

Cost-Benefit Analyses of Internet Investments

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Abstract

“Do we get value or money?” or “Do we have an attractive ROI?” are vital questions that any organisation is encountering today in pursuing an exploitation of the Internet. No matter whether exploitation is in regard to a focus on internal efficiency or external effectiveness the organisation carefully needs to verify the investment in terms of expected costs and likely benefits.

The research question of the paper is to identify the different approaches to cost-benefit methods of Internet investments and to provide an overview of what the approaches sheds light upon. Moreover, the paper provides two examples of cost-benefit analyses. Finally, the paper provides a applicable short-list of important activities and decisions in a cost-benefit analysis.

The paper suggests that cost-benefit analyses should not only contain content variables, but also include flow variables of the communication process, i.e. the variables of volume, data integration, diversity and span.

1. Introduction

Investment analysis in information systems is not a new focus area, neither for researchers and consultants or companies and organisations (Hamilton & Chervany 1981, Willcocks 1994). It is nevertheless an area in constant development where the methods for evaluation of investments are becoming more and more varied and the technology is developing at a rapid pace. This paper presents an introduction to cost-benefit analyses of Internet-investments. Our ambition is to give the reader a subtle picture of the cost and benefit sides, enable the reader to distinguish between financial and non-financial methods and understand the content and flow variables. Flow variables are also called process variables.

There may be many reasons for investing in information and communication technology (ICT) and especially in the Internet. For an organisation, the arguments may range from operational or tactical to strategic statements, or they may represent a combination – depending on the situation. The reasons why an organisation wishes to invest in the Internet may be:

- Commercial vital reasons, as if e.g. it is vital to the organisation's core business or in connection with a project activity.
- Enforced reasons, as if e.g. a supplier or distributive trade demands it and has the negotiating capacity to do so.

- Cost saving and/or profit-earning motives.
- Compensation reasons, as e.g. after a burglary or a damaging virus attack.

Irrespective of reasons, it is often a good idea to make a feasibility study of resource requirements and expected output/benefits – i.e. a cost-benefit-analysis.

Just as the reasons may vary, the level of ambition may also be diverse, and in connection with utilising the Internet, the company can choose to focus on information, communication, transaction and/or integration.

Today, several software programmes include very advanced tools to perform CBA's. It applies e.g. to IT Service Vision in the SAS-package (http://www.sas.com/offices/europe/denmark/itsv/itsv_manager.html).

At several trade associations and consultancy firms, it is possible to download templates with which to perform CBA's. The EDI-Council's server e.g. has a direction to EDI-investments (excel format), which can be downloaded through www.edu.dk/74.htm. The same applies to the American Office of Risk Ass. And Cost-Benefit (see URL: <http://usda.gov/agency/oce/oracba>). An increasing need for visibility of Internet-solutions within a growing number of fields also creates a need to clarify the contributions from the Internet. When the IT-department proposes to upgrade Windows XP, developing a new intranet or supplying all salesmen with a PDA (Personal Digital Assistant) such as Palm Pilot, the question is: “What does the company gain from these investments?”.

2. Research Approach

The research task of the paper is to presents an explorative study of cost-benefit analysis (CBA) practice and research.

The research question of the paper is to identify the different approaches to cost-benefit methods of Internet investments and to provide an overview of what the approaches sheds light upon.

The research method is a literature review of cost-benefit analysis highlighting existing research finding and focus areas. Moreover, the paper reviews different approaches to cost-benefit analysis.

Moreover, the paper provides two examples of cost-benefit analyses. Finally, the paper provides a practical short-list of important activities and decisions in a cost-benefit analysis.

3. Literature Review

A common definition of cost-benefit analysis is that it maximizes a social welfare function that aggregates unweighted and unrestricted preferences, e.g. Adler & Posner (1999). Moreover, Adler & Posner (1999) argue that constrained cost-benefit analysis is consistent with a broad array of appealing normative commitments, and it superior to alternative methods of project evaluation.

Cost-benefit analysis has traditionally been concerned with the meso- and macro- levels of the economy focusing on the welfare of a defined society (Mishan 1971, Brent 1996). Also, cost-benefit analyses are used in various sectors and industries, e.g. Noy (1999), Honig & Lampel (2000), McDonald (2001).

