Investing in strategic information systems: on the role of selection in decision-making

Investing in strategic information systems: On the role of selection in decision-making

Rob M.H. Deitz
Eindhoven University of Technology
Faculty of Industrial Engineering and Management Science
PO Box 513, 5600 MB, Eindhoven, The Netherlands

Within the process of strategic decision-making, 'selection' is an essential phase. Analysing alternatives, judging, bargaining and choosing can be seen as part of selection. Selection-activities can occur several times in the decision process and can serve multiple goals. Further, they should lead to effective decisions, build the necessary commitment and are subject to restrictions in terms of time and money. In this respect, decisions on investments in strategic information systems (IS) may behave very similar to other strategic investment decisions. Despite the available body of knowledge on strategic decision-making, very little attention has been paid so far to the specific role and characteristics of selection in strategic IS-investments. It is attempted here to enhance understanding of this subject, based on IS-literature, economics and decision-making theory. Six cases of strategic IS-investments are described and analyzed after an introduction to relevant theory. The cases are used to describe basic characteristics of strategic IS-investment selection and the way these characteristics appear to be related to contingency factors and to decision-quality. Cost estimation was found to be most problematic. Selection occurs many times during the decision-process and many different approaches are used to support the selection process and qualitative selection-criteria appeared decisive in most decisions, combined with the costs of the investment. Propositions are developed, describing the role of selection and perspectives for future research are given.

1 Introduction

"Although there is a body of normative literature on techniques for strategic decision-making ... the evidence from empirical studies of their application indicates that all too often these techniques have made little real difference in the decisional behaviour of organizations", argued Mintzberg *et al.* (1976). A parallel can be drawn here to the current situation in the research on IS-investment decisions. Many normative approaches have been developed (Bedell, 1985; Parker *et al.*, 1988; Sassone, 1988; Dos Santos, 1991; Farbey *et al.*, 1993; Hogbin & Thomas, 1994) over the years to assist decision-makers in their efforts to guide the allocation of scarce resources to IS, especially by providing concepts to support the selection phase in decisions. On the other hand, evidence is available (Currie, 1989; Yan Tam, 1992; Farbey *et al.*, 1993; Willcocks & Lester, 1993), based on case- and especially survey-results, showing that current practice has only sporadically adopted these approaches and at first sight appears little rational. This might suggest that decisions on strategic IS-investments in practice often tend towards a 'garbage can' model (a metaphor for decisions, resulting from an unstructured 'mix' of problems, goals, participants and situations; e.g. Cohen *et al.*, 1972). This would mean that decisions can hardly be expected to lead to investments which are consciously directed towards firm-objectives.

It is not questioned here that strategic IS-investment decisions are to a certain extent subject to political forces and intuition. Nevertheless, it is hard to believe that there is in general little rationale underlying these decisions. Rather, time pressure, uncertainty, complexity and dynamics unavoidably limit the degree to which decisions can be based on analytical reasoning. A thorough understanding of the role of these factors and the way by which they are managed in practice is considered necessary to achieve more effectiveness in decision-making.

Research of the Eindhoven University of Technology has attempted to enhance understanding of the selection phase in strategic IS-investment decisions by case-study research. In this paper, relevant theoretic concepts concerning decision-making, economics and strategic IS are presented and integrated, serving as a basis for six descriptive case studies. After presentation of the case-findings, the evidence is analyzed, propositions are developed and conclusions are drawn, including perspectives for further research.

2 Relevant decision-making concepts

Simon (1965) distinguished three phases in the decision-making process: intelligence (finding an occasion calling for a decision), design (developing alternatives) and choice (selecting a

course of action). Each phase can be a decision-making process itself. Pool (1990) states that this concept (based on the premise of limited rationality) was addressed by many other researchers and decision models grew more complex until the 'garbage can' model of was introduced. Mintzberg *et al.* (1976) tried to turn this development by identifying the underlying structure of strategic decisions (which they characterise by complexity, novelty and open-endedness). Following the Simon trichotomy, they define 12 basic elements of decisions. A decision process is defined as a set of actions and dynamic factors, starting with the identification of a stimulus and ending with a commitment to action. This descriptive model of Mintzberg *et al.*, who name the basic phases identification, development and selection, will be followed here.

Selection can consist of the following routines: preliminary screening of alternatives, evaluation-choice (including analysis, bargaining and judgement) and authorization. Each routine can occur several times. Bargaining (attempting to resolve conflicting objectives) and judgement (especially when many technical ambiguities limit the possibilities to relate means and ends) can play an important role in the selection process (see also Thompson & Tuden, 1959; Butler *et al.*, 1993). This model only presupposes problem-recognition and choice being part of the decision (other routines are facultative) and is consistent with the findings of Witte (1972), who concluded that the traditional premise of a 'linear' decision process is only true as far as 'problem recognition' precedes 'decision.'

Investments are regarded (e.g. Lumby, 1987; Bierman & Smidt, 1990) as a specific type of decisions, committing the organization to the allocation of scarce resources to uses, which are expected to generate revenues during a considerable time period. There is little reason to suppose that (strategic) IS-investment decisions would not follow the conclusions of the mentioned research. In order to gain generalisable insight in decision processes, Witte (1972) studied 233 computer purchase decisions and Mintzberg *et al.* (1976) studied 25 strategic decisions, several of which were IS-investments. IS-investment decisions, however, appear to have at least the following specific characteristics:

- Obviously, the IS-perspective plays a role which means that IS-expertise will be involved. The rapid developments in technology will increase complexity and the influence of the time-dimension.
- The growing importance of IS and the interdependence between many applications make coordination of the IS-resource on several levels necessary.
- IS-investments are often associated with indirect and difficult to measure benefits.

In literature on IS, the intelligence- and design-phases have received a lot of attention. Methodologies for planning and designing IS (e.g. Information Engineering, BSP and SDM) are discussed extensively. Especially from the beginning of this decade, however, selection has become increasingly popular. An important contribution of Parker *et al.* (1988), Farbey *et al.* (1993) and others has been the introduction of qualitative criteria and structured approaches for dealing with these. What has received little attention, however, is the role of the process and organization of IS decision-making and the relation with the context (e.g. Symons, 1991; Sabherwal & King, 1992; Deitz, 1994); this complex structure of decisions on strategic IS-investments limits the applicability of rational-economic models.

