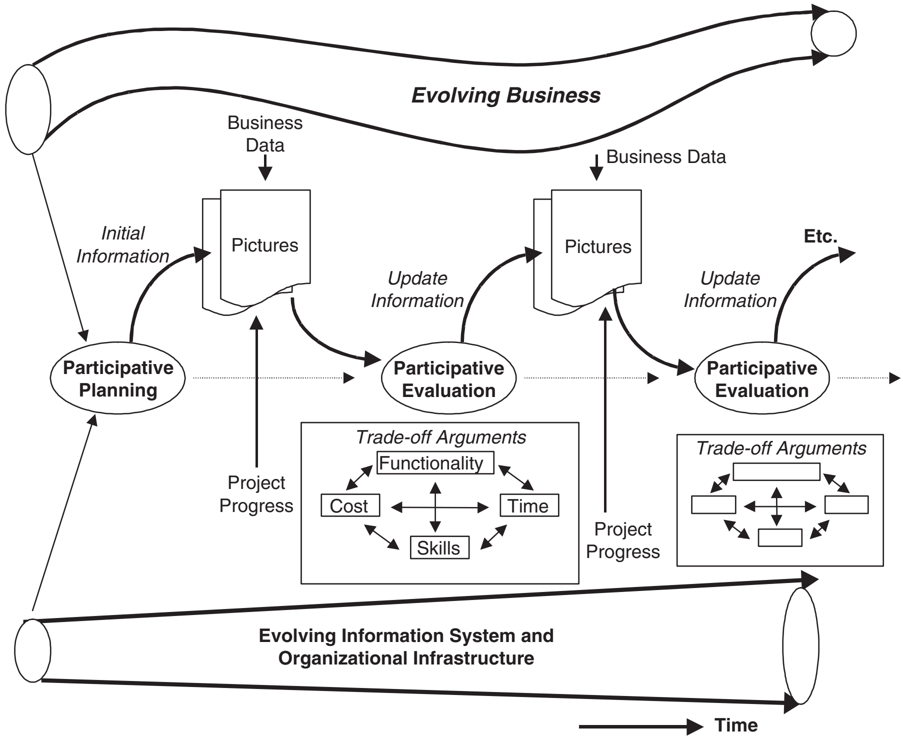

Figure 14.3 A continuous and evolving participative evaluation process

evolving nature of the information systems investment and that a participative[8] approach is required.

At the start of the project there is an initial peak of activity when stakeholders together set up the plans for the project and the framework for evaluation.

The documents that are used for summarizing the evaluation information are called 'pictures'. These documents are discussed in more detail in the next section.

[8] According to Brunner and Guzman (1989), 'Participatory evaluation is an educational process through which the social groups produce action-oriented knowledge about their reality, clarify and articulate their norms and values, and reach a consensus about future action.' A participative approach is not at all easy. Participative evaluation implies that a group of stakeholders is involved. The fundamentals of evaluation and all the complexities of individual interpretation of value persist for a group situation and often further complexity is added. Each individual group member's understanding of the information system will be different, the desirability of the system will be different and in a group situation the personal behaviour and stance of each individual member may influence the evaluation. A common understanding should be arrived at and then an agreed course of action negotiated.

The frequency of the participative evaluation reviews is decided when setting up evaluation in project management. During the most active phases of systems development and implementation these could be fortnightly or monthly. The evaluation process continues during the whole life of the project, and even continues beyond the project as part of operational management for the information system.

Broken down into separate activities, this evaluation process consists of the following seven major activities which are illustrated in Figure 14.4:

1. Initialization, i.e. validation of the project
2. Production of pictures
3. An agreement to proceed
4. System development
5. Evidence collection
6. Review: participative evaluation
7. Development of updated pictures

Repeat cycle from step 3.

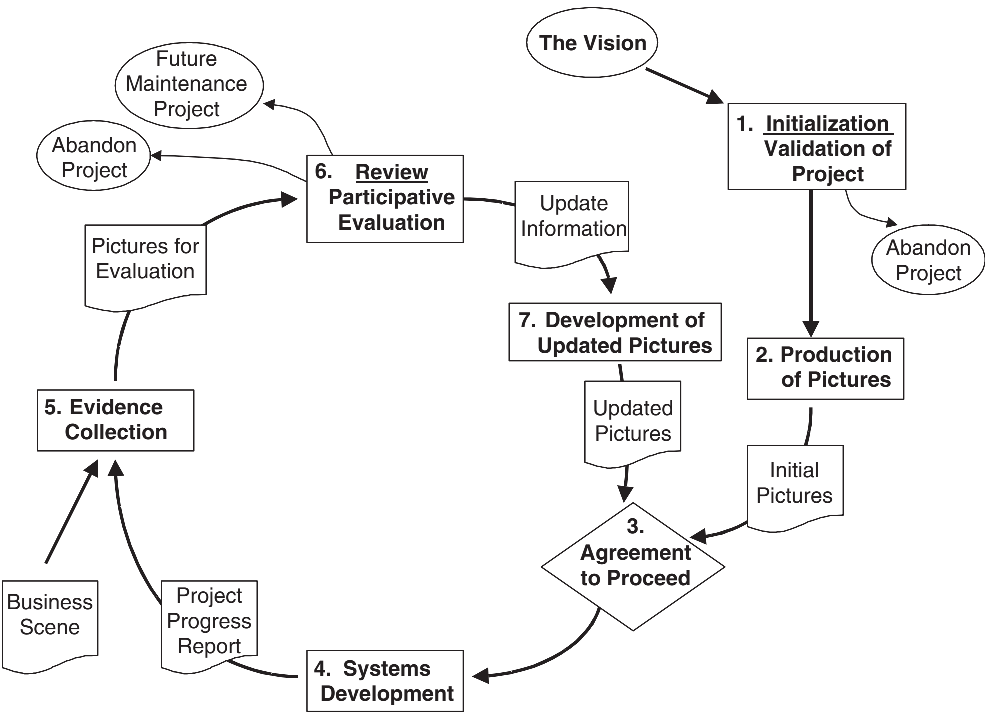

Figure 14.4 The ABR evaluation process

The ABR process usually begins with the vision by an executive that IT can transform one or several of their business processes. The use of IT to support a business activity and the launch of the development of a computer-based system is the appreciation by the organization of a primary business problem that can be resolved or an opportunity which can be grasped by using information technology. The evaluation cycle starts from the point when the problem is first defined or the vision of the opportunity described.[9] This is the entry point into Activity 1.

Activity 1. *Initialization of project*: The first task is to make a clear statement of the problem that the envisaged information system is planned to overcome or of the opportunity to be grasped. One of the primary objectives of the initialization activity is to validate that an IT investment is worthwhile and that the project is worth tackling. The validation depends on a clear statement of the business objectives of the investment.

Some initial analysis is necessary during this first activity. The analysis involves gaining a clear understanding of the organizational objectives that are to be realized as a result of the proposed process change and the information system development. From this analysis, the context for the information system development, as well as the goals and expected benefits of the proposed system, will become clear. The business opportunity is validated by ensuring that it is aligned to the strategy of the organization as expressed by its critical success factors. The deliverable at the end of step 1 will be a document that will contain the terms of reference and an authorization to proceed with the detailed exploration of the proposed project.

Activity 2. *Production of pictures*: This activity requires the preparation of what is termed the initial business picture (IBP) and two supporting pictures, the initial financial picture (IFP) and the initial project picture (IPP). For the purposes of describing this process, these pictures can be viewed as a formalized expression of the process or practice changes and the information systems development project targets in business benefits terms, with the supporting financial budget and the supporting development project plans. Once the pictures have been prepared a key decision-making point is reached. The pictures are a model of the business opportunity, the context, the financial impact of an information system and a project plan. The deliverable at the end of step 2 will be the three pictures required for the

[9] Research suggests that about one half of information technology investments are initiated through the process of formal strategy planning. The other half occurs as the result of impromptu commercial insights and is totally opportunistic in nature.

management of the project. These documents are prepared, discussed and agreed in a participative forum.

Activity 3. *An agreement to proceed*: Based on the information provided by the pictures, a decision can be made and an agreement to proceed may be reached.

Activity 4. *System development*: The actual building and setting up of the organizational infrastructure for the information system is now started. Once a part of the information system has been developed some deliverables exist. At first this may simply be a paper-based report, an analysis report or a systems design specification, but as systems development advances this may be a prototype and eventually will be the results of live testing of the system. The project management will deliver progress reports from this systems development activity.

Activity 5. *Evidence collection*: The stakeholders familiarize themselves with the evidence of progress in the project and bring their expertise of the evolving business scene together. If the stakeholders have genuinely exercised active participation they will be familiar with project progress, they will have looked at prototypes and they will be aware of organizational issues. Evidence collection for senior management may take the form of reading a clearly expressed management summary or the oral presentation of project progress by the project team.

Activity 6. *Review – participative evaluation*: The stakeholders review and evaluate progress. Progress is evaluated against the business, financial and project targets, with specific emphasis on the process change and the resulting business benefits. Regulatory action, to ensure information systems development stays on course to deliver business benefits, is at the heart of the evaluation process. Evaluation for specific aspects of the information system will be supported by techniques that will evidence the evaluation information in an easy to understand way. The business stakeholders participate in the process to ensure that business and not technological issues come to the fore.

Activity 7. *Development of updated pictures*: Making decisions and formulating new agreed plans for continuing the project to its next phase complete the participative and formative evaluation cycle. This activity involves updating the pictures to reflect the new targets and plans for systems development and updating the budget in accounting terms. In this process targets are updated, but another key aspect of this process is that the stakeholders learn to understand better each other's requirements and what is possible. The development process continues by returning to Activity 3 with an agreement to proceed.

14.6 The ABR pictures

ABR requires the production of three pictures. These pictures have a hierarchical nature. Some items on the pictures are simply a statement of a contextual situation or a target that the system development is expected to achieve. Other items are numbers and some may be graphical representations. They are expressed in these pictures in a summary form. Where necessary for the project the higher-level figures or statements are underpinned by more detailed information. This is shown in Figure 14.5.

