

# Some Issues in Building System Dynamics Models designed to improve the Information Systems Investment Appraisal Process

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## **Abstract**

*This paper examines issues in the Information Systems (IS) Investment Appraisal process. It discusses factors that should be incorporated in a system dynamics (SD) model designed to conduct an IS Investment Appraisal exercise.*

*There is evidence that organisations perceive that they are not getting a satisfactory financial return from their IS investments.*

*There may be a variety of underlying reasons for this problem, ranging from difficulties in recognising and measuring the benefits realised by the information systems to managerial and technical failures in the IS development process, but for this perception to have arisen, there must be problems in the techniques utilised for evaluating IS investments.*

*The paper assesses the potential usefulness of SD in exploring IS Investment Appraisal issues. A conceptual model of the 'IS Investment Appraisal Process' is produced.*

## **1. INTRODUCTION**

The "traditional" investment appraisal techniques such as Payback, Accounting Rate of Return [ARR], Net Present Value [NPV] and Internal Rate of Return [IRR], as commonly used, are not able to measure many of the benefits offered by IS investments that are intended to gain tactical or strategic business advantages. This is a particular problem with those projects designed to achieve a 'transformation' of the business processes.

The lack of a consensus as to the existence and importance of the problem of IS Investment evaluation may be judged by comparing the view of Tony Cleaver as chief executive of IBM UK [reported by Farbey et al (1995a)] that finding reliable ways of assessing investments in information systems (IS) was the issue the government needed to address most urgently in relation to IT with the statement of Rt. Hon. George Young MP [reported by Ballantine et al (1995)] that "There can be no excuse for treating investment on computers any differently from any other capital expenditure".

Despite the evidence that IS investments can, in some circumstances, yield competitive benefit, reported performance is very mixed [ Qureshi (1993), Porter & Millar (1995), Ward et al (1995), Strassmann (1985), Hayes & Garvin (1982), Lincoln (1990), Meiklejohn (1989) and Strassmann (1990)]. In the author's opinion the need for concern in the state of IT evaluation within industry may be gauged from the numerous instances of unsatisfactory findings from research conducted to date.

From their own and other's investigations, Remenyi et al (1991) reported the following findings:

- IT is not linked to overall productivity increases.
- 70% of firms report that their IT system were not returning the company investment.
- IT overheads are consistently larger than anticipated.
- 31% of firms surveyed report a successful introduction of IT.
- 20% of IT spend is wasted.
- 30%-40% of IS project realise no net benefit whatsoever.
- 90% of firms did not have a systematic evaluation process.
- 24% of firms surveyed report an above average return on capital from their IT.

These figures illustrate why managing IS/IT is one of the major business challenges. Organisations are not able to effectively evaluate the costs and benefits of IT and so make poor investment decisions. This is confirmed by a survey, which investigated how 48 organisations assess the value of IT and what techniques they use to assess the value of IT [Qureshi (1993)], which concludes that many organisations are not getting 'value for money' from their investments.

Organisations have a variety of reasons for investing:

- To enable them to produce a new product or service or more of an existing product or service (expansion)
- To replace an asset that has worn out or become obsolete (Replacement)
- To cut expenditure on our current or future expenditure (Cost displacement)
- To change the method of operation (Transformation)
- To meet changes in the law or regulations (Regulatory)

It has been suggested that different investment rationales may require different investment appraisal techniques.

Most organisations are still using "traditional" financial management investment appraisal techniques [Hutchinson (1995)], [Weston & Copeland (1988)], such as Payback, Accounting Rate of Return [ARR], Net Present Value [NPV] and Internal Rate of Return [IRR] for evaluating all IT investments [Hares & Royle (1994)], [Remenyi et al (1991)]. It is argued that although these "traditional" investment appraisal techniques are suitable for evaluating IT investments that automate operations where the prime motive of the project is cost displacement they are not suitable for evaluating IT investment that are intended to gain tactical or strategic business advantages.

Two example IT investments will attempt to clarify this. The first example is a Payroll System, while the second example is a Management Information System.

Example 1 - An organisation is installing IT to automate a process, say a payroll. This is a cost displacement project, the reduction in wages will be compared with the initial cost of the new system and operating cost after which cost/benefit analysis can be applied to calculate the investment's NPV (Net Present Value). If care is taken to include all costs and benefits then the organisation can be fairly confident of the accuracy of the NPV.

Example 2 - An organisation wishes to install a Management Information System. The evaluation of this investment is not as straight forward as the evaluation of the payroll system. The system may change the structure of the entire organisation. The main benefits will not be a saving in wages, or head count, but the value of the information supplied by the new MIS. How much is information that is more accurate, timely and flexible worth to the organisation? If through using the information, management are able to reduce development cycle time what is the impact to the organisation's financial performance? The system will facilitate organisation change creating new ways of working so that outputs may not be comparable to those previously produced. It is not suggested that we should ignore financial analysis but it is argued that conventional accounting systems have great difficulty in capturing the benefits in financial terms.