Achieving effective decisions in terms of costs, benefits and risks has traditionally received most attention. It is, however, recognised by many authors (e.g. Vroom & Jago, 1988; Butler *et al.*, 1993) that decision-making (and thus selection) serves several purposes. We want to distinguish the following purposes here: making effective decisions, building commitment and making efficient decisions (in terms of time and money). Decision-making quality is measured in these terms here, since it is felt that exclusively considering effectiveness (the content-dimension) bears the risk of under-estimating the importance of building commitment in the selection phase and the role of time in the decision process.

Figure 1 shows a model, allowing us to describe and analyze basic features of strategic IS-investment decisions. Three 'dependent' variables are shown (the process, content and organization of decision-making) and the contingency-factors (independent variables) which influence the decision. These 'contingency-factors' are *the type of decision* (characteristics of the strategic IS-investment) and *context-variables* (organizational structure, market-characteristics etc.). Finally the 'goal variable', *decision-making quality*, is distinguished (measured in terms of effectiveness, efficiency and commitment). Within the *process-dimension*, the three phases mentioned earlier are distinguished; the selection-phase will be analyzed more deeply. The *organization-dimension*

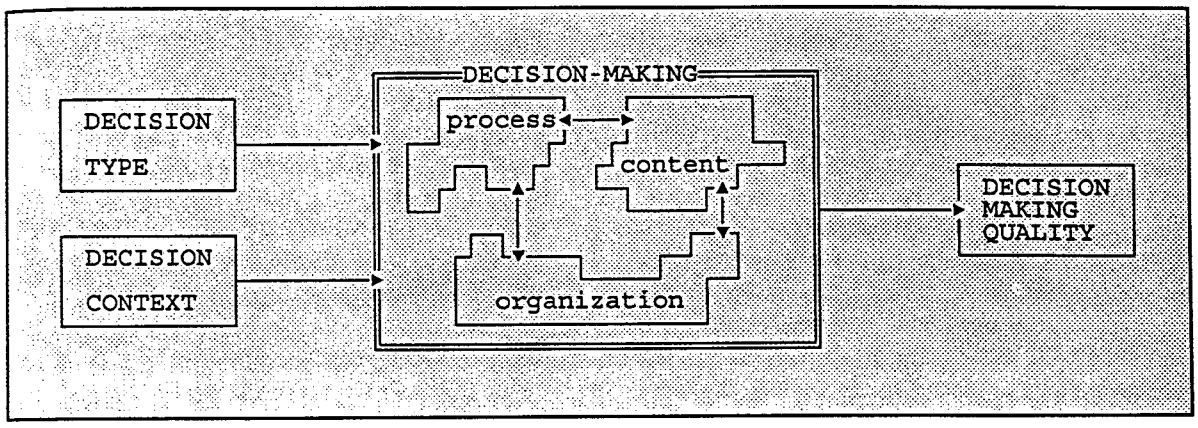

Figure 1. Conceptual model of strategic (IS) decision-making.

describes the way by which decision responsibilities are spread. Within the *content-dimension*, a distinction is made between costs, benefits and risks of strategic IS-investments (in quantitative or qualitative terms).

3 Strategic IS, investment selection and research questions

The field of strategic IS has received a lot of attention recently (e.g. Clemons & Weber, 1990; Barua *et al.*, 1991; Sabherwal and Tsoumpas, 1993; Earl, 1993; Neumann, 1994). The same holds for the strategic use of information technology (e.g. Parker *et al.*, 1989; Earl, 1989; Ward *et al.* 1990; Scott Morton, 1991). Many cases are documented extensively (e.g. Copeland & McKenney, 1988; Doll, 1989; Hopper, 1990). Hopper argues that a shift is taking place in the role of strategic IS: "companies will have to run harder just to stay in place" and "while it is more dangerous than ever to ignore the power of information technology, it is more dangerous still to believe that, on its own, an information system can provide an enduring business advantage." Sabherwal & Tsoumpas (1993) argue that two criteria characterise strategic IS applications. They have a direct link with the business strategy and they significantly affect organizational performance. Strategic IS imply a greater need for competitor analysis, are difficult to evaluate, there is little experience and their impact is more significant in terms of costs and benefits and in terms of organizational changes and internal power shifts. Through case-studies, the authors investigate the influence of environmental uncertainty, organizational size, sector and IS maturity on strategic IS-development, resulting in a number of propositions. They further suggest that "during the process of deciding ... the focus is on obtaining commitment to the vision represented by the system." Neumann (1993) lists the following characteristics which make strategic IS unique: they change the way a firm competes, they have an external focus, they are associated with higher risk and they are innovative.

Strategic IS thus confront the firm with many uncertainties (innovativity, organizational change, change in competition), they are very difficult to evaluate and they may be associated with high risks, sometimes urgency and dynamics. Earl (1989), Scott Morton (1991) and Neumann (1993) have given many arguments why the strategic role of information technology (IT) will probably gain influence in the coming years.

Given the importance of IT and the importance of a thorough analysis of IS-investments, it is not surprising that many normative approaches for selecting (strategic) IS-investments exist (see e.g. Sassone, 1987, Powell, 1992 and Farbey *et al.*, 1994, for an overview), for example:

- financial approaches (e.g. Lumby, 1987; Bierman & Smidt, 1990) like the payback period, return on investment calculation and sophisticated techniques like discounted cash flow calculation;
- techniques for evaluating strategic (IT-) investments like decision-tree analysis, sensitivity analysis and option-analysis (e.g. Dos Santos, 1991; Clemons & Weber, 1990);
- comprehensive methodologies, including the evaluation of 'intangibles', risk analysis and scoring techniques (e.g. Parker *et al.*, 1988; Hogbin & Thomas, 1994; Hochstrasser, 1993).

