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Investment appraisal for information technology—the experience of the English Heritage record of scheduled monuments

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2.1 Introduction

In both the public and the private sectors, there is an increasing emphasis on the need to identify the costs and benefits attributable to alternative methods of meeting objectives. This process can be used to assess and justify computing proposals, not merely as a test of financial viability, but also as a basis for decision-making and the monitoring of a project. The decision-making must be related to the aims of an organisation and how its computing resource should be exploited to achieve those aims. It must also be related to information technology strategy.

In the civil service and elsewhere, simple techniques of investment appraisal (IA) have been evolved to approve and monitor projects and these can be applied to computing proposals of any scale. They include a total assessment of cost over the life of a project, (and it sometimes surprising how these can mount up even for quite modest systems), and ways of assessing the quantifiable and unquantifiable benefits of a proposal. Hardware and software are not usually the major cost compared with staff time on input and editing, consultancy, maintenance, accommodation, training and consumables over a period of years.

Some of the questions which may be asked to test the appraisal are what risk is there that the system will fail to provide the expected benefits, or, are the benefits sensitive to increased costs or the loss of key members of staff? What level of risk or speculation is acceptable and what is the level of probability? Is all the expediture 'upfront' with the benefits arising in five years' time and what are the implications for cash flow?

In this paper, I will define briefly the process of IA as defined by the Treasury, refer to the wider context of procurement decisions and summarise IA as applied by the decision to provide a new computer-based record of scheduled monuments at English Heritage.

2.2 Investment appraisal as defined by HM Treasury

IA is defined by the Treasury guidelines (HM Treasury 1984) as a systematic approach to expenditure decisions which entails deciding clearly on the objectives, the various ways of meeting them and working out and presenting the costs and benefits of each option. It seeks to question and challenge what is being done and sets the tone for rational thought about the use of resources. It does not eliminate risk or speculation, indeed, it may show that a greater risk than originally proposed is worthwhile or that greater expenditure will produce greater returns.

The sequence often followed is;

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1. To define the objectives of a project,
2. To consider the options for meeting those objectives, of which one may be to do nothing and examine the full consequences and another to attempt the maximum possible,
3. To identify the costs, benefits, timing and uncertainties of each option,
4. To discount those costs and benefits which can be quantified in money terms and present a net present value (NPV) for each option,
5. To state and analyse the qualitative benefits, if genuinely unquantifiable, (at the very least, unquantifiable benefits should be analysed in terms of standards of service),
6. To weigh up uncertain factors and assess any other relevant issues,
7. To present the results for decision-making.

2.3 The context of investment appraisal

In this paper I shall be arguing the IA is not just a bureaucratic device but that, used properly, it can assist in determining solutions and monitoring the extent to which projects satisfy their original expectations, particularly in terms of benefits. In the case of the English Heritage computer-based mapping system, (Clubb 1988), an IA demonstrated that the project needed to be expanded to include listed buildings as well as scheduled monuments in order to realise maximum benefits.

IA alone cannot justify all projects since there are also human, intuitive and cultural dimensions. IA is only part of a wider process and not always the most important part.

2.4 Investment appraisal and 'willingness to pay'

In the past, it has been much easier to regard 'heritage' benefits in terms of service alone, rather than the financial value of benefits. However, service has an associated cost which must be met, even in the public sector.

The use of information technology often seems inevitable in an information age. The decision to embark upon a computer application is usually at least partly based on a feeling that a computer solution is correct in terms of the quantity of data to be handled, or the complexities of information handling, or the calculations required or the numbers of users involved. However, all organisations and activities, even universities and pure research, may be subject to externally imposed measures of performance, often of a crude nature. 'Gut' reactions and professional judgement on the one hand and performance indicators on the other may seem miles apart, but they tend to come together at the level of 'willingness to pay'.

To take one example outside the world of archaeology, how much should British Rail spend on safety, bearing in mind that the more spent on safety the less is available for station modernisation and new trains etc? It has been argued (Jones-Lee 1989) that in purely economic terms safety improvements should only be carried out as long as their value exceeds the cost. We can only estimate this if we have explicit costs and benefits. It is relatively easy to estimate the costs of specific safety improvements. I understand that the Department of Transport have traditionally set a value on human life in terms of output through working career. However, most of us value safety because of an aversion to death or injury rather than a desire to protect future

earnings. Ultimately, therefore, the value of our own lives to ourselves depends on how much we are willing, or able, to pay to avoid a transport injury.