It is argued that because one of the major benefits offered by a MIS is gained by an increase in the quality of the decision making within the organisation it can not be evaluated effectively by techniques that only consider quantitative and financial data.

For IT investments that are designed to gain strategic advantage the benefits are likely to be even more difficult to measure than those of an MIS because of the increased number of external and internal factors which are involved.

The main problem lies in the effective measurement and quantification of benefits in practice, as described in section 2 below.

This paper will suggest that organisations that are using narrowly focused evaluation techniques are missing opportunities, while taking on large risks and costs that can be avoided through the use of appropriate and effective evaluation techniques.

## **2. ELEMENTS OF AN INVESTMENT EVALUATION:**

- Cost
- Benefits
- Risks
- Flexibility

### **2.1 Costs**

The conceptual problems with the costs of IT projects are mainly concerned with the identification, categorisation and measurement of "indirect costs". IT costs are consistently larger than anticipated and overheads, especially in user departments, are frequently understated [Remenyi et al (1991), Willcocks (1992), Earl (1989) and Hochstrasser (1992)].

Wilcocks (1992a) identifies some problems with specifying and measuring costs for evaluating IT Projects:

- Understating human and organisation costs
- Overstating costs
- Problem of apportioning costs to user of the system

## **2.2 Benefits**

Perhaps the most serious problem with traditional methods is their inadequate treatment of the benefits of IS developments. There are conceptual problems with the identification and measurement of 'intangible benefits' [Remenyi et al (1991), Ward et al (1995) and Hochstrasser (1992)].

Remenyi et al (1991) identify the following types of Benefits:

- Regulatory Compliance
- Financial Benefits
- Quality of service Benefits
- Customer perception Benefits
- Internal Management Benefits
- Dis - Benefits

Ward et al (1995) suggest that anticipated benefits from a project are often not realised. This is because, in many organisations, no steps are taken to ensure that expected benefits materialised. A benefits management programme is therefore required. They suggest a model :

- Identifying and Structuring benefits
- Planning benefits Realisation
- Execution of the realisation plan
- Evaluating the results of post implementation review - potential for future benefits

## **2.3 Risk Evaluation**

The author would suggest a risk management programme comprising:

- Risk identification - recognise risks of project
- Impact Assessment - Quantification of the damage / loss if the adverse risk occurs
- Probability - What is the likelihood of the event happening
- Avoidance - What steps can we take to minimise the changes of the event

## **2.4 Flexibility**

Flexibility is the degree to which a project is able to adapt to uncertain issues at the time it was being planned. Hares & Royle (1994) identify three base and two support Flexibilities:

### Base Flexibilities

- Product or Service
- Volume of business
- Robustness

### Support Flexibilities

- Organisation
- Technology

### **3. IT PROJECT TYPES**

It has been suggested that IT investments should be analysed into different categories of IT Project Types that have differences which are as a result of both its characteristics and how it is perceived by management. Appropriate investment methodologies may then be selected for each IT Project Type.

Remenyi et al (1991) categorise IT investment as:

- Mandatory / obligatory
- Investment to improve performance
- Investments to gain competitive edge
- Infrastructure investment
- Research investment

Wilcocks (1992a) however categorised IT investments into six namely:

- Effectiveness
- Architecture
- Research and development
- Competitive edge
- Must do
- Efficiency

Other categorisations include Hochstrasser's (1990) who listed eight categories but Farbey et al (1995a) have gone one step further with their categorisation by including the ranking of each project type in what is described as a project ladder:

- Rung 8: Business transformation
- Rung 7: Strategic systems
- Rung 6: Inter - organisational systems
- Rung 5: Infrastructure
- Rung 4 MIS and DSS systems
- Rung 3 Direct value added
- Rung 2 Automation
- Rung 1 Mandatory change

### **4. IMPORTANT SELECTION CRITERIA.**

For any technique to be accepted in this domain, it needs the following attributes:

- A technique which takes account of all important aspects of company performance - not just short run financial returns.
- A technique which offers indicators of future as well as past performance - financial figures are held to be poor on the former.
- A technique which takes account (albeit with difficulty) of intangible costs & benefits - the traditional view is to accurately measure that which can be done easily & ignore the rest.

These subsidiary criteria may also be important:

- A track record - a tried and tested approach is likely to be received much more readily than an untried idea.
- Inherent simplicity - busy executives are more likely to apply a straightforward approach

than one which needs considerable time and effort to master.

- Flexibility - each organisation is unique in terms of its strategy, its competitive position, and other key criteria and will need an approach which is able to accommodate such diversity.
- Measurability - an approach where the information required is obtainable is eminently more useful than one which requires figures which are impractical to obtain.

