# White Paper

*"The evaluation and management issues across system portfolios and lifecycles."*

# Information Technology Investments

*Evaluation and management of information systems/technology investments*

## 1. Introduction

This paper will investigate the above by covering the following topics.

- Why analyse IT Investments?
- IS/IT Management Cycle
- System Portfolios
- System Lifecycles
- Measuring IT value
- Evaluation Methods
- Common Problems with Evaluation Methods
- Benefits of Evaluation

These are discussed below.

## 2. Why Analyse IT Investments?

Before one accepts the proposition that "The evaluation and management of information systems/technology investments has always been difficult", one has to look at why you should focus on Information Technology (IT) at all.

IT is a business. It has all the pressures of any business, but it is strange. For every reason one might want to go into it there is a corresponding reason not to. A "Catch 22".

Increasingly, as IT expenditure has risen and as the use of IT has penetrated to the core of organisations, the search has been directed towards not just improving evaluation techniques and processes, and searching for new ones, but also towards the management and 'flushing out' of benefits.

### 2.1 Pressure of business

In Berger's (1992) article "Critical Issues in IS" (Information Systems), he states that:

> *"Businesses are refocusing on bottom-line costs, customers and quality to increase financial performance and better compete. Competitive advantage always has been and always will be the Holy Grail of business.*
>
> *Tighter, flatter organisations, calling for greater accountability, are having a greater impact on IS as they push to downsize, outsource and consolidate capital-intensive mainframe systems.*
>
> *Keeping up with technology alone is a full-time job.*

He goes further in the article by stating that management responsibility is no longer measured by the amount of budget and people one directly controls, but it is measured by the impact one plays in creating competitive advantage from the use of IT delivering solutions in a reasonable time frame and managing the cost of doing so. It is measured by the effective management of the outsourcing and downsizing teams.

This places extreme pressure on the IT department, it's staff and management.

Cutting costs while still delivering value is one of the greatest challenges facing any business let alone and information systems / technology business. But what misses out or get put off to next year?

Berger (1992) believes that maintaining the corporate infrastructure and providing mission-critical applications will always be the backbone of information technology budget planning. But how?

Berger (1992) points out that IS technological challenges are also becoming more complex. Control and ease of use conflict. This is seen in the emerging technologies such as distributed environments and electronic document management. Keeping up with technology alone is a full-time job without having to manage the business as well.

## 2.2  Catch 22

Willcocks (1996) and Berger (1992) both speak of the need for business and IT to be partners for any business to improve. This partnership is a strange one. It is full of conflicts and contradictions

Some managers would agree that IT has penetrated their businesses but find it hard to justify any further expense! They simply find it difficult to identify the benefits.

Some businesses have had IT become such an integral part of the business that it was fundamental to the way everyday business activities were conducted. This had two different effects.

One was that the business used IT for competitive reasons and therefore to either stay ahead or just to compete with the competition the business could simply not afford NOT to invest.

With IT being such an integrated part of business, Management finds or is finding it increasingly difficult to separate technology savings and benefits.

The fundamental problem is that management in business does not see IT as a Capital Asset. Typically software is only seen as an expense or overhead. Failure to appreciate the size of this investment leads to IS/IT being under managed, a lack of serious attention to IS evaluation and control, and also a lack of concern for discovering ways of utilising this IS asset base to its full potential.

If you look at who is the "management" they are typically accountants or engineers. These two disciplines deal with numbers or values. To communicate effectively and to understand the problem a value measurement system is essential. But how?

Financial reports usually reduce performance to a single number, such as return on assets or gross profit. Human resource reports present such numbers as employee turnover or hours lost per month from accidents. IT reporting should be simple and numeric.

## 3. The IS/IT Management Cycle

Before identifying the issues that effect the measurement of IT investments you need to first understand how the management process works.

Willcocks (1996) in the book "Investing in Information Systems: Evaluation and Management", believes that a management cycle is what is important in the evaluation process. Figure 1 below is a simple diagrammatic representation of the concept.

The process followed is simply described by Willcocks (1996). The table below is taken directly from the process described by Willcocks (1996).