Another example a little closer to home concerns the joint proposal of English Heritage and the Royal Commission on the Historic Buildings of England for a national computerised data-base of listed historic buildings. In 1986, the Environment Select Committee of the House of Commons (House Of Commons 1987) expressed surprise that details of the 400,000 or so listed historic buildings in England were not held on a computer data-base. In the following year, a joint English Heritage/RCHME report (unpublished) to the Department of the Environment (DoE) dealt with the costs and benefits of such a data-base. The DoE has consistently taken the view that the costs of such a system should be carried by those who benefit from it. Clearly, DoE themselves, English Heritage and RCHME could be considered to come into this category, as, perhaps, could local authorities. However, if the net is widened, there may be a number of commercial interests who might gain benefit from such a data-base, including publishers of magazines which exploit interests in period houses and 'country' lifestyles and their advertisers who wish to target the readers of such magazines. Certain types of developer and estate agent might also be interested. Current (1989) feasibility studies into this project are likely to take account of (and possibly carry out market research into) the possible value to such organisations and the likelihood of contributions from them.

Both the examples quoted here show that the value of activities may be some distance away from those providing the service. This has implications in terms of 'willingness to pay'.

2.5 The English Heritage record of scheduled monuments

The existing data-base for records of scheduled monuments (RSM) has been discussed (Booth 1988). As early as 1986 it was recognised that a complete replacement would be required in order to service the scheduling process and the number of additional scheduled monuments anticipated in the course of the Monuments Protection Programme (MPP). Indeed, the existing computer system is approaching the end of its useful life.

The main outputs required from the new system are as follows;

1. Documentation arising from the scheduling process, ie the generation and circulation of scheduling proposals, preliminary notification letters, recommendations to the English Heritage Ancient Monuments Advisory Committee and Commissioners, preparation of recommendations and associated documentation and the generation of the published lists of monuments.

2. Generation of reports to English Heritage Inspectors on the receipt of new management information following the visits of Field Monument Wardens to monuments.

3. Generation of statistics and other data on site management in order that overall resource requirements and priorities for management action subsequent to scheduling can be identified.

4. Reports from the data-base required in the course of case-work, eg distributions of particular monument types, monuments under threat, monuments under management agreements.

5. Output, mainly in magnetic form for data-transfer to RCHME and county-based Sites and Monuments Records.

2.6 Net Present Value

The analysis of costs and benefits is concerned to see if projects are worthwhile from a financial point of view. Almost all projects produce benefits later than costs. However, the value of money spent today tends to fall compared with money spent later. There may be balances to be struck, eg between increased investment now and increased running costs at a later date. In order to estimate the value of a proposed investment and its costs over a protracted time-scale, compared with other options, Discounted Cash Flow or Net Present Value (NPV) can be used to bring all the data back to one common point of time, ie to work out the present value. Discounted costs can then be subtracted from discounted benefits.

The familiar basic discount formula (DF) is expressed to give a factor by which to multiply the original figure by, hence;

$$DF = \frac{1.0}{(1.0 + r)}t$$

where r = rate of discount expressed as a decimal (eg 5% = 0.05) and t = number of years

2.7 Quantifiable costs and benefits

The project costs are set out in Table 2.1, ie non-recurrent costs of £200,900, recurrent costs building up to £57,616 pa and a total project cost of £605,380 over project life.

The discounted cash flow (DCF) is shown in Table 2.2 which gives a DCF of £537,142, after the application of the DF based on Treasury discount tables.

The quantifiable benefits arise from two main sources. Firstly, the administrative processes associated with MPP require increased administrative staff. On a worst 'scenario' basis, it is estimated that a 10–15% increase in productivity is possible. This amounts to the equivalent of four staff who it will not be necessary to deploy for this purpose. These benefits are shown under the heading 'scheduling' in Table 2.2.

Secondly, the supply of information from the system in the course of case-work is estimated to lead to a 5% increase in productivity, (shown as AMD in Table 2.2).

These benefits are quite considerable over the life of the project, ie valued at £757,184, discounted to £612,673. Consequently, the quantified costs and benefits taken together produce a NPV of £75,531. This is not a vast return on the original investment, but is, at least, a positive figure.

2.8 Alternative solutions

Three main alternatives were investigated, ie a fully manual system, a micro-based system, (largely the 'status-quo'), and a system of networked micros controlled by a central file-server.

The fully manual system involved dispensing with the exisiting computer-based record and the various mico-computers already in use for office systems. The additional staff required to provide a basic service over a seven-year period were estimated to cost about £3m and the option was not considered viable.