Wilcocks' (1992a) Evaluation Guidelines:

- Link evaluation across stages & time
- Involve key stakeholders in evaluation at all stages
- Assess the actual against the planned impact of IT
- Evaluate & re-evaluate at all stages of the project
- The concept of learning should be central to the evaluation process. The clamour for adequate techniques may reveal a 'quick-fix' orientation; in the long run getting it right may prove more difficult but add greater value

## 5. INVESTIGATING EVALUATION TECHNIQUES

### Introduction

Table 1 lists a selection of evaluation techniques that have been suggested by their proponents as possible solutions to the problems described in the introduction. The suggestions embrace both academic and practitioner techniques. They were described and evaluated in Kennedy (1996).

**Table 1: A Summary of the Sixteen Evaluation Techniques Examined.**

Tech. No.	Technique Name	Proponent(s)/Ref	Quantitative	Qualitative
<i>Numeric Techniques</i>				
1	Adapting DCF (Discounted Cash Flow)	Kaplan (1986)	•	
2	Calculating the new value of IT	Kent (1991)	•	
3	IVAN	Primrose (1989)	•	
4	Return-On-Management	Strassmann (1990)	•	
<i>Non - numeric Techniques</i>				
5	IT Investment Mapping	Peters cited in Willcocks (1992)		•
6	Guidelines for surviving without numbers	Clemons cited Freedman (1990)		•
<i>Modelling/ Management Science Techniques</i>				
7	Process Flight Simulation	Rubin (1994)	•	•
8	Multi Objective , Multi Criteria	Kenny & Raiffa (1976)	•	•
9	Value Analysis	Melone & Wharton (1982)	•	•
<i>Eclectic Approaches</i>				
10	Information Economics	Parker, Benson & Trainor (1988)	•	•
11	Kobler Unit	Beat Hochstrasser (1992)	•	•
12	The Balanced Scorecard	Kaplan & Norton (1992)	•	•
13	Business Wide Value Model	Esther & Brooks (1995)	•	•
<i>Framework Approaches</i>				
14	Enterprisewide Information Economics	Parker & Benson (1992)	•	•
15	Guidelines for assessing the strategic and economic value of IT	Banker, Kauffman & Mohmood (1993)	•	•
16	BSI	Business Science Internat. cited in Freedman (1990)	•	•

Particular attention is paid to the perspective(s) from which the investment is evaluated by the technique, the technique's application area, and whether the



Fourthly, we may develop models of a business showing business processes before and after a proposed process change. The anticipated value of the benefits derived, (in terms of greater revenues, resources saved or perceived improvements in quality or reputation), can be compared to the estimated costs. This would be of considerable value in "Transformation" type projects.

Fifthly, we may develop "Process Flight Simulators". The concept is that a dynamic model is built of an organisation which allows managers to simulate and study situations before encountering them in reality and so deepen their understanding of the organisation and the likely impact of policies and decisions. Rubin (1994) describes the use of "Process Flight Simulation", using SD techniques in this domain. He describes the construction of a dynamic model of an organisation. This model may consist of processes, events, patterns of behaviour, structures and information feedback flows. Once managers are confident that they have developed a satisfactory model of their organisation, they can simulate a wide variety of business circumstances and scenarios.

## **7. Conclusion**

SD has a direct, but yet to be realised, application for evaluating IT investments. It may be possible to implement several of the evaluation approaches examined in this paper within a system dynamics modelling tool so that when an IT investment is proposed, management could simulate its likely effect within the organisation. Additionally, an organisation could consider cost, time and human resources which would enable the model to estimate intangibles costs that traditional cost/benefit analysis can not measure.

The introduction outlined some difficulties with the current methodologies but there may be problems with the alternative methods described above:

- Over-complexity - while strategic planning departments may well be at ease with some of the more involved techniques, others are less likely to find them appealing or practicable.
- Untried - some potentially promising ideas have yet to be applied successfully in organisations; without a track record many concerns are not prepared to entertain such approaches.

Qureshi's (1993) survey, that investigated 48 organisations and their attitude towards IT, found that organisations' difficulty in assessing intangible benefits was exacerbated by the culture barrier existing between business and IT managers. The survey also uncovered some interesting information on the on how organisations' business and IT plans are linked While 60% of business had separate business and IT plans, 67% of the IT plans were de-coupled from the business plans. SD, though an increased understanding of structure and process, may facilitate a closer "alignment.

The conclusion I would draw from the investigation of these evaluation techniques is that, as yet, no single technique is suitable for evaluating all IT investments. The evaluators should choose the most appropriate technique on the basis of the investment's application area and the perspective from which they hope to gain advantage. The matching of categories of IT investments to evaluation methods is



problematic but of fundamental importance. Farbey et al (1995b), Hochstrasser (1990) and Willcocks (1992) have offered valuable suggestions but the search for a definitive linkage methodology continues. From this paper I would contend that the various potential ways that SD may add to the evaluator's armoury should be further investigated.

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