*Table 1 Process for IS/IT evaluation*

| Step | Process |
|------|---------|
| 1 | Identify the net benefits through strategic alignment and prioritisation |
| 2 | Identifying types of generic benefit and matching these to assessment techniques |
| 3 | Developing a family of measures based on financial, service, delivery, learning and technical criteria |
| 4 | Linking these measures to particular measures needed for development, implementation and post implementation phases. |
| 5 | Ensuring each set of measures run from strategic to the operational level. |
| 6 | Establishing responsibility for tracking these measures, and regularly reviewing results. |
| 7 | Regularly reviewing the existing portfolio, and relating this to the business direction and performance objectives. |



**Figure 1 IS/IT evaluation and the management cycle.**

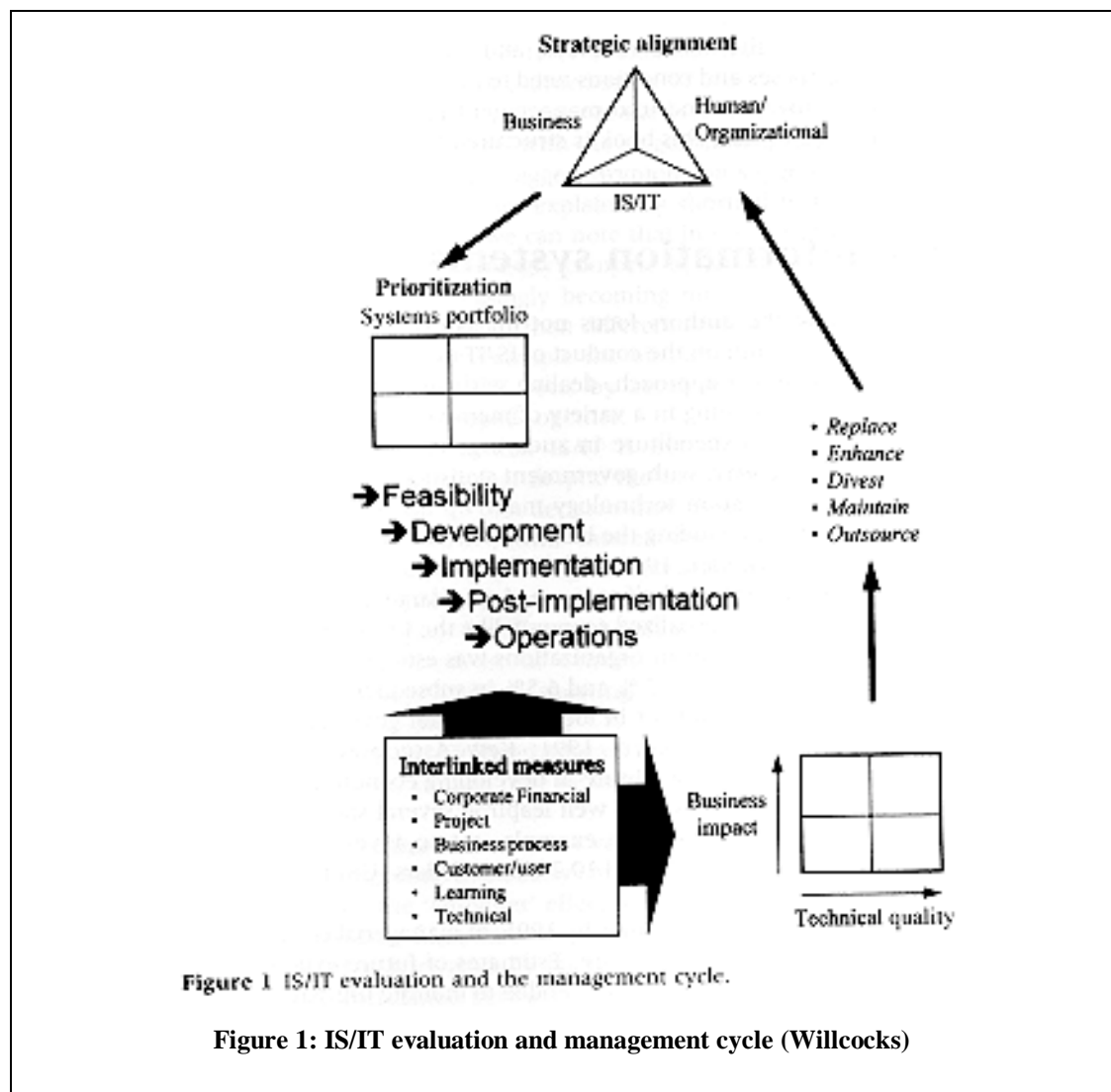**Figure 1: IS/IT evaluation and management cycle (Willcocks)**

*Figure 1 IS/IT evaluation and the management cycle (Willcocks (1996) pp6*

## 4. System portfolios

Going back to the question to be discussed.

> *"The evaluation and management of information systems/technology investments has always been difficult.  Discuss the evaluation and management issues across system portfolios and lifecycles."*

What is the meaning by the term *system portfolios?*  System portfolios are the grouping of System applications into specific classifications.  In 1984, McFarlen put forward the "Strategy Grid" to enable IT Application systems to be classified into four groups.  The grid is illustrated below in Table 2.