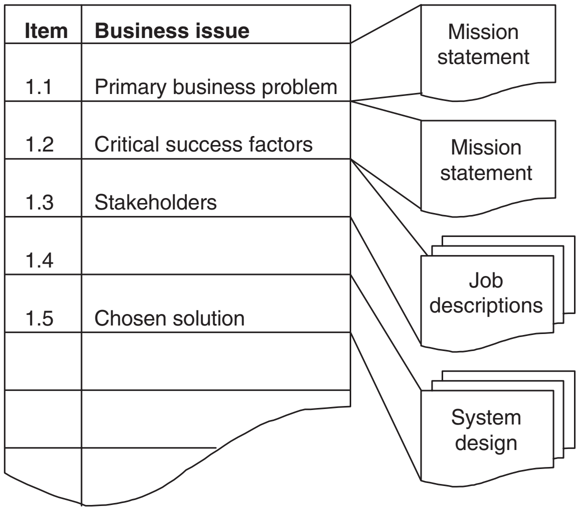

Figure 14.5 The hierarchical nature of the business picture (BP)

The three pictures are produced initially as part of the development of the business case for the investment in a process change and the accompanying information system and are used to support the decision to launch the project.

14.6.1 The business picture (BP)

Table 14.1 lists the issues that need to be addressed in the BP and together these items may be regarded as a business case for the project.

1.1 Primary business problem or opportunity: Item 1.1 expresses the opportunity or the problem that the organization faces. It is a succinct statement and/or list of problems being addressed by the proposed process change and information systems initiative. An example of a problem stated clearly and simply might be

Table 14.1 Business picture

Item	Business issues
1.1	Primary business problem or opportunity
1.2	Critical success factors
1.3	Stakeholders
1.4	Outcome definition
1.5	Chosen solution
1.6	Rationale
1.7	Solution champion
1.8	Ideal term report
1.9	Specific benefits and metrics
1.10	Stakeholder–benefits matrix
1.11	Critical success factor–benefits matrix
1.12	Major risks
1.13	Major risks–benefits matrix

'Gross sales invoice value too small and as a result administrative overheads are too high to provide the required return on investment'.

The statement of the primary business problem or opportunity is an important issue for any project. If the primary business problem or opportunity is not correctly understood the resulting information system will probably be of little value.

1.2 Critical success factors (CSF): Item 1.2, which is entered at the initialization stage of the project, lists the key CSFs for the business or organizational units that are being addressed by the process change. In the context of the BP, CSFs are used to check the relevance of the proposed business opportunity to the stated organizational mission. They help to identify the significance of the possible associated benefits.

CSFs are derived from the organization's objectives, goals and corporate strategy. To deliver real benefits for the organization, the information system needs to be aligned to one or more CSFs.

CSFs may have been prepared for the organization during its planning procedures, but if this has not been the case, time needs to be spent on this issue, as it is a key technique for assisting in the validation of information systems opportunities.

1.3 Stakeholders: Item 1.3 lists the primary stakeholders in the project. This item supports one of the key principles of ABR for setting up evaluation successfully in IT project management. This item records the agreed result of the management discussion and decisions as to who will be ultimately responsible for IT investment and who will participate in the evaluation (and consequently the control) process for the systems development.

Agreeing participation in an IT systems development project is a difficult and sometimes controversial task.

1.4 Outcome definition: Item 1.4 is a statement or a list of the expected results of the process change or information system's initiative expressed in business terms. It relates to the primary business problem or opportunity and represents in concrete terms the vision of how the opportunity will be realized. It is derived directly from the primary business problem or opportunity statement given in item 1.1 of the picture.

The outcome statement should be comprehensive and thus carefully thought through. A brainstorming session involving the principal stakeholders is a useful way of tackling this issue.

1.5 Chosen solution: Item 1.5 is a summary description of the chosen solution. The task of selecting the solution will involve some systems analysis and design work by information systems or business analysis professionals. This work is complementary to the work of reviewing solution alternatives.

1.6 Rationale: Item 1.6 provides a brief statement as to why the particular solution was chosen in item 1.5.

1.7 Solution champion: Item 1.7 records the name of the champion of the chosen solution. If there is no champion for the chosen solution then the business process change and accompanying information systems development is unlikely to realize business benefits.

1.8 Ideal term report: Item 1.8 in the BP is a series of statements expressing the ideal situation the organization hopes to realize in terms of the information systems development project. This is to be expressed in business and organizational terms and an example of such a report is shown in Figure 14.6.

1.9 Specific benefits and metrics: Item 1.9 is derived from the outcome definitions specified in item 1.4 of the business picture and the chosen solution. It identifies the specific benefits that the chosen solution will deliver in business terms. These benefits will not be stated here in financial terms, as financial estimates will be produced for the financial picture (FP).

1 Within one year of the commissioning of the systems the sales revenues have increased by 20%, while.
2 The number of clients has been reduced from 10 000 to 8000.
3 The average value per invoice has increased by at least 20%.
4 There are fewer bad debts both in absolute terms and as a percentage of sales.
5 Sales managers and representatives claim that the system has played a major role in achieving the above.
6 Sales managers and representatives claim that they find the systems easy to use.
7 There is a growing feeling among the sales staff at all levels that information systems can play a major role in helping them do a more efficient and more effective job.

Figure 14.6 An example of an ideal term report

Business benefits will be stated in terms of the effect of the organization's processes. Thus a sales order process system could have business benefits attributed to it.

For benefits to be achieved they need to be measurable, i.e. a stakeholder should be able to assess whether the planned benefits have been delivered. Virtually all process change benefits are measurable, even intangible ones.

The completion of this item of the business picture is at the heart of setting up an evaluation of an IT project. It is by participatively looking at, and planning for, the achievement of the stated benefits, using the prescribed metrics, that business benefits will be realized.

1.10 Stakeholder–benefits matrix: The stakeholder–benefits matrix, item 1.10, lists all the benefits identified in item 1.9 (above). The stakeholder–benefits matrix cross-references each benefit to one or more stakeholders. It is a control item in the BP. It identifies, with an explicit model, the individual stakeholders who will be affected by the realization of that particular benefit during the implementation and from the realization of each different aspect of the proposed process change and information system.

This process allows stakeholders to identify with the targeted benefits of the information system development. Furthermore, it helps draw the stakeholders' attention to the issues and focuses their attention on a more comprehensive statement of possible benefits. It also identifies stakeholders with no benefits accruing from the information system development, which may mean that they have been mistakenly included as primary stakeholders. An example of a stakeholder–benefit matrix is shown in Figure 14.7.

Stakeholder	Increase in sales	No. of clients reduced	Fewer bad debts	Increase in staff satisfaction
Sales manager	*	*	*	
Marketing manager	*			
Credit manager			*	
Sales staff	*	*	*	
Office manager				*

Figure 14.7 Stakeholder–benefit matrix

From the matrix it is clear as to who is associated with what benefit and vice versa. Instead of simply putting an asterisk in the matrix, it is possible to weight and/or score the relative importance of the benefits.

1.11 Critical success factors–benefits matrix: The CSF–benefits matrix, item 1.11, lists the benefits identified in Item 1.9 (above). The matrix cross-references each benefit to one or more CSFs and identifies which corporate CSFs are supported by that benefit. This is another control item in the BP.

Process change and the accompanying benefits accruing from the information system's development should be aligned to corporate strategy. If an anticipated business benefit does not support a corporate CSF[10] then it may not be a benefit at all or at least one of low priority. On the other hand if some relevant identified CSFs are not supported by any business benefits of the information system, then it is possible that the information system development is not adequately targeted. The CSF–benefit matrix can be presented in a similar way to the stakeholder–benefit matrix, as shown in Figure 14.7.

1.12 Major risks: Item 1.12 lists the major risks involved with the process change. Risk should be identified in the BP when setting up an evaluation. Its importance as an item on the BP for systems development is that process change involves new activity and new activities are always risky. The major risks to the non-realization of business benefits and to the negative impacts of the information system development are listed so that the stakeholders can evaluate them as acceptable or not. They can also be monitored during the development of the information system and re-evaluated.

[10] CSFs are viewed here as the detail supporting the organization's corporate strategy and as such CSFs are much easier to work with when discussing process changes or information technology investments than the overarching corporate strategy.

1.13 Major risks–benefit matrix: The major risks–benefits matrix, item 1.13, lists the benefits identified in item 1.9 (above). The matrix cross-references each benefit to one or more of the major risks and identifies to what risks benefit realization is exposed. It also indicates whether systems development is exposed to risk where there is no obvious benefit indicated.

Figure 14.8 illustrates some of the detail of the development process and sequence for the business picture.

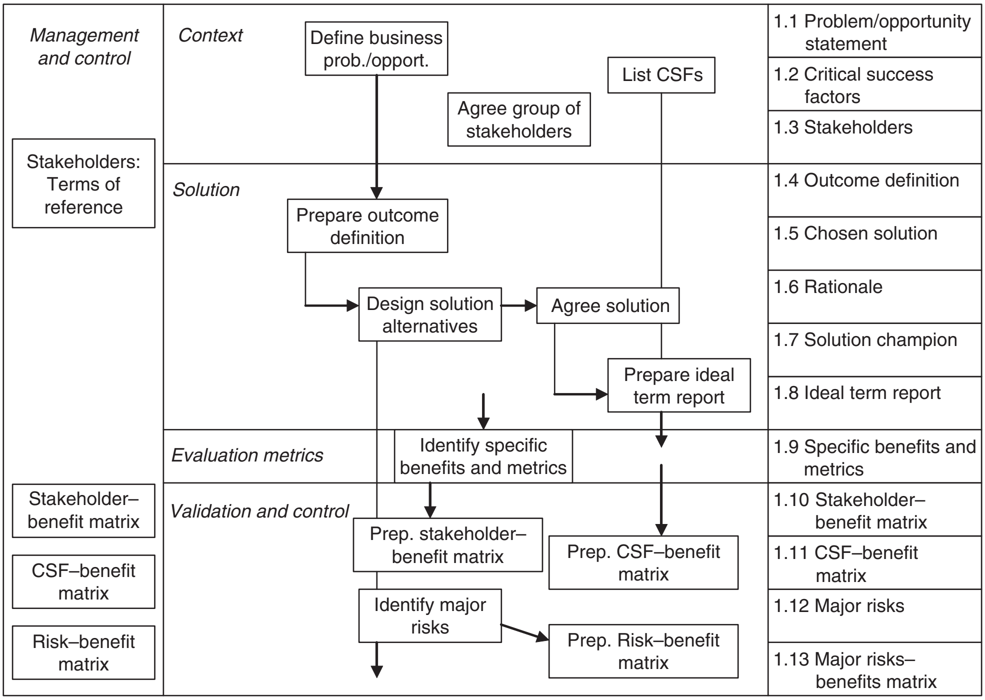

Figure 14.8 Development of the business picture

14.6.2 The financial picture (FP)

The FP summarizes the costs and benefits figures discussed in previous chapters of this book.

This statement shows in money terms the benefits and costs of the project and includes some financial ratios that need to be evaluated and monitored to help manage the financial health of the project.

The FP includes the recognized cost categories for financial planning in information systems development. It also contains a comprehensive list of benefits.