From decision-making theory, however, we learn that restrictions imposed by limited time and money and the importance of commitment might imply that decisions are made without an

exhaustive evaluation. Uncertainties limit the degree to which content-factors influence decisions. It appears therefore, as if content, process and organization of IT-investment selection must be managed concurrently in order to realise high-quality decision-making. Understanding how these aspects are interrelated and related to the quality of decision-making, can provide guidelines to decision-makers on how to 'manage' decisions and as well guide the development of methodologies. This understanding is (see also Sabherwal & King, 1992) currently not very well developed.

This has resulted in the following research questions:

1) What is the role of selection in decisions on strategic IS-investments?
2) What contingency-factors influence this role and how?
3) How are 'process', 'content' and 'organization' influenced to manage selection?
4) How are these aspects related to decision-making quality and how can management support be achieved?

4 Research design and findings

The case-study approach was chosen in order to capture the complexity of strategic decisions. Answering the research questions requires a descriptive and to some extent explanatory approach. To reduce the influence of specific circumstances, it was decided to work with multiple cases, following a replication logic (e.g. Yin, 1991). In 1993 and 1994, case-studies were carried out in four large Dutch firms in which an in-depth investigation of one or two strategic IS-investment projects was done. Evidence was collected by semi-structured interviews (five to ten per company) and document-study (project-descriptions, strategic documents, correspondence etc.). All organizations were profit-seeking enterprises in which IT appeared important.

Key-persons who were involved in the projects (middle and higher managerial levels) from several functions (information management, project management, general management and controlling) were interviewed. Interview-reports were returned to the organizations for approval. First, general company-information was collected (business strategy, IS-strategy, structure and formal procedures for investment decision-making). Then, one or two IS projects were investigated by gathering information on project goals, decision-making (decision process, decision organization and the analyses on costs, benefits and risks which were made) and perceptions on decision-making quality. A brief description of each investment decision is given here. In section 5, a structured analysis will be carried out, using the model described earlier (figure 1). Table 1 lists the main characteristics of the individual cases.

Case 1: An International Transaction Platform for IFC

A specialised financial services firm (with a $ 100 mln turnover and almost thousand employees) offers two service lines through two independent divisions, consisting of international business units operating as profit centres. International Financial Company (IFC), one of the divisions with six business units internationally, spent more than 15% of the total costs (1991) on IT. IFC regards itself as a sector leader in IT-use. The impact of IT on products and processes is important. IT-innovations like file-transfer and electronic banking have enabled service improvements and flexibility in the product range.

At corporate level there is an IS-department (a profit centre with almost 100 employees), and an advisory IS-staff. Business units have local IS-units and are not allowed to acquire IS-services outside the local or corporate IS-department. Large investments must be authorised by the board after approval of the investment budget. IS-investments are classified for decision-making according to their scope: international systems, departmental systems and office automation. The controlling department is limitedly involved in this process; the IS-department has an advisory task. A standard format for analysing IS-investment proposals exists but is rarely used. This is also the case for financial techniques.

The International Transaction Platform

Internationalisation (since 1988) increased the need for communication between business units. Therefore, and because of the increasing maintenance costs of the existing system, the idea was raised (1990) by the director of the largest business unit to develop a new system, which would offer many possibilities for service-innovation within IFC: the International Transaction Platform (ITP). First, the IT-strategy was established and an information architecture was described (assisted by a consultant using a structured methodology). Benchmarking with competitors showed that the IS-costs were relatively high. Cost benefit analysis of the

Case	Project descriptions	Main goals
1. An ITP for IFC	An International Transaction Platform (ITP), for transaction processing, realising an international dimension and more functions within a financial services firm.	International communication Cost reduction Replacement
2. LCS for ICG-D (ICG-1)	A Logistics Control System (LCS), combining several functions in the area of order processing, inventory control and purchasing, including barcoding, within an international consumer goods manufacturer.	Service quality Replacement Flexibility Future options
3. An IBCS for ICG-North (ICG-2)	An Integrated Business Control System (IBCS) for the support of sales-, logistics and administrative operations.	Replacement Cost reduction Quality
4. DDC for ProfSys (ProfSys-1)	A Development Data Coordination (DDC) system in order to support the engineering departments of an international manufacturer of professional systems.	Reducing engineering time-to-market Cost reduction Integration
5. PLS-2 for ProfSys (ProfSys-2)	A new basic Logistics Management (PLS-2) System for ProfSys.	Replacement Cost reduction Quality improvement
6. BTS for ComSer	A new platform for a Basic Transaction Processing System (BTS) for a large services organization.	Increasing capacity Replacement New services and functions

Table 1. Investment characteristics

proposed system (developed in-house) included a cost-specification (estimated at $ 5 mln), and qualitative considerations on organization, technology, products and strategy. Two alternatives were considered: a centralised and a decentralised concept. This exercise showed that the proposed 'innovator' strategy of IFC could not be matched with the cost-reduction objective. Therefore, the system-design was focused on cost reduction (investment estimated at less than $ 3 mln). Modules enabling product improvements would be realised after the basic system. A prioritisation of system-modules to be built was part of the report. The consultant advised the international directors' committee which agreed on the project in mid 1991, after several discussions on cost allocation. While realising the new system it turned out that development costs were likely to amount to $ 5 mln. Therefore and due to decreasing profits (a cost-reduction programme was carried out) it was decided (1992) to cancel ITP (after spending $ 1 mln) and look for standard software to 'link' the business units. This decision was especially influenced by corporate topmanagement tending towards a moreconservative investment policy at that time. Several months later, the IS-department was being decentralised and located within the business units. Only infrastructural services and corporate IS-policy remain centralised. The (new) IS-department started to work on the new system, which is by now realised and expected (after some delays) to become operational in mid 1995. The IS manager stated "For the new system, we carried out a structured cost-benefit analysis but the decision had already been made then. Nevertheless, this exercise has helped us to understand the system."