*Table 2 McFarlen IT Strategy Grid*

| | |
|---|---|
| Strategic | High Potential |
| Key Operational | Support |

The reasons for the classifications of systems into portfolios is in my opinion a way to organise for priorities and to assess what systems (or user demands) will get their share of limited resources.

Simply portfolios are required to:

- Classify the demand for different systems by the business
- Prioritise these demands and assess the IT investment required

### 4.1  Other Factors that affect priorities

In the research for this paper I found that McFarlen Strategy Grid was only one way of working out the priorities.

Figure 2 below is collated from work by Farbey, Land & Taggart (1992), Hochstrasser (1994), Willcocks (1994).  It illustrates the other factors that may affect the decision to invest in an IT system.
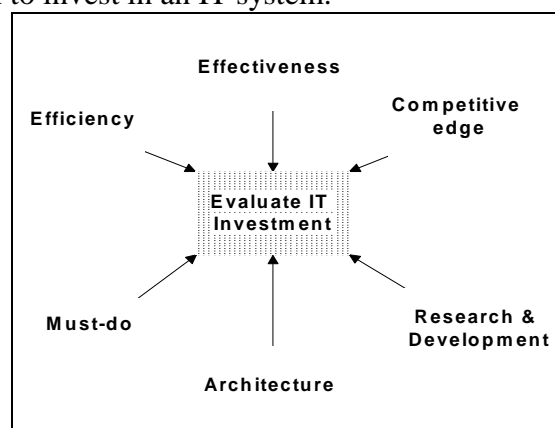


*Figure 2 Factors that affect the prioirity of a system*

Once the decision to invest is made the investment must continue to be managed.

## 5. System Lifecycle

Having decided to invest in IT you then have to evaluate the different projects as they develop. Using the traditional "waterfall" lifecycle Lester and Willcocks (1996) reviewed 250 organisations and presented the results. Figure 3 illustrates the results of their research.

Their research clearly showed that as an IT project developed through the lifecycle little or no further evaluation took place. This is highlighted by the solid black area in Figure 3.
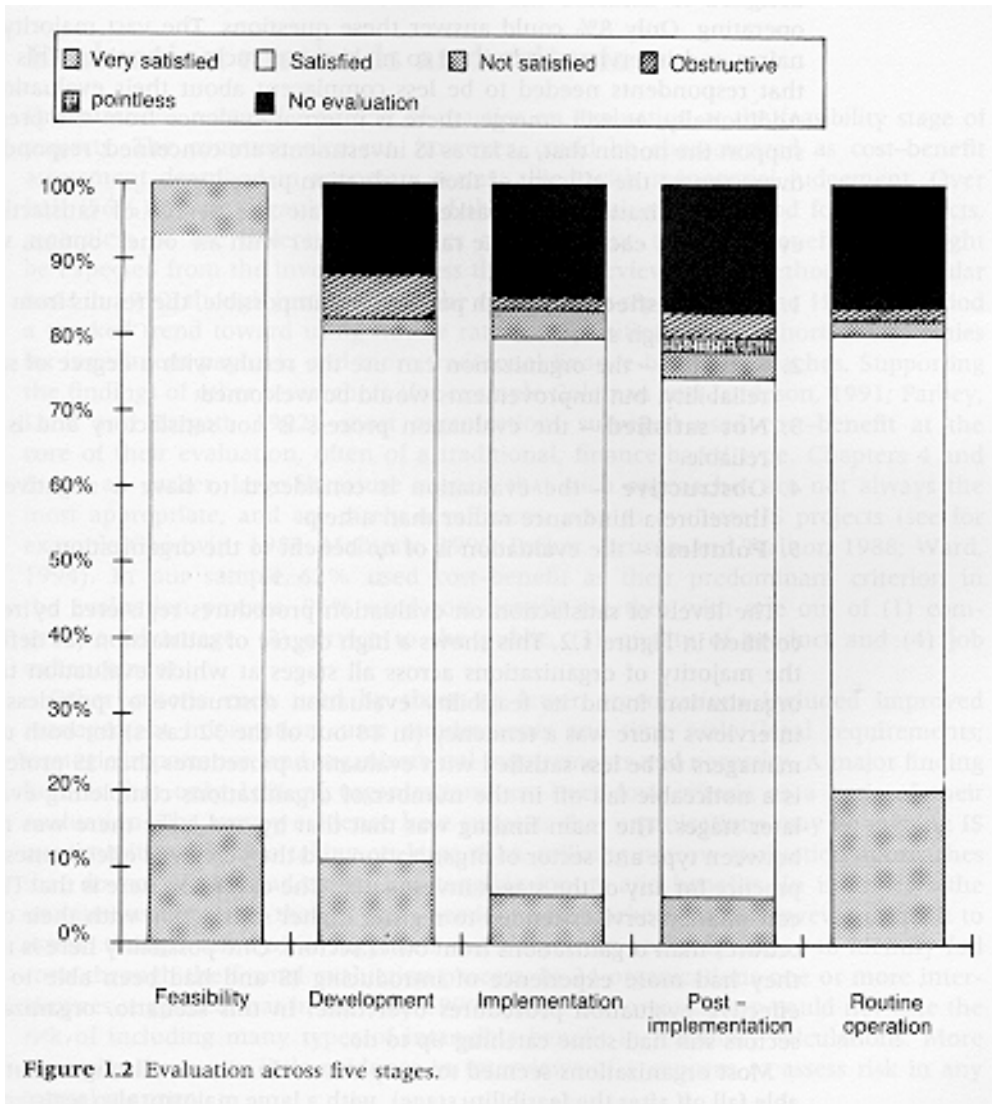
Results for each cycle are described below.