Only the summary of these calculations is included in the FP. The detailed financial information will be available in the form of budgets and costings within the organization's accounting system. Of course the ABR process proposed here does not prescribe the accounting conventions to be used. The FP complements the current financial controls of the organization.

Table 14.2 lists the issues that need to be addressed in the FP.

Table 14.2 The financial picture

Item	Financial issues
2.1	Project duration
2.2	Hardware costs
2.3	Software costs
2.4	Data communications costs
2.5	People costs
2.6	Commissioning costs
2.7	Group productivity tools
2.8	Individual or personal productivity tools
2.9	Informate the organization
2.10	Reduce time and space in business processes
2.11	Create a corporate memory
2.12	Bind the organization closely with clients and suppliers
2.13	Induce discontinuities by BPR
2.14	Required payback
2.15	Required return on investment
2.16	Required net present value
2.17	Major financial risks

2.1 Duration: Item 2.1 of the initial FP is a statement of the anticipated duration of the project.

2.2–2.6 Systems cost: The next five items from 2.2 to 2.6 are the estimated cost of the hardware, software, data, communications, people costs and commissioning costs. It is common practice to supply these forecast costs as a series of single budget or estimate items. It is expected that these costs will be reasonably accurate, i.e. within about 10% of the final costs. If there is a high degree of uncertainty about these cost estimate numbers then, instead of supplying single point estimates, range values may be used and a process of financial risk analysis may be employed to perform the subsequent calculations.

2.7–2.13 Systems benefits: The initial FP provides a list of the major tangible benefits that can be derived from an information system. These are listed from items 2.7 to 2.13 and need to be addressed individually.

2.14–2.16 Required payback, return on investment and net present value: Items 2.14, 2.15 and 2.16 of the FP refer to three classical measures of investment performance. These three statistics, payback, return on investment and net present value, are only examples of a much wider range of financial measures which may be used by accountants to assess the viability of an investment.

2.17 Major financial risks: Item 2.17 lists the major financial risks that an information system development project could face. These are primarily related to escalation in the prices of the various inputs to the project. Thus the cost estimates for the hardware costs, the software costs, the data communications costs, the people costs and the commissioning costs are all potential financial risks. If elements of the system are being imported from a different currency area then the foreign exchange rate constitutes a potential risk area, as does the interest rate if the project is being financed out of borrowed funds. There are of course other possible financial risks that are beyond the scope of this section.

14.6.3 The project picture (PP)

Different project management approaches or methodologies will emphasize different instruments for planning and control of a process change. ABR does not prescribe a definite instrument for project management at this level. ABR suggests an outline of what should be included in a project management summary. The items touched on are: the work packages, resource management to deliver the packages, time scheduling and management, and the identification of problems and risks. These facts should be characterized and evidenced in a way the non-technical management can understand and appreciate. They should be presented to give the evaluator the holistic view required by continuous participative evaluation. They should be presented for frequent review and evaluation synchronized with the cycle of the project evaluation process. In order to satisfactorily complete the PP it is necessary to apply the skills and techniques of project management.

Table 14.3 lists the issues that need to be addressed in the PP. The PP highlights for the primary stakeholders and project management the key project planning issues for an information systems development project. The PP by itself is not a substitute for a comprehensive project plan, which is, of course the responsibility of the project manager. Effective and efficient project management is a critical success factor for any project and it is assumed that the necessary skills for this are in place.

Table 14.3 Project picture

Item	Project issues
3.1	Project manager
3.2	Project deliverables – major products
3.3	Project activities – detailed tasks
3.4	Resources available
3.5	Project duration, time consumed and target completion date
3.6	Current best estimate of completion date, with rationale
3.7	Budget, actuals and cost variances-to-date
3.8	Percentage of job finished by time, cost and by specification
3.9	Forthcoming bottlenecks identified
3.10	Changes identified by formative processes
3.11	Additional funds and time available
3.12	Major risks

14.7 Using the pictures

The presentation of information in an easy to understand and yet rigorous format is essential to setting up the participative evaluation activity in process change or IT project management. The three pictures are offered as a comprehensive framework for this.

14.7.1 Continuous participative evaluation

When setting up an evaluation process for IT project management it is necessary to organize the review and participative evaluation activity. To monitor an activity at weekly intervals, weekly data collection is necessary, and to monitor the activity on a monthly basis involves monthly data collection on progress. Consequently, when setting up evaluation the frequency of the review is significant and the volatility of the data is also significant. As has been highlighted in section 14.6, the most volatile data for monitoring progress stems from the project picture (work package progress, performance measures, time management and cost management) and from the cost management heads of the financial picture. Collecting this data is onerous but is a recognized activity of project management. The evaluation activity piggybacks the regular project management activity. The benefits calculations of the FP (i.e. benefits from increased in-group productivity) are to a certain extent persistent and would only be reviewed as part of continuous evaluation if one of the significant parameters of the calculation changes. So, for example, if one of the identified risks was that the 'sales function' might be outsourced, thus invalidating the projected benefits on calculations sales costs, then new benefits calculations might have to be undertaken.

The data of the business picture is essentially not volatile. Item 1.9 (specific benefits and metrics), depending on what is being measured, may require some more frequent data collection. So when setting up evaluation and developing the BP a realistic view should be taken of the specific benefits to be measured and the metrics to be used. The setting up of the BP and the continuous evaluation activity go hand in hand. The purpose of frequent, say monthly, formative evaluation is to keep the stakeholders informed, identified with and committed so that if one of the items of the BP does change fundamentally or can be seen to be drifting then this can be discussed and formally re-evaluated. It is the stakeholders, through participation, who will bring evidence to the evaluation process, either from their own areas of responsibility if business conditions are changing or from observation and discussion when progress on the project development or day-to-day running is reported on during monitoring sessions.

In the end the challenge for continuous participative evaluation is that the information should be presented for frequent review and re-evaluation.[11] The length of time between reviews will obviously always vary from project to project but they should not be allowed to extend beyond a few months. According to Wick and León:

> We found that goals that take 4 months to accomplish work best. If the time required is shorter, that's fine. If your goal will take longer, then break it into smaller pieces and select a milestone along the way that you can attain in 4 months. (Wick and León 1993)

Once properly set on course through the preparation and discussion of the initial pictures, the cost and management effort of continuous participative evaluation is

[11] It is never an easy task to bring the principal stakeholders together for review sessions and thus the politics of the process change may actually dictate how often this actually happens.

limited. The advantage of the effort put in initially into preparing a business case through pictures is that the monitoring is continually focused on the business case for little effort. The continuous participative monitoring effort is not costly.[12] If the organization is operating in a volatile environment then the use of continuous participative evaluation is even more essential. It is clear in these circumstances that collecting data and reworking the business case will involve costs, which should be budgeted for as part of setting up project management for the volatile environment. Without frequent evaluation sessions it is almost certain that the computer-based system will not meet the changing needs of the organization.

14.8 Summary

Setting up evaluation as part of a business process change or IT investment project is a key part of establishing a sound approach to project management. The focus of this evaluation is the realization that business process change and the accompanying IT investment result in improvements to business efficiency and effectiveness, which in turn lead to benefit streams.

The ingredients of success in this endeavour are participation in the production of the business case using the three pictures described here and the focus on business process changes and improvements through continuous participative evaluation. Participation, by senior management and by business user-owners at whatever level, is necessary for the project, and is one of the keys to motivating benefits realization. Keeping a focus on the efficiency and effectiveness improvements stemming from the investment and not on the technological hype and niceties directly supports the delivery of improved business results and thus benefits.

This chapter has presented the process and the instruments of ABR for initiating a continuous evaluation approach. This evaluation is set up in a way to complement the necessary project management and financial management activities. The cost in management time and in data collection is limited and the payoff in terms of realizing business benefits is often very substantial indeed.

[12] Of course management time is a hidden cost but it may be argued that if management does not put the time into seeing that the IT project is run competently then it will have to put the time into deciding if the project should be repeated or just simply abandoned.

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Final thoughts

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[This] … involves the acceptance that evaluation is:

1. *a management process requiring discipline;*
2. *comprehensive, involving the opinions of all the major stakeholders as informed project partners;*
3. *focused on a full range of benefits or outcomes which include financial and direct business benefits, both tangible and intangible;*
4. *most effective when it is performed regularly perhaps even continuously;*
5. *not critical of change but rather sympathetic to it, encouraging full discussion of co-evolving requirements;*
6. *required to ensure that the object or process being evaluated continues to be relevant.*

D. Remenyi, M. Sherwood-Smith with T. White,
Achieving Maximum Value from Information Systems (1997)

15.1 Introduction

It is not an easy task to measure or manage IT costs and benefits. Many of the problems or challenges associated with this task have been spelt out in some detail in earlier chapters in this book. Some of the challenges are philosophical, such as those that relate to operationalizing the meaning of value,[1] and some are practical, such as those involving the quantification of certain types of benefits. It is interesting how the question of the struggle for the meaning of value reoccurs so frequently in the IT evaluation literature. Bannister and Remenyi (2000) point out:

> It is argued that a weakness in much of the current research is the fact that the definition of value is usually unclear, frequently inadequate, often partisan and sometimes completely absent from the discussion. Until there is a better understanding in the IT community of what value is and how managers attempt to optimise it, current IT evaluation methods for complex decision making purposes will often be neither credible nor effective.

It does appear that few IT professionals, be they practitioners, academics or consultants, have explored and understood all the relevant concepts in this challenging field. However, the issues covered in this book do provide a thorough coverage of many of the important concepts necessary to a good understanding of this field.

[1] With regards to this issue, which is essentially one of economics, the comment, which has been attributed to the Nobel laureate George Bernard Shaw, immediately comes to mind, 'If all economists were laid end to end, they would not reach a conclusion.'

15.2 No obvious methodology

One of the conclusions which may be drawn from a close examination of this subject area is that there is no self-evident methodology for the measurement or management of IT costs and benefits. There are, of course, several different approaches to the problem, but while there is some agreement between academics, consultants and practitioners on which method(s) is(are) appropriate in certain situations, there is a distinct lack of agreement in other situations. Notwithstanding this problem, the challenge of evaluation has to be confronted and resolved. Organizations need to be able to evaluate their business process changes and the accompanying IT investments. The spirit of Edison might well be invoked:

> There aren't any rules here; we are trying to get something done. (Edison 1995)

As has been seen in this book, there are a large number of tools with which to undertake assessments. Since there is no shortage of tools it follows that, when faced with a specific problem, it is up to evaluators to choose from this bag of tricks that tool or set of tools which they believe is appropriate and effective and which they consider will be credible with senior managers and other decision makers. This last point is important. Part of the difficulty with IT evaluation over the past two decades at least is the tendency of evaluators, when pressed, to fall back on those accounting and financial measures that are common currency (perhaps the lowest common denominator) in the language of business evaluation. In these circumstances, evaluation can become more of a political act[2] than an attempt to come up with meaningful measurement. This is a fact of organizational life against which those who seek meaningful evaluations continuously struggle.