Case 2: A Logistic Control System for ICG-Distribution (ICG-1)

International Consumer Goods (ICG) employed over 20.000 people and realised a $ 4 billion turnover in 1993 producing and selling consumer goods. The company is structured towards products (first level) and geographically (second level). Units on both levels operate as profit

centres. Use of IT is aimed at achieving effective management support in a cost-efficient manner. The corporate IS-department (reporting to the vice-president finance) coordinates the local IS-functions. IS planning (corporate-level) is done regularly. Financial planning and control is very important at ICG with return on investment (ROI) as the key performance-indicator. Investments exceeding $ 2500 require a formal capital request (CR) procedure. Major investments must be specified in the long-range plan or in the operating plan; otherwise, they require a more strict authorization procedure. Corporate IS advises the controller about large IS-investments. Local IS-managers prepare the CR, containing a financial summary and a management summary (including ROI, other arguments, a sensitivity-analysis and alternatives considered).

The Logistic Control System (LCS)

ICG-Distribution (ICGD) is a profit-centre, with over 200 employees, responsible for transport and expedition. IT induced many changes recently which is also expected for the coming years (inventory control, export information etc.). ICGD (part of the ICG-logistics division) aims to be an 'innovative' user of IT. Already before 1988, there were signals that the logistic IS was not functioning adequately (unclear data definitions and responsibilities and a need for additional functions). After a first unanswered attempt, a letter was sent by the controller of ICGD to division controlling, responsible for the system, which was then discussed in a steering-committee. It was decided (1989) to start a project group (controlling, Corporate IS and users) for a 'diagnosis' and design. This group reported six months later and proposed to "build a new inventory-system but start with updating the current system since budgets cannot be changed." The arguments were called "hardly financial but mainly strategic." Managers were, however, not very interested but the proposal for the update (a small outlay, shared by several operating companies) was approved of. In March 1990, the local controlling-department thought that there should eventually be a new system, for which reservations should be made in the 1992 budgets.

An initial discussion in a senior management meeting remained without results. Later, the controller of ICGD was able to attract their attention. In April 1991, meetings were held with managers, corporate IS and ICGD, where a draft-motivation was written, encompassing qualitative arguments. It was decided to evaluate the existing system and specify future systems, assisted by a consultant. Consultancy was, however, not hired due to limited budgets. Instead, specialists of ICGD and CIS would study the system, by then called Logistic Control System (LCS). In April 1992, an evaluation of the current systems was finished, after which a specification study started. In November, this blueprint was finished, including a cost-estimation ($ 0.7 mln for hardware, software and development) and goals (better administration, efficiency and flexibility). The arguments for the new system were the problems of the current system and several strategic developments (changing customer attitudes and EDI). In early 1993 the reconstruction of the LCS started. It is further decided on the allocation of costs over the involved operating companies. The original project has evolved into three interdependent parts: the basic LCS, the warehouse-control system (WCS) and the barcoding system (BCS). WCS was seen as a replacement which would be easy to justify and was quickly decided about. A BCS-pilot started in 1993. The building of the basic LCS started in early 1994, the CR-procedure commenced in August resulting in authorization by general management. One interviewee stated "A lot of lobbying and managers who would 'feel' the consequences made this a rather easy decision but it is remarkable that there was hardly any financial justification." All managers had to fund their own involvement, so everybody had to cooperate. The barcode pilot aimed at "gaining experience with barcoding- and scanning-techniques". It was argued "BCS would also have started if we had not been able to show a clear ROI."

Case 3: A Business Control System for ICG-North (ICG-2)

The Integrated Business Control System

ICG-North (ICGN), realising a $ 25 mln turnover with satisfactory profits, was acquired by ICG in 1992. ICGN became part of an international division, reporting to the Dutch headquarters. In late 1991, the ICGN-board planned to replace the existing systems (dating from 1982) for order processing, inventory control, sales and purchasing by a new integrated system (involving hard- and software). The current system was characterised as "unable to support business expansion" due to increasing problems of functionality, maintenance and capacity. Further, the supplier announced to stop servicing this system. A consultant was asked (January 1992) to develop a new 'ideal' systems model. The existing systems were evaluated, a problem analysis was carried out and user requirements

were established. Based on this analysis, vendor proposals were invited and three candidates (standard software) were selected for the software-part. These were tested in three pilot sites (mid 1992).

After this, a selection was made; the Integrated Business Control System (IBCS) was chosen. The accompanying document (including a financial analysis and a description of the alternatives) was reviewed and approved of by the corporate IS-director in early 1993, based on a summary of current problems and expected qualitative benefits (cost reduction, inventory-reduction). Benefits were quantified, based on an estimation of reduced cost of purchasing. Several months later, a 20-page CR was prepared for corporate top-management, including a cost-specification, a cash-flow projection, a summary of the alternatives considered and a calculation of the Internal Rate of Return, the ROI and the payback-period (six years). The total investment amounts to about $ 1 mln. After several discussions with the corporate IS-director and the division-controller, some modifications were made in the ROI-calculation and it was decided to lease the hardware. One letter of Corporate Controlling, asking "Can the business be expanded without the new system?", was answered "The current system cannot support present business; we desperately require this new system to be implemented as soon as possible". Corporate IS wrote to the controlling department "the thorough investigation conducted by the consultant made clear that the system must be replaced to meet business objectives". IBCS was authorised in November 1993. Implementation was monitored closely and IBCS is expected to become operational in 1995.

Case 4: An Engineering System for ProfSys (ProfSys-1)

ProfSys develops, produces and sells professional systems and employs 10.000 people worldwide with a $ 0.5 billion turnover in 1993. ProfSys (subsidiary of a multinational company), is structured in a matrix of Program Units (responsible for product design and production) and Sales Units (marketing, distribution and maintenance/service). The Chief Financial Officer is responsible for the corporate IS-department. IT is mainly used to support the business strategy, although it was expected that future IT-applications might be a source of strategic change. ProfSys regards itself a 'quick follower' in IT-use.