Figure 1.2 Evaluation across five stages.

*Figure 3 Evaluation across system liefcycles(Lester & Willcocks(1996))*

## 5.1 Feasibility Stage

According to Lester and Willcocks (1996) in the Proposal or Feasibility stage the financial and non-financial acceptability of a project was measured against defined organisational requirements and this was assessed against the priorities

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between proposed projects.  "Acceptability' was defined in terms of cost, benefit value or socio-technical considerations.

## 5.2  Development Stage

In Lester and Willcocks (1996) book, Subhash V Parulekar states that during development a project should be monitored in terms of cost, time and performance measures.

Stages of evaluation such as systems testing and acceptance may be included in the development methodology.  The use of different development tools and techniques, eg. prototyping, 4GL, CASE, may imply less clear boundaries between stages and so require different evaluation techniques.

Lester & Willcocks (1996) survey also included asking what methodology was used.  The results are shown in table 3 below.

| Methodology | Organisations |
|---|---|
| SSADM | 7 |
| Phased review | 1 |
| Common sense | 1 |
| BIS Modus | 1 |
| Prototyping | 1 |
| Organisation's own method | 17 |
| No method mentioned | 1 |
| SSADM and organisation's own method | 5 |
| Risk assessment | 1 |
| SDM | 1 |
| Cost-benefit | 1 |
| PRISM | 1 |
| AA Method | 1 |
| No standard method | 3 |
| SSADM, PRINCE and PROMPT | 1 |
| Varies | 1 |

*Table 3: Evaluation methods at development stage (Lester & Willcocks (1996))*

Why this is included is unknown.  What it does show you is the diversity of methods used and that some confusion existed with the respondent.  "Common sense" and "Cost benefit" are not methodologies.  Willcocks does not provide any details if the methodologies contained processes for measuring the productivity of the development phase.

Table 4 below does show you some of the evaluation methods used by the organisations. The majority used some form of numeric evaluation by using the size of the project they were developing.

| Evaluation Method | Organisations |
|---|---|
| Discretion of local director/manager | 3 |
| 4th Generation language uses own method | 1 |
| Size | 11 |
| Executive Management decision | 2 |
| IT committee | 1 |
| Various | 1 |
| Finger in the air | 1 |
| No answer | 1 |

*Table 4: Criteria by which evaluation methods were selected in 21 organisations (Lester & Willcocks)*

### 5.2.1  Development Evaluation

For those organisations that actively used a method for evaluating development, Willcocks posed the questions of what developments were abandoned because of unsatisfactory results.

Table 5 represents reasons given by organisations who abandoned the project in or at the end of the development phase.

*Table 5 Reasons for Abandonment (Lester & Willcocks (1996))*

| | Number of Organisations |
|---|---|
| **Organisation giving one reason** | |
| Over Budget | 4 |
| User requirements change | 3 |
| Organisation needs change | 7 |
| Costs/risks change | 1 |
| **Organisation giving more than one reason** | |
| Over Budget | 13 |
| Organisation needs change | 16 |
| User requirements change | 19 |
| Newer technology available | 2 |
| Higher priority elsewhere | 1 |

Lester and Willcocks (1996) states that 80% of organisations had to abandon projects at some time during this stage. The major reason was going over budget.

## 5.3  Implementation Stage

Lester and Willcocks (1996) found that in the Implementation stage most organisations (86%) used some form of evaluation.

Of the organisations surveyed:
- 36% stated that they only used the evaluation to learn about any changes required during the implementation.
- 33% stated they would use the information for future projects.
- 5% determined acceptability of the end system or to correct design or performance.
- 21% used a combination of the above criteria.

Two organisations used the evaluation to release payment and one used the evaluation decision for a go/no go decision on the project.

## 5.4  Post Implementation Stage

According to Willcocks (1996) 20% of organisations did not evaluate at post implementation stage.