Cost-benefit analysis is applied to the evaluation of various phenomena (Fischer 1994, Nolan et al. 1999). In particular, cost-benefit analysis is widely used on a micro-level evaluation projects, investments, new businesses, etc. (Ngwenyama 1999, Bleichrodt & Quiggin 1999, De Haan & Mol 1999, Julnes 2000, Lee & Cunningham 2001, Dey & Gupta 2001, Bleichrodt & Quiggin 2002).

Applications of cost-benefit analysis ranges from specific and well defined projects to support decision making to "new" management problems within enterprises such as improvement of the quality of working life (De Haan and Terra, 1988), advanced manufacturing techniques (De Haan and Peters, 1989), and environmental management (De Haan and De Groene 1993, Yedla & Parikh 2001).

De Haan & Mol (1999) argue that there are two basic principles for cost benefit analyses at the level of the firm. Firstly, any measure to improve the performance of a firm can be seen as an investment and thus should be evaluated accordingly. Secondly, only changes in the relevant items caused by the measure have to be taken into account.

4. Cost Benefit Analysis

One perspective argues that often Internet investments are not a choice, but an almost unavoidable spiral with very few options. As a part of the launching of Microsoft, the company will not support earlier versions of Windows (95, 98 and 2000) after the month of July. It does not mean that you cannot use Windows 2000 after the 1st of July. But it means e.g. that you cannot expect new gadgets, software and different kinds of hardware to function together with earlier versions of Windows. It is possible e.g. to purchase a printer, but you might have to upgrade to Windows XP to make it function, and in this way a lock-in effect of the customer is obtained, cf. Hax & Wilde (1999).

Another approach to internet-investments regards it primarily as a learning process. It is more important to allow room for experiments with the technology than to settle on one single solution. Correspondingly, attention may be focused on knowledge sharing and exchange or establishing IT and Internet competence in the organisation, which will not necessarily give measurable

results in pounds and pences –and especially not in the short term.

Two main schools of measuring effects have crystallized: financial and non-financial measurements or said in a more popular way: "hard and soft" measurements, cf. Dempsey et al. (1998). At company level, the financial methods include bottom line results for the organisation or department, present value and cost-benefit analyses of projects. At society level, the financial methods comprise effects on the GNP, export/ import, the interest rate and, if any, supply and demand effects.

An alternative financial evaluation method of IT investments is to use the "real options" theory, cf. Li & Johnson (2002). Li & Johnson suggest that different models are used depending on the level of the technological "switching costs" and the competitive situation of the organisation. The real options theory can also be used as a starting point for strategic actions and support the decision-making process relating to evaluation and justification of IT investments (Kim & Sanders 2002).

At company level, the non-financial methods deal with portfolio and "balanced score card" techniques and at society level with more general issues such as qualification of the labour force. Environment, working environment and social responsibility may be focus areas on both company and society levels.

Table 1: Measuring Effects.

	Financial Effects	Non-financial Effects
Company Level	Return on investment (ROI), Net Present value (NPV), Cost-benefit	Portfolio, Balanced Score Card, Environmental, Working Environmental, and Social Responsibility
Society Level	Gross National Product (GNP), Export/Import, Interest Rate, Supply and Demand	Environmental, Working Environmental, and Social Responsibility, Job Content and Quality

In large organisations with several IT-projects running simultaneously, portfolio management of the IT-projects is often necessary (Solomon 2002). In this connection, it may be an advantage to perform cost-benefit analyses of the individual IT-projects/investments to allow management to see where the money has been spent, why it is or is not necessary to maintain projects and which resources are vital to continue the drive. Therefore, portfolio management makes it necessary to establish comparable criteria in cost-benefit analyses.

Regardless of perspective, it is rarely an advantage to disregard the financial perspective. Attention to the operating profit and ROI (return on investment) is crucial,

cf. King (2002).

5. Objectives and Principal Elements in CBA

To make a proper cost-benefit analysis (CBA), it is crucial to know the owner of the investment and what objectives the owner, i.e. person, department or private/public organisation, wants to achieve with the IT-investment. A number of studies show that IT-investments are not always based on or part of a strategy, which is why the relevance of cost-benefit analyses might be unclear (Clarke 1995). Even when the objectives are clearly stated, it is paramount to know where and how to achieve and measure the benefits. In other words, it is necessary to have general strategic objectives that can be decomposed into measurable and localised benefits.