Development Data Coordination (DDC)

Around 1986, the IS-department recognised the necessity of integrating the existing engineering applications with applications in Production and Sales & Service. The existing applications in engineering were CAD applications. Further, some engineering applications were part of the logistics system. Is was expected, however, that integration of different functional areas would speed up product development significantly.

An increasing number of requests for changes and additional functions resulted in an initiative to consider a new system. Lacking integration of the existing systems made this even more necessary. This concerns the integration within the engineering-function, as well as the integration between this department and the production-, sales and service departments. In this period, software-suppliers presented many new solutions promising full integration so ProfSys started a working group (assisted by a consultant) to investigate these new systems. A pilot was carried out with a system, chosen after a first selection. Unfortunately, the expectations were not realised and other suppliers could not convince ProfSys of their ability to obtain better results. However, the pilot was said to have 'wakened' users and stimulated them to think about improvements. In this period, one engineering department invested in a local application with some new functions.

As part of a cost-reduction programme, it was decided in 1988 to establish an IT-policy and to benchmark ProfSys with competitors. This showed possibilities for improvement in the engineering function. Combined with the fact that available standard systems seemed improved, a new supplier selection and a second pilot-project were started (1990). This pilot confirmed the expectations but due to insufficient cash flows, nothing happened after the pilot until the manager of the development department required new actions (1993). The second pilot was evaluated thoroughly and a new committee was installed. Potential suppliers were screened, resulting in a 'hotlist' of 'preferred' suppliers. The director of one engineering department was convinced that an external analysis by a consultant could lead to more commitment with his colleagues. This consultant indicated huge potential improvements from DDC (the system was being called Development Data Coordination now) which convinced topmanagement; approval was given. In early 1994, supplier selection started. New enthusiasm within corporate IS and increased budgets resulted in a new IS strategy study. This

was necessary since many opportunities appeared (logistic systems, infrastructural systems and sales support systems). Assisted by a consultant, the IS strategy was developed and approved by the board. Later, a choice was made concerning the preferred supplier. A working committee is currently preparing the design and implementation but still, no commitment has been made to a supplier. Further, there are new developments (E-mail and developments in the administrative area) which might change the list of priorities. Nevertheless, a lot of commitment for DDC has been built within ProfSys.

Case 5: Improving logistics with PLS-2 (ProfSys-2)

ProfSys Logistics System PLS-2

ProfSys Logistics System (PLS-1) was implemented in 1984. Growing maintenance costs and the availability of less expensive alternatives made the IS-department consider a replacement of the existing system. In 1991, corporate IS started a study, although current users still appeared to be satisfied with the existing system. The committee considered alternatives like building an own system, buying standard software or revising the existing system completely. It was concluded that it would be difficult at that time to start the replacement, given the financial restrictions in those days. The report was offered to decision-makers. However, they did not regard it as something which required immediate follow-up ("perhaps due to the technical approach of the report" stated one interviewee). A more effective 'trigger' was a consultant who had been involved in the implementation of PLS-1 and convinced managers that less expensive alternatives were available. One manager started (late 1992) a committee and asked the consultant to advise on possible improvements. The results of the first committee were said not to have influenced this decision. The most important reasons then to start these actions were maintenance problems and increasing user-demands.

The consultant started his work within one department which was interested (especially the logistics manager), partly because of their wishes to reduce costs and partly because of the relative low complexity of this organization. In his report, an evaluation of costs and benefits for the department was made and an 'estimation' for the entire plant. A second assignment was then given to do this study for the entire plant. In this time, an additional argument came up to replace the existing system. Decentralisation within the organization induced a wish for additional functions. The first phase of this new study resulted in process-descriptions and preliminary specifications, without a cost/benefit analysis. The second phase included selecting software, which resulted in a list of relevant questions to be asked to suppliers. After this, several suppliers were selected and visited, resulting in a report (June 1993). In this period, the working group functioned mainly to 'assist' the consultant and to establish the communication with their own departments. One of their tasks was interviewing persons involved. Further, the committee estimated the costs of the current system. Defining the correct cost drivers was the most difficult aspect of this exercise which was not experienced as too hard; "it was shown that a lot of money was involved and could be saved".

The consultant specified two alternatives: 'maximum functions' and 'minimal cost'. The first alternative was chosen. The committee defined a shortlist of possible suppliers, visited all and made a final assessment. Management however, was giving DDC higher priority, which meant that PLS-2 had to be postponed since it was not possible to start both projects. Currently, new developments are taking place. In early 1994, the IT-strategy was defined and the committee was 'revived' to define the system for two different departments. The software supplier has been chosen. In two different departments, two different module will be implemented to start with. There is a lot of confidence in the viability and effectiveness, especially since other companies have had good experiences with the software. One important argument was the possibility to integrate this system effectively with systems, used in other departments. Further important arguments were the reputation of the supplier and the possibilities to add functions later.

Case 6: A new transaction system for ComSer

ComSer is the largest division of a major provider of information and communication services. The early 1990s showed a strategy which was focused on quality and service improvement. Currently, the importance of efficiency and innovation is growing. Within ComSer there is a large central IS department and a staff-department, with responsibility for the IS-policy (which focuses on being a 'fast follower' on IT-use within the market). IT is already (and will increasingly be) of strategic importance. Decision procedures within ComSer are rather formalised, which holds especially for

investments. There are several specific procedures for IS-investments.

Basic Transaction System-2

A basic transaction processing system (BTS-1) provides the basic production capabilities for one of the product lines for ComSer and further provides basic information for administrative purposes (management information, invoicing etc.). The product line was introduced in the early 1980s and is since then supported by BTS-1, purchased in 1983. In 1990, it became apparent that BTS-1 was no longer able to meet the increasing capacity demands. Further, changes which were required by the marketing-department for the product line could not be implemented because of technological limitations. However, the supplier was not anymore supporting this system's software and was only willing to assist in solving problems. The process seemed vulnerable but capacity-problems were the main argument then. A first initiative, a joined effort of the marketing-department and a technical department, resulted in a request to one supplier. The offer was, however, perceived as too expensive since budgets were rather limited then; there were further some technical problems. The manager of the marketing-department functioned as 'champion'. The project had no high priority then, which was attributed to the fact that an other department was (and still is) developing technology-solutions promising long term improvements for important problems with the current technology. However, it became clear then that problems with the new technology will not be solved in short term. Other suppliers were hardly considered since this was associated with possible new technology- and architectural risks. Due to other priorities, 1992 was a rather quiet year for this project.