Of those that did Norris  (1996) stated that two of the organisations made direct comparison with the original proposal or feasibility study while one based evaluation on ensuring that business objectives were not being met.  37 of the organisations surveyed used a combination of these criteria.

Of 40 organisations that did an evaluation at Post implementation review:
- 83%     made a direct comparison with feasibility study
- 63%     evaluated the cost effectiveness of the final solution
- 53%     reviewed the quality of product
- 48%     based their evaluation on the availability of the system
- 44%     evaluated the productivity on the business
- 22%     surveyed the job satisfaction the system allowed.

Norris (1996) states that not all of the organisations used all of the criteria.  15% used a combination of all of them while another 15% used all but did not include job satisfaction.  A further 10% used all of them but did not include job satisfaction and quality of product as criteria.

### 5.4.1  How to do a Post Implementation Review

In Norris' (1996) article in Willcocks (1996) book, he describes a process for doing a post implementation review (or audit, as he calls them).  This is illustrated in Figure 4 below.
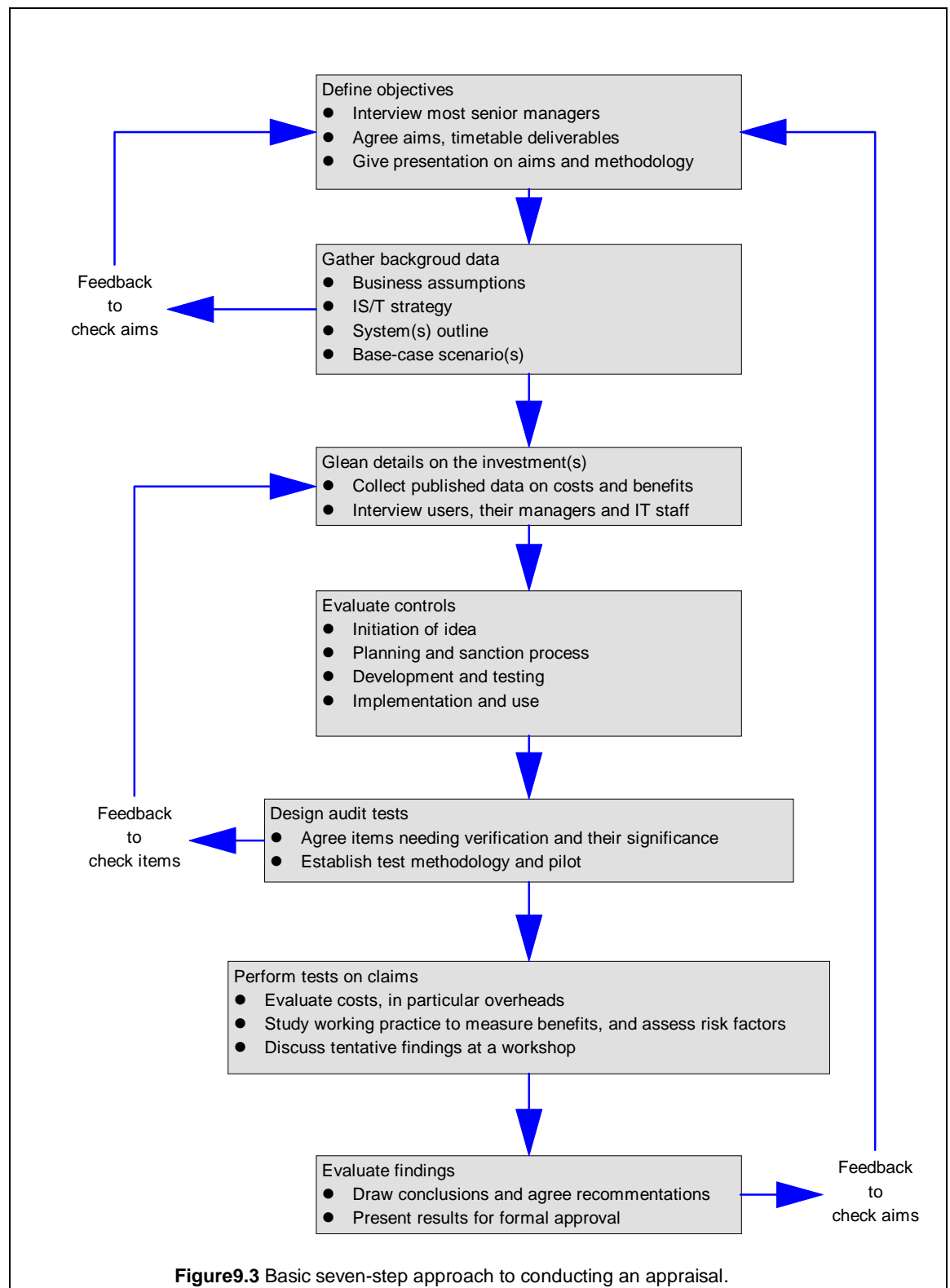
**Figure9.3** Basic seven-step approach to conducting an appraisal.