It also needs to be borne in mind that some organizations do not have a measurement culture. These organizations will, of course, keep accounts but they do not see much need to spend time and resources on attempting to calculate detailed performance metrics that try to reflect all their activities. Such organizations believe that it is the action that counts and not the estimates made in advance or attempts to reduce the effect of some activities after the event to a set of numbers. This type of organization also tends to believe that poring over reports of past performance is a distraction from effective current management. Creating evaluation reports does take time as does reading them and reflecting on their

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[2] The term political act here refers to corporate politics which may at times be quite nasty as ambitious individuals jockey for position.

meaning. There are also resources consumed in planning and executing remedial action when such action is needed. ICT consultants may be employed to undertake the evaluation and to report on it and consultants can at least appear to bring a degree of objectivity to this exercise. But consultants are not always as objective as they appear as sometimes they are employed simply to support difficult decisions management has made. They are also expensive. It is perhaps fortunate that there are not many organizations that fall into this category.

15.3 Start with the high-level view

Where there have been attempts to measure IT costs and benefits, one of the features tends to be a considerable focus on detail. Sometimes IT investments are costed[3] at the feasibility stage and estimates of some of the possible benefits are made without understanding the full implications of the system and its role in supporting the process changes that would lead to business benefits. On the more positive side, some of the most effective management of IT value is achieved by just this level of attention to detail. The fact that it is difficult or even impossible to foresee all the consequences of an IT project does not mean that clear goals should not be set and performance against those goals measured. Many organizations are good at the former; surprisingly few are good at the latter. Yet the very process of *ex-post* evaluation is a valuable learning activity for the organization. Organizations which never measure how well they have performed relative to the goals they set forgo a significant opportunity for corporate learning. Some organizations need to learn both about the setting and achieving of targets and about the nature of the unexpected – be that benefit or cost.

The suggestion that managers should focus on business process change, which when supported by appropriate IT investment leads to improvements in efficiency and effectiveness, and thus business benefits, is (to borrow from Wittgenstein) essentially the same as obtaining 'a free view over the whole *single* great problem'. Cronk (2003) calls this process 'holistic construal', the internalization within the mind of the whole picture and the making of a balanced judgement of the value achieved for the cost incurred. This approach places the costs and benefits analysis above the clutter of the detail and allows the big picture to be revealed.

[3] The emphasis here was on low-level detail that did not address the important issues as discussed in Chapter 2.

15.4 Know the purpose of the evaluation

What is also clear is that the measurement and management of IT costs and benefits should not be an *ad hoc* event. It needs to be incorporated into the way that the organization conducts its business. To be able to do this successfully it is necessary to have a clear picture as to how this activity will support corporate objectives. There is no point in evaluating an IT project just for the sake of it. Without a specific objective the energy and the cost of the evaluation is likely to be dissipated, if not entirely wasted. In the worst case the reports produced end up being used as a political weapon with which to achieve some advantage over some party, often, though not always, the IT department or some members thereof.

Establishing the objectives of the evaluation exercise may not be a simple matter as Walsham, Farbey and others have pointed out. Having a clear set of operationally based objectives, related to the ICT investment objectives, makes the evaluation process meaningful as well as more straightforward. If there are any hidden agendas in the evaluation, these will lead to questionable results, from both a practical and ethical point of view.[4]

There is always the question of how objective an evaluation is. Even when working consciously to be as non-partisan as possible it is difficult to produce a fully objective view of the process change and the accompanying information systems investment. As noted above, evaluation, if it not already inherently so, can readily become a political act or process. This is a particular risk when a new IT system impacts on different stakeholder groups in different ways or alters the power relationships in an organization. This is not a problem specific to IT. Many a consultant's report has been the subject of contention within organizations. But as with the problem of method, the problem of objectivity should not be regarded as a reason for running away from the question. The professional evaluator does what he or she can to present a clear and detached picture, to tell it like it is. Once again, it is important to be pragmatic.

15.5 Evaluation is never trivial or inexpensive

The evaluation process is itself a management information exercise. Hopwood, in his discussion on 'Evaluating the real benefits' of information technology,

[4] There are obvious ethical considerations which impinge on ICT evaluation. It would generally be regarded as unethical to conduct an evaluation exercise with the objective of undermining someone or some part of the organization and by so doing obtain an otherwise difficult to achieve advantage.

points out that an evaluation is a complex information processing event (Hopwood 1983).

An evaluation exercise requires the establishment of an inquiring system,[5] the purpose of which is to produce knowledge to support the assessment of the business process or IT investment. This is rarely a trivial task and therefore should not be undertaken without having in place the resources required to do it properly.

There is no body of research related to either how much the evaluation process should cost or how long it should take. Common sense suggests that the evaluation process should not be unduly burdensome and the evaluation activity relatively economical in terms of management time and evidence collection effort.[6] It also sensible that, when setting up an evaluation process, the scale of the evaluation effort should reflect the importance and be in proportion to the size of the project itself. The evaluation work should only be a small part of the project management effort.

15.6 A tool kit

This book offers a wide range of tools and supporting techniques with which IT costs and benefits can be measured and thus managed. These range from business case accounting approaches to value for money studies to user information satisfaction surveys. Some of these tools are designed to be used before the IT investment is made in the so-called *ex-ante* mode, while others are only appropriate to be used once the information system has been in place some time and an *ex-post* evaluation is required. Furthermore, some of the tools are used to evaluate a process change or a single system while others are intended to help in the overall assessment of an information system's function or department or a section thereof. The book leaves it up to the reader to choose which tool(s) is(are) more to his/her own circumstances. It is interesting that, in recent years, the number of new tools and techniques emerging from research has slowed to a trickle. It may not be that there is not much new left under the sun to be discovered in this field – only time

[5] An inquiring system is 'A system which produces knowledge'. A complete discussion can be read in Churchman's book (1971). The term is used here in the sense that to support the final act of evaluation it is necessary to produce knowledge about the substance and the qualities of the system to be evaluated and to produce knowledge about the measurement norms.

[6] It is worth noting that it is quite possible to evaluate the costs and benefits of the evaluation process itself. As Shadish *et al.* (1991) point out: 'We can evaluate anything including evaluation itself.'

will tell. This is not to say that there are no new ideas. Theorists are still looking in fields as diverse as complexity theory, value and option pricing. Whether these will yield new, exciting and practical methods of evaluation remains to be seen.

15.7 A change in culture

First, ABR, which is described in Chapter 14, is not a tool *per se*, but rather a framework for improving the rate of success with the implementation of process change-based IT projects. Although the tools (or perhaps pictures) described in this chapter are important, the approach of employing continuous participative evaluation is perhaps more so. Participative evaluation is sometimes more difficult than it first appears and may require a change in corporate culture, which embraces a higher degree of glasnost or openness than the organization has been accustomed to heretofore. ABR is not for all organizations and especially those that do not have an established climate of openness.

Second, *ex-post* evaluation can be difficult to do in organizations that have a culture of blame. The purpose of *ex-post* evaluation is not only about finding out whether value was received, but to learn why it was or was not achieved. If such an exercise is likely to lead to a search of the guilty, then there will be a cultural reluctance to do it and managers may find their efforts stalled by a variety of territorial games and internal political manoeuvring. For evaluation to be effective, this culture has to change.

Third, evaluation is hard to do in organizations which don't believe in planning in the first place. One of the only 'half in jest laws' of project management is that project teams hate targets as these tend to show up how badly they are doing. Some organizations are reluctant to set targets, or where they do, prefer to make them general (e.g. 'improve sales performance') rather than specific (e.g. 'increase market share by 1.5%'). Fuzzy objectives tend to lead to fuzzy evaluation.

15.8 Summary and conclusion

The work involved in developing a comprehensive understanding and approach to the identification and management of IT costs and benefits is not complete and is unlikely ever to be so. Despite over 40 years of research, IT evaluation remains a lively topic in academia and in the professional and public press. In some ways, IT evaluation has all the hallmarks of an unsolved or unsolvable philosophical problem. Maybe people will still be pondering these things in another two millennia!

That said, there are probably too many issues and concepts, and there are too many different ways of thinking about these issues and concepts, to make it probable that a final position can ever be reached. This should not discourage those who are interested in improving our understanding of this challenging, and at times exasperating, subject.

The secret is to do something and to learn as one goes. Learning may not be guaranteed by experience, but experience, if reflected upon, does help increase understanding.

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APPENDIX A

Glossary of terms

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Artificial intelligence (AI)
An approach to developing systems so that they will function in a way not dissimilar to the human brain. The most frequently encountered application for artificial intelligence is expert systems, which allow very efficient rule processing to be performed.

Benefit
A term used to indicate an advantage, profit or gain attained by an individual or organization.

Bottom-up planning
Bottom-up IS planning is an approach which addresses the current IS requirements and focuses on priority settings and resource allocation to achieve these requirements.

Business vision
The business vision is what the management wants to achieve with the enterprise in the future. A business vision usually refers to the medium to long term. It is often expressed in terms of a series of objectives.

CAD (computer aided design)
A computer system or software package providing facilities for simplifying the design of items. Systems may be specialized towards engineering, architectural or electronic applications.

CAM (computer aided manufacture)
Wide-ranging term to describe computer systems that improve the firm's ability to improve its manufacturing efficiency.

CASE (computer aided systems engineering)
Term used to refer to software products that improve the efficiency of systems planners, systems analysts and systems designers. Some CASE tools will also include code generators that can produce final programs in Cobol.

Corporate strategy
The method through which the firm finds, gets and keeps its clients. In a broad sense it refers to how the firm relates to and interacts with its environment, including its stakeholders.

Cost benefit analysis
The process of comparing the various costs associated with an investment with the benefits and profits that it returns.

Cost leadership
A generic strategy by which the firm presents itself to the marketplace as a low-priced, no-frills supplier.

Critical success factors (CSF)
Those aspects of the business that must be right for the enterprise to succeed in achieving its objectives. It is also sometimes said that even though all other aspects of the business are going well, if the critical success factors are not, then the business will not succeed.

Data processing (DP)
Early term given to the use of computers in business for the purposes of record keeping and providing regular reports to assist in the functioning of the firm. The term was originally referred to as electronic data processing (EDP), but the E was dropped by most members of the industry.

Decision support systems (DSS)
Information systems that support semi- or unstructured decisions in the area of strategic planning, management control or operations control.