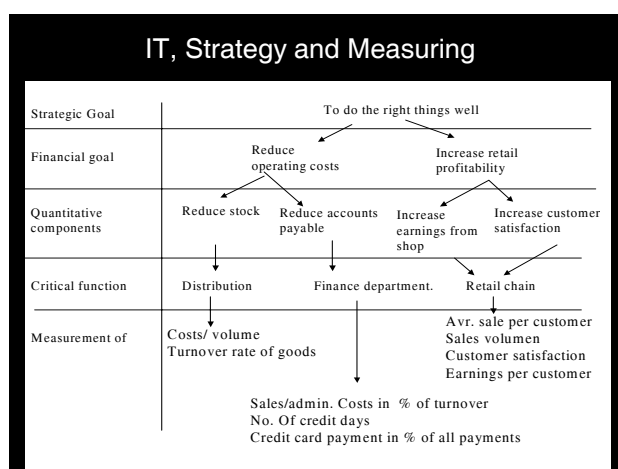


Figure 1: IT, Strategy and Measuring.

Source: Developed after
(Willcocks, Feeny et al. 1997).

CBA's of Internet solutions assume that they have a direct or indirect impact on e.g. the company's operating profit as direct cost saving or indirect cost avoidance measures and that the strength of the impact is expedient and feasible to determine (situation 1). Others believe that the relation between organisation and IT, including derived effects/learning processes, is so complex that it is futile to talk about CBA of IT (situation 2). Others again argue that it only has limited value to focus on the company's CBA of IT in the network society. Instead, we ought to focus on the dependencies – static as dynamic - of which both the technique and the company are part. CBA is hardly the most suitable tool for such purposes (situation 3).

Fundamental choices before CBA

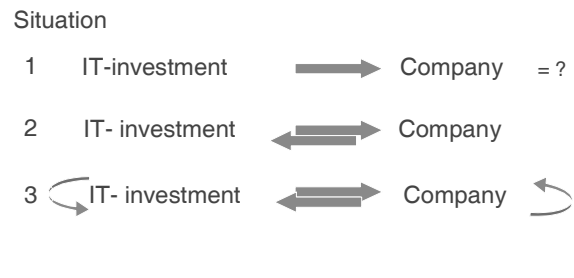


Figure 2: Fundamental Choices Prior to CBA.

5.1 CBA Elements

A relevant CBA question to an IT-project is: What does it cost and which benefits do we derive? However, after this question it becomes more difficult. A basic advise is to clarify the conditions on which the CBA is based, including the organisation's general approach to IT-projects and management of IT-projects (Cadel and Yeates 2001).

It makes a big difference whether the approach favours an extension of the ideas in the waterfall model about IT-systems development separating pilot surveys (Bødker, Kensing et al. 2000), implementation and utilisation (Earl 1999) or whether e.g. the phases are regarded as an integrated and repetitive process.

The simple CBA comes in three versions:

- Economic efficiency model
- Resource allocation model
- Alternative costs model

The economic efficiency model focuses on the IT-project's costs (C) and benefits (B). In allocating resources, e.g. between one department's application of an Internet solution and another department's system application, allocation weights are used to ensure that department 2's benefits are larger than department 1's costs (disadvantages) in e.g. presentation of an Internet solution. Finally, the alternative costs can be evaluated, i.e. do department 2's benefits from the Internet solution exceed the reallocated resources in the department and the loss, if any, in department 1 as a result of the Internet solution.

The Simple CBA

Economic efficiency: $\frac{B-C}{B+C}$
(B: benefits, C: costs)

Allocation politics: $\frac{a_2B-a_1C}{a_2B+a_1C}$
(a: allocation weights)

Alternative costs: $\frac{a_2B-a_2R-a_1L}{a_2B+a_2R+a_1L}$
(L: loss, R: re-allocation)

Figure 3: The Simple CBA.

Of course, it may be difficult to determine benefits, but some benefits are more difficult to determine than others. The figure below lists a range of factors that can be measured directly such as productivity, production costs, administration costs and IT-expenses. The figure's right side shows effects that are more difficult to measure such as increased control of resources and job satisfaction. Whereas the left side illustrates all the interesting measures or input reflecting such measures, the right side may be seen as variables explaining why some Internet solutions are not appreciated or fail to get support from employees.