*Figure 4: Excerpt for Lester & Willcocks (1996) Figure 9.3 pp207*

Simply, Norris (1996) proposes the following stages:
1. Define Objectives
2. Gather background data
3. Glean details on the investment(s)

4. Evaluate controls
5. Design audit tests
6. Perform tests on claims
7. Evaluate findings

This seven-step process involves checking aims and inspecting the results.  It involves "quantifying" the criteria.  ie. turning the criteria into numbers.

## 5.5  Routine Operation

Lester and Willcocks (1996) found very little research in the Operations, Maintenance or Routine Operation phase.  Those that did used the criteria included in Table 6 below.

*Table 6 Major Evaluation Criteria Lester & Willcocks (1996) pp32*

| Criteria | Organisations |
|---|---|
| System availability | 26 |
| System capabilities | 18 |
| Organisational needs | 16 |
| Departmental needs | 15 |
| Response time | 3 |
| Cost | 2 |
| IS department operational constraint | 1 |
| System reliability | 1 |
| Traffic on communication lines | 1 |
| Technical currency | 1 |

Even though Lester and Willcocks said that they found little evidence of Investment criteria their results showed that 83% of the organisations surveyed had some form of continuous monitoring in place.

In my experience this would be the norm where a mainframe or substantial IT infrastructure was in place.  Table 6 clearly illustrates that System availability was the number one criteria.

Most Operation managers have been using some form of quantitative reporting for a long time.  Uptime and Downtime graphs have been a regular part of life in Australian Corporate IT for some time.  This group has been used to measuring their systems if not their value.

## 6.  Basic Principles for Measuring Value

But how do you measure.  This section details the basis principles of measuring IT value.

In Carlson and McNurlin (1992) article  "Basic Principles for Measuring IT Value" they looked at the increased importance of information technology investments and what companies did to evaluate or measure these investments.

## 6.1 Benchmarking

They specifically looked at benchmarking. The "before" and "after" measurements and how that related to business performance.

They found that few companies did it and one reason was there was no measurement framework within the organisation. Another was the lack of basic principles for guiding measurement programs.

I think they were saying that IT and business measurements are not different. They focussed on quality and how this had been used to measure businesses and their effectiveness or performance.

Examples they gave included Eastman Kodak Company and Federal Express. Both of these organisations won the coveted "Malcolm Baldridge award" for quality.

Measurement within Kodak's Management Services Division began in 1987 to answer management's questions about quality: What are our key processes? How well are we doing them? and How do we plan to improve them? This division answered management's questions by defining two key processes - system delivery and system support - and proposed measuring quality and efficiency in both areas, using 1988 as the baseline.

Kodak have started a portfolio management system which contains an inventory of the division's systems, along with each one's age, customer, technology platform, maintenance team, and two quality indexes.

The *functional quality index* is created by asking the users whether the application contains the appropriate functions, if the data is reliable, and so forth. The *technical quality index* is derived by asking questions of the maintenance staff.

Using this application repository, Kodak's Management Services Division now has the facts to help user management create an information technology (IT) investment strategy. Carlson and McNurlin (1992) state that by reviewing the complete portfolio of applications, Kodak's functional management can better evaluate the risks of remaining on an obsolete technical platform as well as decide what to do with systems that do not meet users needs.

Carlson and McNurlin (1992) noted that the Management Services Division was measuring productivity using function points per labour month and measuring quality using defects per 100 function points.

Federal Express was a similar story. Federal Express, with headquarters in Memphis, Tennessee is the leading overnight package carrier in the world.

One of the cornerstones of their quality effort was their decision to track failures rather than percentages of success. Their failure measure, Service Quality

Indicator (SQI), is the sum of the daily averages in 12 failure categories.  These categories include:

- failures as missed pick ups,
- lost package,
- delivery on wrong day,
- late delivery on right day,
- customer request about package status.

Although focused on the customer's view some failures are more severe than others. The day they achieved the lowest SQI - 99.7% service level- was the same day they also achieved the lowest cost per package.

## 6.2  Eleven Guiding Measurement Principles

Carlson &  McNurlin (1992) suggest that if you wish to improve you need to measure.  With measurement you can then evaluate.  This could then be used for IT investment or value.

Carlson and McNurlin (1992) believed that most organisations didn't know how to measure and put forward eleven principles for measurement.