Differentiation
A generic strategy by which the firm presents itself to the market as a high quality supplier, and therefore asks for a premium price for its goods or services.

Electronic data interchange (EDI)
Technology that facilitates computer application to computer application communications. EDI is designed to allow structured messages to be transmitted across a network. It relies on adherence to data communications standards. These standards have to include details of how EDI partners are prepared to receive standard business documents such as purchase orders, sales invoices, etc. This means that careful attention must be given to the definition of such documents.

Electronic point of sale (EPOS)
Technology for recording retail sales directly onto a computer. This can be achieved through a variety of devices ranging from computerized tills where operators enter the data, to various forms of scanning machines. EPOS produces instant updates to

inventory records as well as valuable sales information. It can also have a very much lower error rate than traditional systems.

Electronic trading opportunity (ETO)
Use of computers to buy or sell in the marketplace. This is a wide-ranging term and includes systems such as airline reservations through which organizations can sell their services, as well as applications used for purchasing from a vendor or vendors.

End-user computing (EUC)
Term referring to the supply of computer power to management in order to increase its efficiency and effectiveness.

Enterprise Resource Planning (ERP)
An information system whose scope can potentially embrace all aspects of an organization in a highly integrated manner.

Executive information systems (EIS)
Systems used by top executives to assist in the planning and control process of the firm. It involves the use of an information warehouse or repository, which is accessed through a series of easy-to-use tools. EIS also normally implies the use of communications to address external databases.

Factory system
A computer system that assists the firm in achieving its required level of efficiency and effectiveness. These systems are also sometimes referred to as critical information systems (CIS).

Gantt chart
A chart on which activities and their durations are represented by lines drawn to a time scale.

Generic strategy
One of the basic ways in which a firm can find, get and keep its clients. There are two generic strategies, which are *cost leadership* and *differentiation*. A generic strategy may be broad-based or focus on a niche in the market.

Hard cost
Costs associated with an investment that are agreed by everyone to be directly attributable to the investment, and which can be easily captured by accounting procedures.

Hidden cost
A non-obvious cost associated with an investment that may in fact appear to be due to another source.

Industry driver
Condition which directly influences or affects the performance of all the firms in the industry. Examples include major changes in competition, deregulation and new technology developments.

Industry value chain
A concept developed by Michael Porter (1985), which shows how the value chains of individual firms within an industry are related. It is an excellent basis from which to find SIS opportunities.

Information and Communications Technology (ICT)
The term ICT has largely taken over from IT, which was previously used. ICT does give more emphasis to the fact that computing in the twenty-first century is highly dependent on data communication.

Information system (IS)
General term to describe the use of hardware and software to deliver information to businesses.

Information systems department (ISD)
Department in the firm responsible for managing the information systems function. Sometimes also referred to as the information technology department (ITD).

Information technology (IT)
Wide-ranging term to describe the use of computers and telecommunications.

Information weapon
A term used by a number of authors to describe the firm's efforts to gain a competitive advantage through the use of IT.

Intangible benefit
Benefits produced by an investment which are not immediately obvious and/or measurable.

Internal rate of return (IRR)
The return generated internally by an investment throughout its life, also referred to as the yield of the investment.

IT benefit
The benefit produced by an investment in information technology. It is likely that such an investment will produce both tangible and intangible IT benefits.

Just in time (JIT)
Approach to manufacturing which requires raw material to be delivered to a firm exactly when required. The objective of a just in time system is to minimize raw material inventory and work in progress.

Local area network (LAN)
The joining together of a number of personal computers or other devices in a network that operates within a limited geographical area.

Management information system (MIS)
There is no general agreement in the industry as to a precise meaning of the term MIS. Initially, it was used to describe systems that would play an active role in assisting managers make decisions. However, with the arrival of decision support systems and executive information systems, the term MIS has been used to describe information systems that perform routine data processing and supply regular reports.

Management support system (MSS)
Information system that provides reports which assist management in its decision-making function.

Network
A series of important points connected together. In IT terms a network may be defined as a number of computing devices connected together electronically.

Niche
A clearly defined market segment at which the firm aims its corporate strategy.

Office automation (OA)
Provision of computer power to white-collar workers in order to improve their efficiency and effectiveness. The key to an office automation system is its connectivity whereby data is shared between a group of people working in the same office or the same firm.

Opportunity cost
The opportunity cost of an investment is the amount the organization could have earned if the sum invested in IT was used in another way.

Payback
The amount of time, usually expressed in years and months, required for an original investment to be repaid by the cash-in flows.

Project management workbench (PMW)
Software product used to plan and control projects. It produces various forms of Gantt chart, etc.

Return on investment (ROI)
Accounting or financial management term to describe how well the firm has used its resources. It is usually calculated by dividing net profit after tax by total net assets.

Soft cost
Costs associated with an investment that are not readily agreed by everyone to be directly attributable to the investment, and which are not easily captured by accounting procedures.

Software platform
An already existing IS which may be extended so that it acquires a strategic dimension. An example would be a sales order entry system to which clients are given access through an external network so they can monitor the progress of their orders.

Strategic information system (SIS)
An information system that directly assists the organization in achieving its corporate strategy. These applications are sometimes referred to as competitive edge systems.

Strategic option generator (SOG)
A system application developed by Charles Wiseman (1985), which may be used to identify SIS.

Strategic vision
How the top management of an enterprise believes it can achieve its objectives in the medium to long term.

Strategy
The formal use of this word refers to the way a firm finds, gets and keeps its clients. Common usage has reduced the meaning of strategy to be synonymous with plan. See also ‘corporate strategy’ and ‘generic strategy’.

Support systems
Basic record keeping systems that the firm requires to function. These systems are also sometimes referred to as vital information systems (VIS).

Tangible benefit
Benefits produced by an investment which are immediately obvious and measurable.

Technology vision
How the organization considers the application of technology within the business. This term is usually used to refer to a relatively mechanistic application of technology within the firm.

Top-down planning
Top-down IS planning attempts to develop IS which support business objectives and strategies.

Top management
A term used to refer to the chief executive and other senior members of the board of directors.

Transaction processing system (TPS)
Computer system that processes large volumes of data. These systems are normally online or real time.

Turnaround system
Experimental information systems developed by the organization. This is the research and development aspect of the information systems department. It is hoped that turnaround systems will eventually become SISs.

Value activities
The term used by Michael Porter (1985) to describe the individual aspects or functions of an enterprise.

Value chain
A value chain is a method described by Michael Porter (1985) for the detailed analysis of an enterprise.

Value added network (VAN)
A facility whereby an organization can sell its network to third parties, thus allowing them the facility of large-scale data communications without its initial set-up costs.

Vision
Sometimes referred to as strategic vision or business vision, this term refers to how the firm can successfully function in the marketplace in the medium to long term. It usually encompasses how the firm will find, get and keep its clients.

APPENDIX B

Acronyms

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ABR	Active benefit realization
BP	Business picture
CAD	Computer aided design
CAM	Computer aided manufacturing
CASE	Computer aided systems engineering
CBA	Cost benefit analysis
CEO	Chief executive officer
CIS	Critical information system
CSF	Critical success factor
CUI	Character user interface
DCF	Discounted cash flow
DP	Data processing
DSS	Decision support system
EDI	Electronic data interchange
EIS	Executive information system
EPOS	Electronic point of sale
ERP	Enterprise resource planning
ETO	Electronic trading opportunity
EUC	End-user computing
FP	Financial picture
GP	Gross profit
GUI	Graphical user interface
HCR	Health check review
IBP	Initial business picture
ICAEW	Institute of Chartered Accountants of England and Wales
ICT	Information and communication technology
IFP	Initial financial picture
I/O	Input/output
IPP	Initial project picture
IRR	Internal rate of return
IS	Information system
ISD	Information systems department
IT	Information technology
ITAM	Information technology assessment metric
ITB	Information technology budget

JIT	Just in time
KMO	Kaiser–Meyer–Olkin
KPI	Key performance indicator
MBA	Master of business administration
MD	Managing director
MIS	Management information system
MIT	Massachusetts Institute of Technology
MSS	Management support system
NP	Net profit
NPV	Net present value
OA	Office automation
OECD	Organization for Economic Cooperation and Development
PC	Personal computer
PI	Profitability index
PIA	Post-implementation audit
PIN	Personal identification number
P&L	Profit and loss
PLC	Public listed company
PMW	Project manager workbench
PP	Project picture
PSIS	Potential strategic information system
R&D	Research and development
ROE	Return on equity
ROI	Return on investment
ROM	Return on management
SD	Standard deviation
SIS	Strategic information system
SISP	Strategic information systems plan
SOG	Strategic options generator
SPSS/PC	Statistical Package for the Social Sciences/PC-based
TIMIS	Totally integrated management information system
TPS	Transaction processing system
TQM	Total quality management

UIS	User information satisfaction
US	User satisfaction
VAN	Value added network
VDU	Visual display unit
VFM	Value for money
VIS	Vital information system
WAN	Wide area network

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APPENDIX C

Financial measures used in cost benefit analysis

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Payback

The payback may be defined as the amount of time, usually expressed in years and months, required for the original investment amount to be repaid by the cash-in flows. This measure is sometimes used with nominal cash-in flows and sometimes used with discounted cash-in flows. Nominal cash flows are the amounts unadjusted for the time value of money. The most popular form of payback used today is referred to as the exhaust method. The exhaust method of payback calculation involves the deduction of each year's cash-in flow from the original investment until the original amount is reduced to zero. This method should be contrasted with the average payback method which only gives a rough approximation of the period of time required to recover the investment amount when the cash-in flows are relatively constant.

Exhaust method

$$\text{Payback in time (years, months, etc.)} = \text{Investment} - \text{Cumulative benefit}$$

The calculation of the payback by the exhaust method is a reiterative process which requires the cumulative benefit to be subtracted from the investment until the result is zero. The time at which the result is zero represents the period that is required for the investment amount to be returned.

Average method

$$\text{Payback} = \frac{\text{Investment}}{\text{Average annual benefit}}$$

If there is any substantial variability in the annual benefits this method will produce meaningless results. Many organizations use the payback as the primary criterion for deciding whether an investment is suitable or not.

It is generally considered that the cash flows used to calculate the payback should have first been discounted. This is referred to as a discounted payback. If this is done it will produce a time value-based payback measure that will reflect the cost of capital. A discounted payback will always show a longer period than those based on nominal values.