In early 1993, a working-group analyzed the situation. A memo was sent to the automation department requiring changes in the current system and in late 1993 a formal request was sent in, after which a formal decision statement was formulated. The investment turned out to be far more expensive than the 1991 offer. Discussions with the potential supplier resulted in a drastic revision of the architecture; the relation to the new technology, still under development, was a major item in these discussions. A 'financial paragraph' was made in this period and a decision statement was prepared by a project group and discussed and authorised in a staff-meeting in December. Further, the business unit directors decided on the system. They indicated, however, that some important questions still remain which must be investigated. Next, the project was sent to the investment committee to receive a budget. In June 1994 there are some major changes in the financial evaluation which are discussed by the directors. An increase was necessary, and some delay in delivery is expected. Risks were reported to have grown due to time pressure. Currently, a third intermediate evaluation is carried out, and again, a budget increase and a delay will be necessary. The system is planned to be delivered in April 1995 and in August, the formal responsibility will be handed over to the 'line'.

The estimated investment budget exceeded $ 25 mln (including hardware, software and other project costs) in 1993. This amount has significantly increased by now. A financial evaluation of the project has been carried out several times, where the base-case (continuing the current situation) is compared to the situation with the new system). The project is divided into 9 subprojects. Although the budget had to be increased several times and some 'stakeholders' would have wished quicker decisions, ComSer was in general rather satisfied with the project. The 'link' with the new technology remains an important item for discussion but timely delivery is crucial now given the existing situation.

5 Structured case analysis

The first part of the analysis focuses on the role of selection in IS-investment decisions and contingency-factors influencing this role. Then it is summarised how selection is used in practice and the interaction between the content, process and organizational dimension is shown. Thereafter, it is attempted to relate the 'design' of the selection to the perceived quality of decision-making and finally, propositions for further research are generated.

The role of selection in decision-making and contingency factors

Selection was found to be very much dispersed throughout the decision process and in each case, five to ten major phases (listed in table 1) of selection of different types were found. Most common are qualitative analyses in general terms, considering the organizational, technical and strategic consequences and financial analyses. Most projects had to undergo several informal and formal accept/reject decisions and authorizations. Selection can be followed choosing an alternative design (e.g. the ITP and

BTS), by a rejection (resulting in some delay and a new proposal; this was found at least once in all cases except for the IBCS-case), by a decision to proceed the development and by a 'final' decision (characterised by a commitment to an investment). Selection is thus an important part of decision-making (apart from the final choice) and contributes to the development of the decision in several ways.

Many contingency factors appeared to influence the selection. Several possible factors have been investigated: the formal decision procedures, the IT-strategy, organizational structure, the type of decision and urgency. Formal procedures (especially authorization) had an impact in almost all decisions. This was rather strong within ICG (demanding especially ROI calculations) and ComSer (where different types of analyses are requested) and rather weak for IFC and ProfSys.

At ProfSys (both cases), IFC and ICG-North, the impact of these systems resulted in (re-)formulating a new IS-strategy in order to be able to justify and prioritise these systems adequately. At ICG-D and ComSer, the IS-strategy was not redefined explicitly. The establishment of the IS-strategy was strongly connected with the system-design in the IFC-case and at ICG-North. These projects resulted in a completely new IS-architecture. At ProfSys, several other large project were also involved in the IS-strategy. LCS (ICG-D) and BTS had to compete with several other investments.

Proposition 1: Strategic IS-investments which, 'individually', have an important impact on an enterprise or business unit require the IS-strategy to be redefined to allow for justifying the investment (to define criteria) and to define priorities.

Some relationships could be identified between the organizational structure and the selection. For DDC one manager remarked "one of the problems were the many changes in the organization, which created problems of 'ownership'". Several business units had to cooperate in (and pay for) the investment and after management changes, new people had to be convinced. The role of IS-management was important within ProfSys. It appeared as if IT-awareness was not yet very high within the organization, which automatically would give the IS function this responsibility. The functional division between 'production-functions' and 'marketing-functions' at ProfSys and at ComSer appeared to influence the joint responsibility of these functions in the decision.

All decisions were of strategic significance on corporate or local level and in each case (except for the DDC), the replacement of an existing system was an important 'trigger' for the project. This replacement necessity resulted in an opportunity for improvement and innovation. Problems with the existing systems caused urgency in the ProfSys-2 case and in the ComSer case. All investments represent a 'complex' of many different types of arguments (replacement, innovation, cost reduction etc.).

Urgency was especially high for the PLS-2 and the BTS. At ComSer, a responsible topmanager stated "we want to have the project finished in May and I have therefore refused to talk about the 'innovative' improvements which were proposed by the sales-department". There were some indications that urgency is associated with higher risk-avoidance in selection. Standard-solutions are chosen which need not to be evaluated too long. At both ProfSys cases, urgency was less, which enabled them to 'consider' the investments for a longer period.

Proposition 2: The perceived urgency influences selection of strategic IS-investments. Urgency may shift selection towards risk-avoidance.

Process, content and organization of selection

Many different 'perspectives' are involved in selection-activities, although with varying impact. Summarising the cases, seven typical 'stakeholders' were identified, having a more or less important role in selection. Table 2 lists, for each 'type' of stakeholder, the (estimated) relative importance in selection. It shows that local topmanagement (general management of the unit which is most affected by the system) and corporate topmanagement (higher level management, responsible for authorization) are essential parties in selection. Their strategic perspective on strategic IS-investments ensured that the investment matches with the business strategy. IS-management appeared to be important within ProfSys and for the LCS-investment (especially in early selection phases). Others involved (except for the 'user-champion' for LCS who ascertained the system being realised) did not appear to have an essential role in selection. Selection of IS-investments appears

thus to be the responsibility of local and (sometimes) corporate topmanagement. Others play a secondary role, in terms of preparing the decision (especially designers/project manager, users and consultants) or in terms of assuring the quality of the proposal (controlling and IS-management). It is thus essential to prepare the decision in the proper strategic and financial terms which are important to topmanagement.