These were:
1. Credibility starts with proven systems department efficiency.
2. Business and technology factors need to be integrated.
3. Both business performance and quality need to be measured.
4. No single measure is available.
5. Executives must be educated.
6. Quality Management requires strong participation by the I/S department.
7. Models now exist.
8. Benchmarking is essential.
9. Poor systems quality hurts business performance.
10. High effectiveness of the systems department leads to high organisational performance.
    - Linking office worker productivity with IT
    - Linking firm performance and IS department effectiveness
11. Asset accounting is essential.

## 7.  Evaluation Methods

In Farbey and Targett (1992) article "Evaluating Investments in IT they define what a method is.

> *The criteria by which a system should be judged must reflect the nature and purposes of that system.  An evaluation method must therefore include, or provide a means for establishing, these criteria. For example, if a system investment is made for strategic purposes, to increase revenue, then the system must be evaluated using a method which includes increased revenue as a criterion for evaluation.*

Once you take these measurements what do you do with them?

You use different methods to evaluate the results.

During my research three basic categories of techniques materialised.  These were Traditional, Modern and Experimental methods.

### 7.1  Traditional Techniques for Investment

Traditional techniques generally fell into the following subcategories.
- Cash Flow analysis
    - Return on Investment (ROI)
    - Cost benefit analysis
    - Net Present Value (NPV)
- Efficiency

Each of these are described below. These have been taken from Farbey and Targett (1992) article unless otherwise indicated.

### 7.1.1  Return-on-investment (ROI)

The method is derived from classical cost accounting.  Costs of developing, implementing and operating the system are estimated and compared with the value of the benefits it is anticipated the system will generate.  The method is used where the benefits can be directly attributed to  the change of system and are realised in the form of cost savings or cost displacement.

### 7.1.2  Cost Benefit Analysis

Cost benefit analysis (CBA) is an approach that attempts to find (or compute) a money value for each element contributing to the cost and benefit of a development project.  The approach originated as an attempt to deal with the problem that some elements regarded as benefits or costs have no obvious market value or price whilst other elements incur costs or achieve benefits which are 'external' to the company making the investment.

In CBA all benefits and costs are assigned a money value based on some notion of valuation. The resulting cost-benefit values can be fed into a decision model based on one of the standard ROI methods. The main weakness of classic cost-benefit analysis is the artificial nature of some of the surrogate measures. In practice the recommendations coming from cost-benefit analysis are often overturned by decision makers who cannot accept the values selected by the analysts.

Information economics is a variant of CBA developed specifically for evaluating information technology projects.

### 7.1.3  NPV

Net Present Value(NPV) is another form of Return on Investment(ROI).

## 7.2  Modern IT investment appraisal frameworks

Modern techniques include:
- SESAME
- RoM (return on Management)
- MOMC
- Boundary Values
- Value Analysis
- Kobler Unit Framework
- The application transfer team (ATT) approach
- Holistic Approach

Each of these are described below. These have been taken from Farbey and Targett (1992) article unless otherwise indicated.

### 7.2.1  SESAME

In this method the cost-benefit from a project is derived by computing what the costs would have been if the same functionality as the proposed system had been delivered by non-computer-based methods. The net benefit is the computed cost minus the costs of the new system.

### 7.2.2  ROM

Return on management (ROM). ROM is defined as the residual value after deducting from total revenue the cost and value added by each resource, including capital, but excluding management, and the cost of management. ROM is best suited to evaluating existing systems.

### 7.2.3  Multi-objective, multi-criteria methods (MOMC)

Multi-objective, multi-criteria methods (MOMC)start from the assumption that the value of a project can be measured in terms other than money. MOMC allows decision-makers to appraise the relative value of different outcomes in terms of their own preferences.

They can rank goals by applying a preference weight to each. The end result is to evaluate the project in terms of a utility rather than money.

### 7.2.4 Boundary Values

Boundary values provides a crude check on the comparative spend on IT systems. They were first proposed by James Martin in 1990 and are often based on ratios of total IT expenditure against other known aggregate values. A typical ratio would be total IT expenditure against total revenue, or against operating expenses. Other ratios used include IT costs per employee, and net benefits attributable to IT systems against IT expenditure.

The ratios can be used in two ways. As a rough guide on the level of IT expenditure for which the enterprise should plan. Alternatively, they can be used as a check on the efficiency of the IT group in the enterprise.

### 7.2.5 Value Analysis

Value analysis attempts to evaluate a wide range of benefits including intangible benefits. The method is based on the notion that it is more important to concentrate on value (added) than on cost saved. To get at value the intangibles must be assessed. eg. value analysis may use an iterative approach, such as the Delphi method, to provide answers.

Until recently the precise impact of introducing new systems could only be estimated because the investment in developing a system to the stage of getting actual impacts was very high. Today a range of software development tools and simulation methods make it possible to develop a prototype or model of the new system rapidly and cheaply.