Table 2: Measuring Benefits.

Measurable Benefits	Benefits difficult to measure
Increased productivity	More efficient use of production facilities
Lower production costs	Improved resource control
Reduction of employees	Improvement of planning function
Lower IT-expenses	Increased flexibility
Lower third party supplier costs	Punctual and more information
Lower administrative costs	Improved organisational learning
General cost reduction	Increased job satisfaction
	Improved decision making
	Improvement of routines
	Increased user/customer satisfaction
	Improvement of image

A third of the orders are placed with sales representatives at visits, another third via telephone/fax/e-mail, a sixth via physical purchases in shops and a sixth with the suppliers via the Internet.

The administrative costs are estimated to be DKK 80,- per order (ordering, invoice processing, payment). When reordering, the total administrative cost is estimated to be DKK 100,-.

Now, an internet-based purchasing solution is established. It requires an initial investment of DKK 1 million, including training. If all purchasers are going to

have a PDA, it will cost another 3 million.

In the solution, the useful life of the investment is estimated to be 2 years after which the replacement price will be DKK 2 million. If the austerity model without PDA is chosen, the replacement price after 2 years will only be DKK 500,000.

From day one, 300 suppliers are part of the solution, and at the end of the first year another 100 suppliers have joined. At the end of the second year, another 250 have joined. At the beginning of the first year, 40% of all orders are covered by the solution. At the end of the second year, it is estimated that 80% of all order lines are covered. At the end of the second year, it is also estimated that the total decline in faulty orders is 50% among orders placed via the Internet. The increase in the number of digital suppliers and orders including the reduction in faulty orders is a linear and inter-polar process.

The interest level is fixed at 7%.

A government agency wants to introduce self-service via the Internet. The objective is to improve citizen service, make cold hands warm and facilitate analyses of work processes.

The agency is primarily occupied with case administration and has approx. 100 employees. The annual payroll costs are DKK 32.5 million (in total 166,000 working hours). 55 employees are directly engaged in casework (in total 91,300 hours). The total operating budget including payroll costs amounts to DDK 51 million, out of which 18.5 million is allotted to other operations. This amount is not affected by the Internet solution.

Annually, there are 8,000 completed cases (on average 12.5 hours/case), 17,300 inquiries from citizens about cases (on average 15 minutes spent directly) and 7,000 inquiries from citizens (telephone, letter, fax, e-mail) that have nothing to do with concrete/non-completed cases (on average 10 minutes spent directly, 10 minutes follow up).

In addition, there are 2000 annual inquiries from politicians, departments and other bodies (on average 20 minutes spent directly, 30 minutes follow up).

Table 3: Consumption per hour before implementation of IT-solution and after implementation of alternatives A and B.

			Alternative A	Alternative B
Workflow	Sorting and achieving	10.000 h	5.000 h	5.000 h
	Find cases	15.000 h	4.000 h	21.000 h
	Evaluate content	5.000 h	5.000 h	23.000 h
	Meetings	35.000 h	25.000 h	37.000 h
	External meetings	21.207 h	10.000 h	45.000 h
(1)	Total	85.207 h	49.000 h	131.000 h
Inquiries	Handling the case	15 min. x 17.300	5 min. x 10.000 inq.	5 min. x 50.000 inq.

		inq.		
	General inquires	10 min. x 7.000 inq.	3 min. x 17.000 inq.	1 min. x 87.000 inq.
	Internal / from politicians	50 min. x 2.000 inq.	15 min. x 1.700 inq.	10 min. x 31.000 inq.
(2)	Total	7.169 h	2.108 h	7.083 h
(3) Other		72.634 h	72.634 h	72.634 h
Total		166.000 h	123.742 h	210.717 h

They have now adopted an Internet solution that involves complete indexation of cases, IT-project management on case, employee, department and management levels and 'open' access to all input, output, content and benchmarks for at least one person other than the relevant caseworker. The initial investment (development and implementation) including training is estimated to DKK 1½ million and adjustment of existing applications will cost another 4 million. The useful life of the solution is estimated to be one year with an annual replacement price of DKK 750,000. The interest level is fixed at 7%.