Proposition 3: Local topmanagement and corporate topmanagement are the key-players in selecting strategic IS-investments. Preparation of these final decisions should thus be carried out in terms which are important to topmanagement.

In both ProfSys cases, the IS-function played an initiating role. In the other cases, the IS-function was especially supporting (IS-expertise) and safeguarding the long-term developments in IS. Redefining the IS-strategy (a task of the IS-function) means establishing criteria for prioritisation.

The following 'impacts' of the financial perspective were perceived:

1) Limiting budgets in financial planning, which requires priorities to be determined. Budget limits were found to be important within all cases.
2) Further, controlling was responsible for assisting in the financial analysis, controlling the formally requested financial analyses (especially ICG-2 and ComSer).

The role of the financial analysis within the selection-process was found to be rather limited in many cases. Some statements which illustrate the limited role of financial analysis are given below:

- "financial analysis is more a formalism than a decision tool" (BTS-project manager);
- "the fact that the new system would be approved was already decided before the CAR, since we should keep these well-performing people motivated" (division-controller on IBCS-project);
- "it is remarkable that the benefits of this investment have hardly been quantified whereas this is a strategic decision" (user-champion for LCS);
- "the impact of the financial analysis on the decision has been very limited" (local topmanager on DDC).

Nevertheless, it appears as if a difference should be made here between cost-estimation and benefits-estimation. Cost estimation was essential within IFC (project cancelled) and ComSer (first offer) and is closely monitored within ICG and ComSer. Serious doubts were expressed as to the cost-estimation within ProfSys for both projects. The financial perspective from the cost side is thus found important which is partly induced by restricted budgets. Benefits, expressed in financial terms, seem of less importance for IS-investment decisions although they certainly may not be underestimated and may have an important function in 'developing' the decision process.

In all cases, a number of approaches was 'used' in selection, including:

- financial analysis, varying from global cost-estimations to sophisticated cost-benefit calculations, including a sensitivity-analysis in (only) the ProfSys-1 case;
- the evaluation of pilot-projects which gives indications on the potential risks and benefits of the system;
- qualitative analysis, the most frequently used approach, seemed 'basic' to most decisions;
- screening/selecting suppliers, which was only done if standard software was considered, especially at ProfSys, using a structured approach (checklist);
- prioritisation, which occurred especially for ELC, DDC and PLS-2, often influenced the final decisions;
- risk analysis, which was explicitly done, very limitedly, for the PLS-2 system and within ComSer;
- impact-analysis, which was standard within ComSer, consisting of an integral analysis of organizational and technical consequences;
- authorization, which occurs (several times) in every decision, sometimes from different perspectives. Controlling, IS-management and topmanagement were involved in authorization. In many cases (ITP, LCS, DDC and PLS-2), all these perspectives were involved in the decision-preparation, which would make the final authorization a 'formality'.

Selection in decision-making					
IFC (ITP)	ICG-1 (LCS)	ICG-2 (IBCS)	ProfSys-1 (DDC)	ProfSys-2 (PLS-2)	ComSer (BTS)
1• Cost estimation 2• Qualitative cost benefit (two altern.) 3• Prioritisation 4• Decision-evaluation 5• Authorization 6• Cost monitoring 7• Cost benefit 8• Decision-evaluation	1• Decision-evaluation 2• Financial cost benefit 3• Qualitative analysis and cost estimation 4• Prioritisation 5• Authorization (financ.) 6• Financ. authorization	1• Qual. and quant. analysis 2• Offer evaluation 3• Qualitative selection (pilot) 4• Authorization (IS-man.) 5• Authorization (financ. and qualitative)	1• Supplier selection 2• Qualitative select. (pilot) 3• Qualitative select. (pilot) 4• Pilot evaluation 5• Supplier selection 6• Cost benefit 7• Cost benefit 8• Risk analys. 9• Prioritisation 10• Supplier selection	1• Technical evaluation 2• Local CB-analysis 3• Supplier selection 4• Cost benefit 5• Selection of alternative solution 6. Authorization 7• Prioritisation	1• Offer evaluation 2• Qualitative evaluation 3• Choice of architecture 4• Impact-analysis 5• Offer evaluation 6• Financial Analysis 7• First and second authorization 8• Monitoring

Table 1. An overview of selection activities

Involvement in selection						
Type	IFC (ITP)	ICG-1 (LCS)	ICG-2 (IBCS)	ProfSys-1 (DDC)	ProfSys-2 (PLS-2)	ComSer (BTS)
Loc. Topm.	+++	++	n.i.	+++	++	+++
Cor. Topm.	+++	+/0	0	++	++	+++
IS-manag.	+	++	+	++	++	+
Controll.	0	n.i.	+	+	+	+
User cham.	+	+++	n.i.	+/0	+/0	+/0
Designers	0	+	n.i.	+	+	+
Consultant	initiating	n.a.	initiating	confirming	initiating	n.a.

Types of involved stakeholders: topmanagement of the user organization (loc. topm.), corporate topmanagement, IS-management, controlling (financial department), champion from the user-organization, designers (those involved in designing the system) and consultant (external expertise).

Listed is the perceived impact between essential/scale-turning (+++) and none/very little (0), in the selection phases. Further possibilities are n.a. (not applicable) and n.i. (no information available).

Table 2. Involved 'stakeholders' in selection

It is doubted here, that one single approach can capture all perspectives which should be used for selecting strategic IS-investments. The requirements of the situation and characteristics of the investment were seen to vary significantly, which calls for a situation specific approach. If, however (as is the case within ICG and ComSer), large/strategic IS-investments occur frequently, it might be helpful to define a number of 'standard' requirements for selecting this type of investment, beside the formal procedures for financial planning which exist in many large organizations.