Net present value (NPV)

The net present value may be defined as the difference between the sum of the values of the cash-in flows, discounted at an appropriate cost of capital, and the present value of the original investment. Provided the NPV is greater than or equal to zero the investment will earn the firm's required rate of return. The size of the NPV may be considered as either a measure of the surplus that the investment makes over its required return, or as a margin of error in the size of the investment amount.

$$\text{Present value of benefit} = \frac{\text{Benefit}}{(1+i)^n}$$

Where i = rate of interest
n = number of years

$$\text{NPV} = \Sigma \text{ Present value of benefit} - \text{Present value of investment}$$

The interpretation of the NPV should be based on the following rules:

If NPV > 0 then invest

If NPV < 0 then do not invest

The size of the NPV represents the margin of error which may be made in the estimate of the investment amount before the investment will be rejected.

Profitability index (PI)

The profitability index is defined as the sum of the present values of the cash-in flows divided by the present value of the investment. This shows a rate of return expressed as the number of discounted pounds and pence that the investment will earn for every pound originally invested.

$$\text{PI} = \frac{\sum \text{Present value of benefits}}{\text{Present value of investment}}$$

Internal rate of return (IRR)

The internal rate of return is the rate of interest that will cause the NPV to be zero. It is the internally generated return that the investment will earn throughout its life. It is also frequently referred to as the yield of the investment.

$$\text{IRR} = i \text{ such that NPV} = 0$$

Rate of return or return on investment (ROI)

The rate of return or return on investment, which is sometimes referred to as the simple return on investment, is calculated by considering the annual benefit divided by the investment amount. Sometimes an average rate of return for the whole period of investment is calculated by averaging the annual benefits while on other occasions the rate of return is calculated on a year-by-year basis using individual benefit amounts.

$$\text{ROI} = \frac{\text{Average annual benefit}}{\text{Investment}}$$

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APPENDIX D

Factor analysis

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Factor analysis is the generic term given to a group of multivariate statistical techniques that can be used to identify, from a large pool of variables, the important variables related to a study. Variables that are interrelated in terms of their correlations can be grouped, thereby possibly identifying some otherwise hidden concept(s). The variables that group or cluster together can be combined into a weighted linear combination called a factor, which can then be used to measure concepts not otherwise directly observable. Thus factor analysis can facilitate the reduction of focus to a smaller set of variables, facilitate concept identification and facilitate measurement of these concepts.

The various techniques of factor analysis differ in the manner in which the weights for the variables constituting the factors are determined. The most widely used method for determining factors is that of *principal component* analysis, which is the method used in analysing the responses to the user satisfaction questionnaire as described in Chapter 13. In the sequel the term factor analysis is used as a synonym for principal component analysis.

Factor analysis can be used both for exploratory and confirmatory studies. The use of factor analysis for concept identification illustrates how the technique can be used in an exploratory manner. It is used in a confirmatory sense when, for example, the factor analysis solution is compared to some *a priori* postulation concerning the grouping of the variables into factors. In our study it was used for exploratory purposes.

Once the analyst has identified the variables that are to be analysed, there are three main computational steps to the factor analysis, namely, the construction of a correlation matrix, the extraction of initial factors and the rotation of the initial factors.

Correlation matrix

In factor analysis the starting point is to convert the observations on the variables to a correlation matrix whose elements are the pairwise correlations among the variables being factor analysed. For a factor analysis to be worthwhile in terms of grouping the variables into a smaller number of factors the elements of the correlation matrix should generally display significant correlation. A measure that can be used to decide whether to proceed with a factor analysis is the Kaiser–Meyer–Olkin (KMO) statistic. The KMO is a function of the pairwise correlations between the variables.

Should the calculated KMO be 0.80 or more the factor analysis is likely to lead to substantial simplification of the data set. Should the KMO be below 0.50 then it is unlikely that much will be gained from performing a factor analysis.

Initial factor extraction

The aim of the initial factor extraction is to determine the extent to which the original set of variables, p (say), can be summarized into a much smaller set of factors, m (say), where each of the factors is a linear combination of the original variables. The method of factor extraction described here is that of principal component analysis. The factors are constructed so that they are uncorrelated with one another or as it is sometimes expressed, 'orthogonal to one another'.

Thus through the application of principal component analysis the set of correlated variables is transformed into a set of uncorrelated factors which are themselves linear combinations of the original variables.

The extraction of the principal components or factors can be viewed as being derived in a sequential manner from the original X variables. The model used to extract the principal component factors is (see Lehmann 1989)

$$F_j = I_{j1}X_1 + I_{j2}X_2 + \dots + I_{jp}X_p$$

where

F_j = jth principal component factor
I_{ji} = the coefficient linking the ith variable to the jth factor

$$(j = 1, 2, \dots, p; i = 1, 2, \dots, p)$$

Invariably it is the standardized variables rather than the original variables X that are subjected to a principal component analysis. This approach is particularly important should the original variables be measured on different scales. The standardization procedure reduces all variables to the same units so that the standardized variables all have mean zero and unit standard deviation. When we use standardized variables the principal components procedure is essentially extracting factors from the correlation matrix. In this case the factor loading coefficients I_{ji} are the ordinary correlation coefficients between the ith variable and the jth factor. Thus it is possible in this case to talk in terms of statistical significance and non-significance of the factor loadings. For example, for a sample of 100 respondents to a questionnaire a factor loading of 0.30 will be statistically significant at the 5% level. Thus factor loadings of 0.30 or more can be considered significant.

The components are extracted sequentially in the following manner. The first component is the linear combination of the original variables that explains the most variation in the sample, the second is the linear combination that explains the second most variance and so on for the other factors. It is possible to extract as many principal component factors as there are variables.

Practical considerations require that the number of factors to be retained is determined, as well as those factors that load 'significantly on' or 'belong to' the retained factors. Some guidelines are provided.

First, the importance of the derived factors must be defined and measured. The importance of a factor is determined by the amount of the total variance that it explains, usually expressed as a percentage. The variance of a factor is related to its so-called eigen value. For example, the eigen value for factor j, which is denoted by I_j, is the sum of the squared factor loadings I_{ji} of the original variables with the factor. Thus,

$$I_j = \sum_{i=1}^{p} I_{ij}^2$$

where $j = 1, 2, \ldots, p$.

When working with the standardized variables the sum of the p extracted eigen values must equal the number of variables p. The jth principal component will explain $((I_j/p) * 100)\%$ of the total variance. Also we have,

$$\sum_{j=1}^{p} I_j = p$$

This information can then be used to determine how many factors to retain. There is, however, no hard and fast rule as to how many factors should be retained. Three approaches are frequently used in practice. Approaches include the following (Lehmann 1989):

1. Retain those factors which have an eigen value greater than 1. Since we are working with standardized variables this implies that each standardized variable on its own can be expected to explain $((1/p) * 100)\%$ of the variance and so the eigen value greater than 1 rule will at least ensure that the newly created variable or factor will explain more variance than any one of the original variables on its own.
2. Retain those factors that collectively explain a pre-specified proportion of the total variance.

3. Factors are extracted sequentially until they begin to explain an 'insignificant' amount of the still unexplained variance.
4. The most frequently used approach is the eigen value greater than 1 rule. This is the default option on most statistical software packages, of which SPSS is one.

Rotation of factors

In situations where two or more factors are retained by the principal component analysis we invariably find that the manner in which the variables load onto the factors does not lend itself to interpretation that makes sense. The reasons for this are that we are likely to find that most of the variables load highly on the first principal component or that variables are highly correlated with (i.e. load onto) more than one factor. This is an artefact of the mathematical procedure that determines the factors.

It can be shown that when there are more than two factors retained, neither the factors nor their loadings are unique with respect to orthogonal transformations. There are numerous methods for performing orthogonal rotations with the *varimax* procedure the most widely used.

The purpose of the rotation is to facilitate interpretation by redistributing the variance among the retained factors so that there is little or no ambiguity concerning the factor onto which the original variables load. Thus after *varimax* rotation one is likely to find that if a variable loads highly on one factor then it is likely to load lowly on the other factors. Opinion differs as to what is to be considered a high loading. The authors have found that using loadings of 0.50 or larger regularly leads to satisfactory results. Some practitioners consider loadings of 0.30 as their cut-off.

In practice the meaning of the factor is usually established by identifying the variables that load 'significantly' on the factor and then trying to establish, usually through brainstorming, with those who are knowledgeable in the area being studied, what underlying characteristic is most likely to provide the link between them.

Summary

In order to factor analyse the responses to a questionnaire on user satisfaction, the following steps should be taken:

1. Calculate the correlation matrix. A study of the correlation matrix will provide a 'feel' for how the variables are likely to group.

2. Look at the Kaiser–Meyer–Olkin (KMO) statistic. If the statistic is in excess of 0.70 then it is likely that the factor analysis will lead to substantial reduction in the data. If less than 0.50 there is no need to proceed with factor analysis.
3. Extract factors using the principal components procedure.
4. Decide on the number of factors to be retained. Retain only those factors which have an eigen value greater than 1.
5. Rotate the initial solution using the *varimax* routine. Rotation of the factors precedes interpretation and naming of the factors.
6. Interpret the factors for measuring. Interpretation is facilitated by focusing attention on those variables that load heavily on it. Concentrate only on variables with a loading of 0.5 or more, and then establish, possibly by 'brainstorming' with experts, what it is that links these variables together.
7. Name the factors. An output from the interpretation phase described in 6 above is that each of the retained factors is given a generic name.

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APPENDIX E

Sample sizing scenarios

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Scenario one

International Enterprises plc

International Enterprises plc is an extensive user of personal computers with more than 12 000 installed worldwide. In the United Kingdom alone there are more than 9500 in use.

The firm wishes to conduct a survey to establish how their users regard the personal computer service offered by the firm. It is realized that the total number of personal computer users is too large to be able to survey them all. Therefore it is agreed to use a sampling technique.

After much discussion it was decided that in the first instance only the office system OA2000 would be surveyed. There are 2750 users of this system.

Management have asked the survey team to design the measuring procedure so that they can have 95% confidence that their results will be accurate to within 2%.

1. How big a sample will they need to measure the OA2000 system?
2. How will the sample size change if management change their mind and want to have 99% confidence that their results are accurate to within 1%?
3. After completing the OA2000 review International Enterprises plc want to extend the survey to include all the other users in the United Kingdom. How big must the sample be if management want 5% accuracy and a confidence level of 95%?

There are two ways in which a sample size needs to be calculated. First, there is the issue of measuring a percentage of a population, and second, there is the issue of measuring a mean on a scale.

International Enterprises plc solution

Size of sample required giving management 2% accuracy and 95% confidence.

Sample size to estimate a percentage
In the first instance calculate a sample size assuming an infinite population as described in Chapter 12, section 12.4.8.

$$n = \frac{3.84 \times 50(100 - 50)}{2^2} = \frac{3.84 \times 2500}{4} = 2400$$

Check whether the calculated sample size exceeds 10% of the population size. As it does, then a correction must be made to reduce the sample size.