In alternative A, the number of time-consuming direct inquires about specific cases declines. As a result of the Internet solution, citizens can now find answers to some inquires from the information available at the Internet. There is a small drop in inquiries about the progress of cases from other employees and politicians, but a significant drop in the number of minutes that each inquiry takes. On the other hand, there is a marked increase in general inquiries. However, now they only take 3 minutes compared to 10 minutes previously.

In alternative B, the number of inquiries explodes from all sides: case inquiries increase from 17,300 to 50,000, general inquiries increase from 7,000 to 87,000 and 'internal' inquiries increase from 2,000 to 31,000. A cost benefit analysis is made for alternatives A and B.

5.2 The Point is the Result as well as the Process

Partly, examples A and B provide inspiration by showing two interesting cases, and partly they illustrate that efforts to acquire the necessary data often give us the chance to look at the IT-solution in ways that we would not have done without a CBA. We are forced to explicate preconditions and assumptions about IT-investments. We readily admit that often it does not make sense to make a CBA. In several studies at the Department of Informatics, we have continued our research into the elements in CBA that can be measured directly or are difficult to measure. We distinguish between content variables and flow (process variables).

5.3 Content and Flow Variables in Determining Benefits

Content variables in a CBA may include capacity, interaction, values and orientation. The capacity variable deals with the quality of information, efficiency and effectiveness. The interaction variable focuses on control and power, including customer relations. Values comprise e.g. stress and legal protection. Finally, orientation relates to how often the Internet solution leads to a more digital decision-making process reducing other communication and decision forms. In a large-scale international study, we have found that the effects are unmistakably positive on the capacity side, but predominantly negative on the value side.



Figure 4: Content Variables.

Through the process variables, we focus on the flow in communication. The four variables in the flow analysis include volume, data integration, diversity and span. We might expect that companies selling via the Internet would score 100% on the variable data integration. But that is not at all the case. Only 25% of the companies selling via the Internet are capable of effecting an automatic integration with the IT-systems in charge of executing orders (delivery, production, etc.). Approx. 14% of the companies have integrated Internet sales with the invoice system (Danmarks Statistik 2002).

Table 4: Process variables (flow)

Variable	Description
Volume	What percentage of the total number of documents is exchanged via this solution?
Integration	What percentage of documents received digitally is forwarded digitally?
Diversity	What percentage of the total number of different types of documents is included in the digital solution?
Span	What percentage of business partners takes part in the digital exchange?

Source: Andersen et al. (2001).

6. Managerial Overview of the CBA of Internet Investments

In this paper, we have looked at different approaches to and perspectives on cost-benefit analyses of Internet investments. We have especially focused on distinguishing between financial and non-financial methods and the identification of content and flow variables.

In the paper, we have highlighted a number of recommendations summarised in the table below:

No.	Recommendations
1	Identify the owner of the planned investment
2	Identify investment objectives
3	Choose perspective (additional earning capacity, cost reduction, development of communication/relations and/or learning/knowledge management)
4	Choose method (financial and/or non-financial)
5	Identify content variables in CBA
6	Identify flow variables in CBA
7	Perform the CBA

However, cost-benefit analyses should not stand alone. Often, it is an advantage if organisations look at “Total Value of Ownership” (TVO). TVO consists of three elements, cf. Dempsey et al. (1998). The first step involves a thorough cost-benefit analysis to evaluate the expected increase in value from the investment. Second, sturdy management processes are important to integrate IT and Internet into the normal business planning. And finally, it is important to have some experience in business evaluation to be able to make difficult trade-offs efficiently.

7. Conclusions and Future Research

The paper addresses the important issue of cost and benefit evaluation when organisations are considering investing in exploitation of the Internet.

In particular, the paper address different approaches to CBA and suggests that evaluation ought to consider content as well as flow variables

The paper presents two case studies. The first case study is from the private sector and deals with purchasing via the Internet. The second study, which is from the public sector, deals with self-service via the Internet.

Finally, the paper provides an applicable short-list of important activities and decisions in a cost-benefit analysis.

Future research will go into in-depth case studies and comparable studies in order to provide further empirical data. Moreover, the analysis method will be challenged with other bodies of theory in order to provide a robust approach.

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