### 7.2.6 Kobler Unit Framework

The Kobler Unit Framework consists of four modules. The first involves evaluating the proposed project against a checklist of critical success factors. The second is to define a clear understanding of true costs of the proposed IT system prior to evaluation and the third is the identification and specification of business performance indicators in comparison to the relative merits of an alternative IT system.

The fourth is the collation of these into a framework. This is suppose to be a practical and readily implemented method that allows adaptation to specific requirements.

### 7.2.7 The application transfer team (ATT) approach

The ATT approach identifies three stages of cost justification. These are:
1. Concept - considers strategic issues
2. Calculations -quantify high level justifications
3. Control - monitor costs during project implementation

The system is relatively complex and time consuming and appears to require a high degree of commitment from a large team of managers.

### 7.2.8  Holistic Approach
This is where surveys are conducted into such issues as:
- User Satisfaction
- Three gap approach
- Survey of IT effectiveness

It is typically time consuming and costly to collate and report.

## 7.3  Experimental appraisal frameworks
There are three main categories of experimental method:
- Prototyping involves the rapid development of a prototype form of the system typically using a 4th generation language.
- Simulation probably has the longest history.
- Gameplaying can be used to assess the outcome.

These have been taken from Farbey and Targett (1992).

## 8.  Problems with Evaluation Methods

Both Traditional and Modern methods have a problem with when the evaluation is done.  The time and the level at which it is carried out is important.

### 8.1.1  Inadequacies of Traditional Method
Willcocks (1996) states that the major problems with traditional evaluation methods are to do with:
- Estimation Problems at the beginning of the project or plan
- Unquantifiable factors exist at the beginning ie.  The Crystal Ball
  - $\Rightarrow$ System performance
  - $\Rightarrow$ Non economic factors
- System structure: An unstructured, ill-defined system will be much more expensive to develop than a similar system that is well planned and documented.
- Risk is usually unknown.  ie. Not all risks are known.
- Holistic methods find it hard and costly to collect survey information for large organisations and that wording of questions can be very difficult.

### 8.1.2  Inadequacies of Modern Method
Farbey & Targett (1992) found that the inadequacies of the modern methods were a lot simpler.  They were:
- No  coherent methodology.  All the methods were new and needed time to be tested .
- Intangible benefits were either not handled or were very subjective.  This lead to the same problems as in the traditional methods.  eg. Estimation.
- Estimation.  eg.  Estimates for future revenue

## 9. The Benefits Achieved

### 9.1.1 No single measure is available.

Carlson W & McNurlin (1992) state that their research indicated that IT managers learn quickly to explain to business executives they have to speak in simple numbers based on analysis of proven relationships and that no single measure is available.

They need to use many different ones that are either tied to the business or are understood by other business management.

### 9.1.2 Education

Historically, top executives have spent a large part of their time enforcing the KISS (Keep it Simple) principle   But there is no simple answer to quantifying the benefits from using IT.

Carlson and McNurlin (1992) state that in manufacturing many of the benefits are intangible, - eg.  employee satisfaction, fewer meetings, more sales calls, etc., even though these may be watched and trended.

Carlson and McNurlin found that executives need to be shown and frequently reminded that uncovering IT payoffs requires careful study of five different sources of value in a formal framework.  These are:
- Technical
    * efficiency of IS activities
    * effectiveness of IS management to handle new demands
- Business
    * efficiency of operations
    * effectiveness of business units in remaining competitive and gaining market share
- Company wide programs

The key to success lies in creating a reporting system that covers each of the five areas of the framework and educating management on their needs.

## 10. Summary

Glen Peters (1996) summarised the IT management issues affecting business today.  He looked at what made a good company.  He found that the Companies that succeeded had positive attitudes and had the following qualities.
- Had Steering committees (or project boards)
- Members followed project from start to post implementation
- Members were accountable or took responsibility for benefits
- All benefits were measurable variables
- Not necessarily costs terms eg. sales calls per day
- Steering committees regularly reviewed for benefits

- concentrated on finding benefits missed in original study

All of the Projects had clearly defined responsibilities and criteria that was measurable.

Peters (1996) stated that where specific criteria was used the project typically *over performed* their original criteria.

All of these projects had four basic qualities. This paper has reviewed these. They are:
1. That evaluation criteria has to be measurable (or quantifiable)
2. It should be clearly stated at the beginning of the project and continually reviewed during the lifecycle.
3. Many different criteria should be used.
4. Formal methods should be used. These may be traditional or modern, but they must be consistent across the whole organisation (e. Kodak and Federal Express)

Management issues in IT are no different to any other business. They require the involvement and backing of senior management in all aspects of a project, not simply the initial stages.

Management involves the review of the process and the inspection of the final product. IT unlike most products requires a discipline to formulate various metrics to measure its success or failure.

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