Apply the sample size correction factor to calculate the appropriate sample size under these circumstances.

$$n' = n \times \left(\frac{N}{N + n - 1}\right)$$

where n' is the appropriate sample size.

$$n' = 2400 \times \left(\frac{2750}{2750 + 2400 - 1}\right)$$
$$n' = 2400 \times (0.534)$$
$$n' = 1281$$

Therefore if 1281 responses are received and the percentage of the sample that holds a particular view is calculated and quoted, then we can be 95% confident that the percentage quoted is accurate to within 2%.

Sample size to estimate the mean response

Again we start by applying the formula assuming infinite population size. Thus,

$$n = \frac{3.84 \times S^2}{E^2}$$

We need to estimate S, the standard deviation, assuming a 4 point scale on the questionnaire:

$$S = \frac{\mathrm{Max}(X_i) - \mathrm{Min}(X_i)}{4} = \frac{4 - 1}{4} = 0.75$$

Therefore $S^2 = (0.75)^2 = 0.5625$.

Now we need to express E in terms of the measurement scale's units.

The measurement scale goes from 1 to 4.

Take $E = 2.5 \times 0.02$. (0.02 corresponds to 2%, which is the required accuracy.) Thus $E = 0.05$. Hence,

$$n = \frac{3.84 \times 0.5625}{(0.05)^2} = \frac{2.160}{0.0025} = 864$$

Again the calculated sample size does exceed 10% of the population size, so a correction must be made to reduce the sample size.

The sample correction factor is applied, giving:

$$n' = 864 \times \left(\frac{2750}{2750 + 864 - 1} \right) = 864 \times (0.761) = 658$$

Therefore 658 responses to the questionnaire are required in order to estimate the mean response to a 2% accuracy with 95% confidence.

Size of sample required giving management 1% accuracy and 99% confidence.

Sample size for percentage p – 99% confidence; 1% accuracy
Proceed as before, but using the appropriate formula.

$$n = \frac{6.66 \times p(100 - p)}{E^2} = \frac{6.66 \times 50(50)}{1^2} = 16\,650$$

(The 6.66 represents 2.58 standard deviations. Some sources use 3 standard deviations, in which case the multiplication factor would be 9 and not 6.66.)

However, 16 650 is more than 10% of the population size, therefore applying the correction factor we get

$$n' = 16\,650 \times \left(\frac{2750}{2750 + 16\,650 - 1} \right) = 2360$$

Sample size determination for the mean – 99% confidence; 1% accuracy
Proceed as above, but using the appropriate formula

$$n = \frac{6.66 \times S^2}{E^2} = \frac{6.66 \times (0.75^2)}{(0.025)^2} = 5994$$

Again there is a need to apply the sample correction formula. Thus,

$$n' = 5994 \times \left(\frac{2750}{2750 + 5994 - 1} \right) = 1886$$

Size of sample required giving management 5% accuracy and 95% confidence.

Sample size to estimate percentage
Applying the formula as before the required sample size is 384. Thus,

$$\frac{n}{N} \times 100 = \frac{384}{9500} \times 100 = 4\%$$

Since the sample size is less than 10% of the population size there is no need to apply the correction formula.

Sample size to estimate the mean
In this case we need to express E in terms of the measurement scale units. Thus we have $E = 2.5 \times (0.05)$. (0.05 corresponds to the 5% required accuracy.)

Also the standard deviation S = 0.75. Hence,

$$n = \frac{3.84 \times (S^2)}{E^2} = \frac{3.84 \times (0.5625)}{0.0156} = 138$$

Scenario two

Engineers Unlimited plc

Engineers Unlimited plc is a large engineering design and consulting firm in the Midlands. The firm has a long tradition of using computers but was relatively slow to acquire personal computers. It has been using various forms of end-user computing for the past five years, but throughout this period there have always been continual complaints.

Engineers Unlimited plc decided to conduct a survey to establish exactly what the end users felt about the systems which were installed and also to find out what new systems the staff felt they should acquire.

There are about 985 end users in Engineers Unlimited plc and a 20 page questionnaire was sent out to all of these individuals. Only 315 completed questionnaires were returned.

1. The firm would now like to know the degree of accuracy and the degree of confidence that it may associate with the results of the questionnaire.
2. It is believed that with a reasonable amount of effort another 75 questionnaires could be rounded up. How would this affect the accuracy and the confidence level?

Engineers Unlimited plc – solutions

The total population is denoted by N and the number of returned questionnaires is n'. Therefore $N = 985$, $n' = 315$ and thus $n' > 10\%$ of N, so the correction factor must be applied.

Estimating the percentage accuracy associated with 95% confidence, sample size n'

$$
\begin{aligned}
E &= \sqrt{\frac{3.84p(100-p)}{n'} \times \frac{(N-n')}{N-1}} \\
E &= \sqrt{\frac{3.84(2500)}{315} \times \frac{(985-315)}{985-1}} \\
E &= \sqrt{\frac{(9600)}{315} \times \frac{(670)}{984}} \\
E &= 4.6\%
\end{aligned}
$$

(Note: If n' is small relative to N then $\dfrac{N-n'}{N-1} = \textit{approximately } 1$)

Therefore the percentage accuracy associated with 95% confidence is 4.6% for a sample size of 315.

Accuracy achieved when estimating the mean

$$E = \sqrt{\frac{3.84(0.5625)}{315} \times \frac{(985-315)}{985-1}} = \sqrt{0.0047} = 0.07\text{units}$$

Therefore if the sample mean is 2.5, the estimate of the true mean is accurate to 0.07 units with 95% confidence.

Accuracy achieved when estimating the percentage using an additional 75 questionnaires

$$
\begin{aligned}
E &= \sqrt{\frac{3.84(2500)}{390} \times \frac{(985-390)}{985-1}} \\
E &= \sqrt{14.89} = 3.86\%
\end{aligned}
$$

Therefore the percentage accuracy if another 75 questionnaires are included is 3.86%.

Accuracy achieved when estimating the mean

$$E = \sqrt{\frac{3.84(0.5625)}{390} \times \frac{(985-390)}{985-1}} = \sqrt{0.0033} = 0.06 \text{ units}$$

Therefore the additional 75 questionnaires improve the accuracy of the estimate of the mean from 0.07 to 0.06 units.

APPENDIX F

Measurement of IS effectiveness – a questionnaire

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PART A – Please supply the following information about your position:

1 In which department or section do you work (tick one)?

☐ Inland Operations
☐ Operations Services
☐ Infrastructure Planning
☐ Strategic Planning
☐ Public Affairs
☐ Information Services
☐ New Works
☐ Analytical Services
☐ Process Services
☐ Geographic Information Systems
☐ Finance & Administration
☐ Human Resources
☐ Other, please specify

2 How many years have you been working in the organization? ____

3 How many years' experience have you had working with a PC or terminal? ____

4 How many years' experience have you had working with a PC network or mainframe? ____

5 How many hours per week do you use a PC or a PC network or mainframe? ____

PART B – Expectations under ideal circumstances

Please respond by ticking the number that corresponds to how much you agree or disagree with the following statements of expectation, ***given an ideal situation***.

		Strongly Disagree … Strongly Agree
1	I expect ease of access to computing facilities.	1___2___3___4___5___6___7___8___9___
2	I expect up-to-date hardware.	1___2___3___4___5___6___7___8___9___
3	I expect up-to-date software.	1___2___3___4___5___6___7___8___9___
4	I expect access to external databases.	1___2___3___4___5___6___7___8___9___
5	I expect a low percentage of hardware and software downtime.	1___2___3___4___5___6___7___8___9___

		Strongly Disagree Strongly Agree
6	I expect a high degree of technical competence from systems support staff.	1___2___3___4___5___6___7___8___9___
7	I expect to have a high level of confidence in the systems I use.	1___2___3___4___5___6___7___8___9___
8	I expect to have a high degree of personal control over the systems I use.	1___2___3___4___5___6___7___8___9___
9	I expect the ISD to be responsive to my changing needs.	1___2___3___4___5___6___7___8___9___
10	I expect confidentiality for my own data.	1___2___3___4___5___6___7___8___9___
11	I expect a provision for disaster recovery.	1___2___3___4___5___6___7___8___9___
12	I expect piracy avoidance procedures to be in place.	1___2___3___4___5___6___7___8___9___
13	I expect excellent system's response time.	1___2___3___4___5___6___7___8___9___
14	I expect excellent technical training.	1___2___3___4___5___6___7___8___9___
15	I expect fast response time from support staff to remedy problems.	1___2___3___4___5___6___7___8___9___
16	I expect to participate in the planning of system technology requirements.	1___2___3___4___5___6___7___8___9___
17	I expect a positive attitude from support staff.	1___2___3___4___5___6___7___8___9___
18	I expect overall cost effectiveness from information technology.	1___2___3___4___5___6___7___8___9___
19	I expect the use of IT to improve my personal productivity.	1___2___3___4___5___6___7___8___9___
20	I expect the use of IT to enrich my working experience.	1___2___3___4___5___6___7___8___9___
21	I expect standardization of hardware.	1___2___3___4___5___6___7___8___9___
22	I expect excellent documentation to support technical training.	1___2___3___4___5___6___7___8___9___
23	I expect help to make the most of my application software.	1___2___3___4___5___6___7___8___9___

		Strongly Disagree Strongly Agree
24	I expect to be able to communicate by e-mail with colleagues.	1___2___3___4___5___6___7___8___9___
25	I expect to have access to the World Wide Web.	1___2___3___4___5___6___7___8___9___
26	I expect to find the time to learn the systems I use.	1___2___3___4___5___6___7___8___9___
27	I expect there to be a service level agreement in place.	1___2___3___4___5___6___7___8___9___
28	I expect IS professionals to monitor their performance in delivering IT services.	1___2___3___4___5___6___7___8___9___
29	I expect prompt processing of requests for changes to existing systems.	1___2___3___4___5___6___7___8___9___
30	I expect IT to be aligned to the overall corporate plan.	1___2___3___4___5___6___7___8___9___
31	I expect there to be short lead times for the development of new systems.	1___2___3___4___5___6___7___8___9___
32	I expect systems analysts to understand my business requirements.	1___2___3___4___5___6___7___8___9___
33	I expect a high degree of flexibility in the system with regards data and reports.	1___2___3___4___5___6___7___8___9___
34	I expect the portfolio of software applications available to me to be continually increased.	1___2___3___4___5___6___7___8___9___
35	I expect the benefits derived by myself from the systems I use to be measured.	1___2___3___4___5___6___7___8___9___

PART C – Actual performance

Please respond by ticking the number that corresponds to how much you agree or disagree with the following statements of performance, ***i.e. what actually happens***.