A more realistic option was a micro-assisted project. This was very largely the 'status-quo'. which provides for word-processing, basic data-bases and simple monitoring of progress. This option failed to make any additional improvements in staff productivity and resulted in a negative NPV of −£384,057, in effect most of the project costs since the productivity arising from the 'status quo' had already been taken into account in the staffing levels provided for MPP.

1. Non-recurrent costs	£
Terminal × 12 (local)	13,400
Terminal support equipment	5,600
Printers × 4 (local)	1,800
Auxiliary storage (600 mbytes)	11,700
Processor	59,300
Tape Drive	19,200
Console printer	1,400
Cabling etc	500
Operating software	23,000
Application software	32,000
Software development	33,000
Total N/R	200,900

2. Recurrent costs	*Y0*	*Y1*	*Y2–7*
Maintenance	Nil	25,112	25,112
Consumables	Nil	5,000	5,000
Additional staff	8,168	24,504	25,504
Training	5,000	3,000	1,000
Total R	13,168	57,616	55,616

3. Total project cost (Year 0–7) = £605,380

Table 2.1: Project cost

Discounted cash flow

	88/89 0	89/90 1	90/91 2	91/92 3	92/93 4	93/94 5	94/95 6	95/96 7	TOTAL
Noncurrent	£187,900	£13,000	£0	£0	£0	£0	£0	£0	£200,900
Recurrent	£13,168	£57,616	£55,616	£55,616	£55,616	£55,616	£55,616	£55,616	£404,480
Total costs	£210,068	£70,616	£55,616	£55,616	£55,616	£55,616	£55,616	£55,616	£605,380
Cumulative cost	£201,068	£271,684	£327,300	£382,916	£438,532	£494,148	£549,764	£605,380	£605,380
DF	1.000	0.952	0.907	0.864	0.823	0.783	0.746	0.711	—
DCF	£201,068	£67,226	£50,444	£48,052	£45,772	£43,457	£41,490	£39,543	£537,142
Cumulative DCF	£201,068	£268,294	£318,738	£366,790	£412,562	£456,110	£497,599	£537,142	£537,142

Benefits and NPV

	88/89 0	89/90 1	90/91 2	91/92 3	92/93 4	93/94 5	94/95 6	95/96 7	TOTAL
Scheduling	£0	£36,118	£72,236	£72,236	£72,236	£72,236	£72,236	£72,236	£469,534
AMD	£0	£0	£26,150	£52,300	£52,300	£52,300	£52,300	£52,300	£287,650
Total Benefits	£0	£36,118	£98,386	£124,536	£124,536	£124,536	£124,536	£124,536	£757,184
Cumulative Benefits	£0	£36,118	£134,504	£259,040	£383,576	£508,112	£632,648	£757,184	£757,184
DF	0.000	0.952	0.907	0.864	0.823	0.783	0.746	0.711	
Discounted Benefits	£0	£34,384	£89,236	£107,599	£102.493	£97,512	£92,904	£88,545	£612,673
Cumulative Discounted Benefits	£0	£34,384	£123,620	£231,220	£333,713	£431,224	£524,128	£612,673	£612,673
Discounted net Benefits	(£201,068)	(£32,842)	£38,792	£59,547	£56,721	£53,964	£51,414	£49,002	£75,531
MPV =	£75,531								

Table 2.2: Discounted cash flow

The option of a network of micro-computers linked by a central file server merited more detailed consideration. This would provide office automation facilities and the use of elementary data-bases to handle indexing and searching. Local micro-computers would be connected via a local area network to a high capacity disk storage. The option produces some of the benefits of the preferred option, ie those resulting from the scheduling process, but not those associated with case-work. The costs of this option over 7 years were quite high, (£497,950, discounted to £438,204). The scheduling benefits were £469,950, discounted to £383,573, producing a negative NPV of −£54,631. There was concern that the option would provide a limited service without any significant interactive use by those needing to consult the records or to drive the administrative processes associated with scheduling and case-work.

2.9 Unquantifiable benefits

The unquantifiable benefits of the project are summarised as follows;

1. A complete, accurate and updatable base of data is essential to ensure the effective application of scheduling legislation and the management of monuments with statutory protection.
2. It will provide the opportunity for action to be taken in the light of knowledge of the state of scheduled monuments and their management, including statistics. It should lead to more effective policies for monument management and conservation in the light of priorities for action.
3. It should lead to the better provision of information to Government ministers, the DoE and local authorities on the stock of scheduled monuments and their characteristics.
4. Automatic transfers of data between local authorities, RCHME and English Heritage will encourage more integrated conservation computing and record-keeping.
5. There will be opportunities to monitor staff output and performance.
6. There will be opportunities to develop confidence and expertise among staff and a contribution towards staff morale and to enhanced effectiveness and reduction of routine clerical work.