		Strongly Disagree ... Strongly Agree
1	I have easy access to computing facilities.	1___2___3___4___5___6___7___8___9___
2	I have up-to-date hardware.	1___2___3___4___5___6___7___8___9___
3	I have up-to-date software.	1___2___3___4___5___6___7___8___9___
4	I have access to external databases.	1___2___3___4___5___6___7___8___9___
5	I experience a low percentage of hardware and software downtime.	1___2___3___4___5___6___7___8___9___
6	I experience a high degree of technical competence from systems support staff.	1___2___3___4___5___6___7___8___9___
7	I experience a high level of confidence in the systems I use.	1___2___3___4___5___6___7___8___9___
8	I have a high degree of personal control over the systems I use.	1___2___3___4___5___6___7___8___9___
9	The ISD is responsive to my changing needs.	1___2___3___4___5___6___7___8___9___
10	I have confidence in the confidentiality for my own data.	1___2___3___4___5___6___7___8___9___
11	I am satisfied with the provisions made for disaster recovery.	1___2___3___4___5___6___7___8___9___
12	I am satisfied with the provisions made for piracy avoidance.	1___2___3___4___5___6___7___8___9___
13	I experience excellent system's response time.	1___2___3___4___5___6___7___8___9___
14	I receive excellent technical training.	1___2___3___4___5___6___7___8___9___
15	I experience fast response time from support staff to remedy problems.	1___2___3___4___5___6___7___8___9___

		Strongly Disagree / Strongly Agree
16	I participate in the planning of system technology requirements.	1___2___3___4___5___6___7___8___9___
17	I experience a positive attitude from support staff.	1___2___3___4___5___6___7___8___9___
18	I am satisfied with the overall cost effectiveness of our information technology.	1___2___3___4___5___6___7___8___9___
19	The use of IT improves my personal productivity.	1___2___3___4___5___6___7___8___9___
20	The use of IT enriches my working experience.	1___2___3___4___5___6___7___8___9___
21	I have standardization of hardware.	1___2___3___4___5___6___7___8___9___
22	I receive excellent documentation to support technical training.	1___2___3___4___5___6___7___8___9___
23	I receive help to make the most of my application software.	1___2___3___4___5___6___7___8___9___
24	I am able to communicate by e-mail with colleagues.	1___2___3___4___5___6___7___8___9___
25	I have access to the World Wide Web.	1___2___3___4___5___6___7___8___9___
26	I find the time to learn the systems I use.	1___2___3___4___5___6___7___8___9___
27	There is a service level agreement in place.	1___2___3___4___5___6___7___8___9___
28	IS professionals monitor their performance in delivering IT services.	1___2___3___4___5___6___7___8___9___
29	I experience prompt processing of requests for changes to existing systems.	1___2___3___4___5___6___7___8___9___
30	IT is aligned to the overall corporate plan.	1___2___3___4___5___6___7___8___9___

		Strongly Disagree Strongly Agree
31	I experience short lead times for the development of new systems.	1___2___3___4___5___6___7___8___9___
32	Systems analysts do understand my business requirements.	1___2___3___4___5___6___7___8___9___
33	I experience a high degree of flexibility in the system with regards data and reports.	1___2___3___4___5___6___7___8___9___
34	The portfolio of software applications available to me continually increases.	1___2___3___4___5___6___7___8___9___
35	The benefits derived by myself from the systems I use are measured.	1___2___3___4___5___6___7___8___9___

PART D

Please rate your ***overall opinion*** of the computer services offered by the information systems department.

	Strongly Disagree Strongly Agree
On the whole our information systems are excellent	1___2___3___4___5___6___7___8___9___

Please supply any further comments you wish concerning the effectiveness of your computer network system.

____

____

____

____

____

____

____

____

APPENDIX G

Active benefit realization – a questionnaire

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Part One – The business opportunity or problem identification and validation

1 Does your organization have a formal procedure for identifying business opportunities or problems?

Yes ☐ No ☐

2 If the answer to question 1 is yes, briefly describe how this formal procedure operates.

____

3 If the answer to question 1 is no, how are business opportunities or problems identified?

____

4 How frequently does IT play a role in assisting your organization to exploit a business opportunity or to solve a business problem?

All the time ☐
Some of the time ☐
Occasionally ☐
Hardly ever ☐

____

5 If IT is hardly ever perceived as a facilitating agent to assist your organization with its business opportunities or problems, what do you regard as the main purpose or function of your information technology?

____

6 When IT is identified as an important aspect of the solution to the business problem or opportunity, who normally points out the role which IT can play?

IT staff ☐
Eventual users of the system ☐
Administrators ☐
Consultants ☐
Others (please specify) ______________________________

7 Does your answer to question 6 differ depending on the size of the project or the type of application?

Yes ☐ No ☐

8 If the size of the project is critical is that size measured in terms of person years, money amounts or other?

____

9 Is a formal definition of a business problem or opportunity produced?
Yes ☐ No ☐

10 If the answer to question 9 is yes, what does the formal definition look like?
Half-page written description ☐
Calculation of cost reduction or profit improvement ☐
Other (please specify) ____________________

11 Proposed or suggested IT projects may sometimes be inappropriate, i.e. too expensive or inconsistent with the organization strategy. How do you check to see if the proposed IT system is relevant and appropriate?

____

12 In performing a relevance and appropriateness check which of the following do you use?
Strategic alignment test ☐
Internal benchmarking ☐
External benchmarking ☐
Brainstorming techniques ☐
Some other technique (please specify) ____________________

Part Two – Stakeholder issues

13 How many different types of stakeholders are typically involved or concerned with a major IT project?

____

14 Although each project will have a different set of stakeholders, are there certain groups of stakeholders that will be involved in almost all projects? If so who are these?

____

15 How are appropriate stakeholders identified and who does this identification?

____

16 Are formal stakeholder meetings convened?
Yes ☐ No ☐

17 If the answer to question 16 is yes, how frequently are these meetings held?

____

18 On the assumption that there are primary and secondary stakeholders of the IT project, which stakeholders would you normally regard for a typical project as primary and which as secondary?

____

19 Are the eventual users of the systems always included among the stakeholders?

Yes ☐ No ☐

20 If the answer to question 19 is yes, how influential is the eventual owner in the project decision making?

____

21 Do you attempt to involve top management (someone at director level or someone reporting to a director) as a stakeholder?

Yes ☐ No ☐

22 If the answer to question 21 is yes, would you attempt to sustain the attention of top management throughout the project and if so how would you do this?

____

23 How important is the issue of partnership between the stakeholders?

Essential ☐
Very ☐
Quite ☐
Not at all ☐

24 If you consider the issue of partnership to be essential or very important how do you attempt to create a partnership approach and how successful are you in this endeavour?

____

25 Who makes the final decision whether to proceed with an IT project?

Senior managers ☐
Eventual users ☐
IT staff ☐
Accountants and administrators ☐
Others (please specify) ______________________________

26 At what stage in the project is the eventual ownership of an information systems project identified?

At the outset ☐
When the project is authorized ☐
During project production ☐
At testing ☐
When the project is commissioned ☐

27 How are the eventual owners of the information system identified?

____

Part Three – Feasibility study issues

28 Does your organization generally perform a formal information systems feasibility study?

Yes ☐ No ☐

29 If the answer to question 28 is yes, are information systems costs and benefits estimated?

Yes ☐ No ☐

30 If the answer to question 29 is no, how are the decision criteria for approving an information systems project presented?

____

31 If the answer to question 29 is yes, how are these cost estimates obtained?

Vendor supplied ☐
From internal know-how ☐
Use consultants ☐
Others (please specify) ____________________________

32 When benefits are estimated, how is this done?

Stated as financial numbers in the form of single point estimates ☐
Stated as financial numbers in the form of range estimates ☐
Stated as business issues such as higher customer satisfaction ☐
Other (please specify) ____________________________

33 If benefits are stated as business issues such as higher customer satisfaction how will it be established whether these benefits have been, in due course, delivered?

____

34 Are any benefits, either financial or business, validated as appropriate by establishing whether they are aligned with the organization's corporate CSF?

____

35 If financial figures are used in the feasibility study which investment indicator is calculated?

Payback ☐
ROI ☐
NPV ☐
IRR ☐
Other (please specify) ____________________________

36 Are solution alternatives considered as part of the process of deciding whether or not to proceed with a project?

____

37 At what stage, if ever, do your project management procedures address the question of risk?

____

38 Could risks be identified and associated with different benefits, different CSFs and different stakeholders?

____

39 Do the feasibility study or any other aspects of the preparation process for a project require an outcome statement?

____

Part Four – Culture gap issues

40 Sometimes there are language difficulties in discussing information systems, especially when information systems staff and eventual users have to exchange ideas about a system. How do you attempt to minimize communication problems between these groups?

____

41 At the time of the project being initiated which of the following issues have been resolved?

The budget ☐
Who the system's champion will be ☐

The system delivery date ☐
The test data ☐
User's responsibility ☐
System's ownership ☐
Strategic implication of the system ☐
Other (please specify) ________________________________

42 How long does it typically take (in months) from system's concept initialization to project approval?

____

APPENDIX H

Issues addressed in effectiveness surveys

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Functioning of existing transaction/reporting systems

The following represents the issues on which the 38 questions in the Miller–Doyle effectiveness measurement instrument are based.

- Completeness of output information
- Accuracy of output information
- Presence of monitoring systems
- Relevance of report contents
- Currency of output information
- Volume of output information
- Report availability and timeliness
- More exception systems

Linkages to strategic processes in the organization

- Top management involvement
- Strategic IS planning
- Business-related systems priorities
- Using database technology
- Overall cost effectiveness of IS
- Use of steering committee

Amount and quality of user involvement

- Users' feeling of participation
- Users' control over IS services

Communication between IS and user management

- Users' understanding of systems
- Users' confidence in systems

Responsiveness to new systems needs

- Prompt processing of change requests
- Short lead time, new systems development
- Responsiveness to changing user needs
- IS support when users prepare new systems proposals
- Flexibility of data and reports

End-user computing

- More analysis systems
- More enquiry systems

- Effective training of users
- Ease of user access to systems

Quality of IS staff

- User-oriented systems analysts
- Competence of systems analysts
- Technical competence of IS staff
- Larger IS effort to create news systems
- Positive attitude to IS by users

Reliability of service

- Low percentage of hardware and systems downtime
- Efficient running of current systems
- Data security and privacy

APPENDIX I

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