Some of the unquantifiable benefits could be subjected to cost-effectiveness appraisal, but only in terms of an investment appraisal on the value of conservation itself.

In general, unquantifiable benefits should be subjected to some form of cost-effectiveness assessment, at least in terms of the standard of service provided, expressed in financial value, wherever possible.

2.10 Uncertainties

The next stage in the IA process was to consider the uncertainties on the basis that activities rarely turn out as expected. The main potential uncertainties for the RSM were whether the savings in staff productivity would be realised and whether the software development costs had been accurately estimated. In addition, staff costs may. or may not, keep pace with inflation. The less staff are remunerated over time, the less the financial savings arising from productivity benefits will be. Uncertainty may move in two directions since the benefits may be more or less than expected and

many computer projects have resulted in advantages not considered at the time of justification.

There are two main approaches to uncertainty, ie risk analysis and sensitivity.

In risk analysis, the aim is to quantify the potential differences between the estimated outcome against a range of expectations from the optimistic to the pessimistic. The object is to force project leaders to think about potential problems in advance and to identify the critical elements determining the success or failure of the project and the probability of those risks actually occurring. Also, the optimistic view may identify benefits not thought of, perhaps a long way from the original project boundaries, and these may help to establish who is receiving value from the system.

Sensitivity testing around the central assumptions of a project is intended to quantify the effects of uncertainties on the outcome, firstly by identifying the key elements and then varying them to calculate a series of new overall outcomes.

An example of the approach is that the rate of inflation on wages is currently higher than increases in the costs of computing equipment. It may be necessary to apply differential inflation rates to different elements of the options. This tends to favour machines rather than employees, depending on assumptions about exchange rates affecting the prices of imports.

In calculating the NPV for the English Heritage system we had already built in an element of risk analysis since the costs and benefits had been calculated on the basis of the most pessimistic 'scenario' which would result in a positive NPV. The main areas of uncertainty evaluated in detail included the following;

1. The solution proposed did not involve 'leading edge' technology. There was no reason to believe that the requirement was not achievable through the solution proposed or that the computing environment would not be supported by suppliers in the foreseeable future.

2. Most of the proposed users of the system had at least some keyboard experience and no significant user resistance was expected.

3. The requirement had evolved during a period of 18 months thought and analysis.

4. The main area of uncertainty related to the costs of software development. It was decided that any additional expenditure here must be subject to a separate IA for which the Project Team would take responsibility in the first instance.

2.11 Conclusions

The project was approved by the Treasury in November 1988. The process of securing approval had taken about 12 months and this paper does not pretend to deal with all the issues and analysis carried out. The IA was a requirement of the Treasury and all aspects of the system were subjected to considerable scrutiny.

In many respects, the IA did not produce any new evidence to be taken into acccount in the procurement decision, particularly since a viable alternative to the proposed solution did not emerge. Also services such as improved management information cannot be valued in purely financial terms. In addition, in a world of uncertainty, intuitive judgement by those with experience is highly relevant. However, English Heritage will be able to undertake the development of the system with a full awareness of the costs and their implications, together with the potential risks and pitfalls and can take management action to avert or mitigate them.

The IA demonstrated that the financial benefits were relatively sensitive to variations in the levels of productivity actually achieved. The extent to which English Heritage was prepared to finance any shortfall (ie a value which is less than the

investment) depended on the unquantifiable benefits and the strong view of those most directly concerned as users and curators of the data that the system was essential and that the relatively small financial benefits had been calculated on a pessimistic interpretation of likely events.

The test of the accuracy of the IA will emerge in the course of the project implementation. However, it has already provided a firm base for the monitoring of the project. This will include the direct costs and benefits and the major state of the world asumptions against which the original proposal was framed. There will be a need for post-implementation reviews and retrospective appraisals in order to ensure that best value is secured for the cost and that the project is questioned and challenged and continues to receive rational thought and planning. It will also ensure that lessons are drawn from any mistakes made.

It is a requirement of human psychology that people at work need to feel justified and valued, just as in other areas of life. Disciplines such as archaeology will be increasingly challenged unless an attempt is made to place value on the services provided, particularly since they consume resources provided by someone. The costs of services and their relationship with potential paymasters are coming into sharper focus as certain types of archaeological service are privatised, (or partially so). Methods of evaluating such service outputs are being refined and improved constantly and the profession should be prepared to embrace them to ensure that funds for continuing activity are forthcoming.

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