Proposition 4: Only a portfolio of selection approaches can lead to high-quality decision-making on strategic IS-investments. Only if investment-types occur frequently, a certain extent of formalisation might be appropriate.

The number of main alternatives which were considered in the selection-phases was in some cases limited to two (invest or do nothing, which concerns the cases ICG-1, ICG-2 and ProfSys-1) or three (do nothing and two alternative 'designs', like in the IFC-case, the ProfSys-2 case and within ComSer). Another level to consider 'alternatives' is the level on which a selection is made between available standard software. In ICG-2 and both ProfSys-cases available software was evaluated and compared.

The quality of decision-making

It was attempted to measure the quality of decision-making on three aspects: decision quality, efficiency and commitment. All these aspects appeared very relevant in all cases. It even seemed as if all aspects are vital for achieving high-quality decisions. A summary of case-findings, including the quality dimension, is presented in table 3.

The most important problems which were mentioned by interviewees concerned the cost-estimation. Assessing benefits was not perceived as problematic although the financial impact often proved very hard to measure. It appeared to be accepted that qualitative arguments are sufficient to justify outlays for strategic IS-investments (even if formal procedures require the quantification of benefits). At ComSer, the time-dimension appeared essential in selection, which seemed to restrict the possibility to design and choose a high-quality innovative system immediately. For the DDC-system, the organizational aspects (organizational change, training etc.) was the most important 'worry' of those involved, which was expected to affect the cost of the system.

Otherwise, not many clear relationships could be identified between quality-variables and characteristics of the selection. The time, spent on selection, was not found to be related with decision quality. No relation could further be identified between the importance of selection and the quality of decision-making. In the IFC-case and the ComSer-case, limited attention for selection might have resulted in some discrepancy between the expected cost and the realised cost of the system. However, this relationship was only very weak and, in contrary, the many selection-phases for the DDC investment did not appear to have resulted automatically in a high-quality decision. On the contrary, many doubts about the estimation of costs and benefits were still expressed and commitment was not found to be especially high.

Proposition 5: The time which is spent on selection is of no direct influence on the quality of decision-making.

The findings, presented here, do not fully confirm the findings of Willcocks & Lester (1993), who conclude that most organizations use cost/benefit at the core of the evaluation, often of a traditional, finance-based type. It was found that, although all organizations use a formal (standardised) financial approach in decision-making, qualitative arguments were central. Sabherwal and Tsoumpas (1993) suggest that the focus during the decision-making process on strategic IS applications should be on obtaining commitment to the vision represented by the system. Commitment indeed appeared to be an essential aspect here and seemed mainly based on qualitative/strategic aspects. Adequate communication of those preparing the decision and the final decision-makers was found to be important on many occasions.

Bacon (1992), found that strategic criteria (response to business objectives) were most important, followed by financial criteria, when deciding on IS-investments. The findings from the cases suggest that these strategic/qualitative criteria are indeed considered first (especially by topmanagement). The most important financial criterion, however, appears to be the cost of the investment (which ranks second in the research of Bacon). Financial benefits were not considered

Variable	IFC (ITP)	ICG-1 (LCS)	ICG-2 (IBCS)	ProfSys-1 (DDC)	ProfSys-2 (PLS-2)	ComSer (BTS)
IT-strategy	innovative	innov./sup.	sup.	innov./sup.	innov./sup.	innov.
System goals	cost reduct. quality	quality replacem.	capacity replacem.	lead-time strategic	replacem. cost/quality	replacem. innovation
Impact of formal procedures	appeared little	medium	medium	medium	medium	medium
Urgency/time restr.	not	rather	rather	some	some	urgent
Associated risk	high	low	n.i.	med./high (organiz.)	med./high (organiz.)	med./high (time)
Organization (most important)	topmanag. loc. manag.	loc. manag. user cham.	loc. man.	IS-manag. loc. man.	IS-manag.	topman. loc. man.
Content-analysis (importance and aspects)	little (cost and qua. benef.)	medium (cost and qu. benef.)	medium (cost and qu. benef.)	high (financial and qual. analysis)	medium (cost and qu. benef.)	high (costs, risks and qu. benef.)
Results of selection	started and cancelled	start building	clear decision	unclear decision	unclear decision	start building
Perceived problems	cost estimation	estimating cost and benefit	n.i.	organiz. impact and cost	cost estimation	timing
Quality of decision	discrepant	high	n.i.	weak	high	some discrep.
Commitment	weak?	high?	high	weak	high	n.i.
Efficiency	n.i.	weak	n.i.	high	weak	high

n.i. means that no clear information was gathered on these points; if a question mark is added, the available information tended towards a certain 'score' but not sufficiently clear. Discrepant (quality-measure) means that there is clear discrepancy between some predicted variable and the realised variable (especially costs).

Table 3. Comparative analysis of six cases

very important here. The importance of 'championship' (e.g. Farbey *et al.*, 1992) was confirmed in most cases (especially LCS and DDC). Despite the high potential benefits which were promised in many cases, the presence of a champion to 'pull' the decision process personally was often vital. The finding of Farbey *et al.* (1992), that quantification of benefits is not always required was confirmed here.

The cases have clearly shown the intertwinedness of aspects of content, process and organization of selection. Further, some relationships were addressed between situational factors and the selection. All aspects of decision-quality seemed important within the cases, but only few clear relationships with characteristics of selection could be identified.

Proposition 6: Selection of strategic IS-investments is the result of a complex interaction of content-aspects, the decision-process and the organization. Urgency, the IT-strategy and the organization do influence selection.

Selection of strategic IS-investments was thus found to be a very difficult and complex task. When analyzed, however, the basic elements can be discovered which all represent rather 'standard' problems like cost-estimation, benefits-estimation, risk-analysis, defining the IS-strategy to establish criteria, prioritisation, evaluation of qualitative arguments, building commitment, involving experts, following formal guidelines and so on. Many of these problems have been

dealt with in literature and normative approaches exist.

Much more complex, however, is the challenge which faces decision-makers in practice, who have to deal with all these aspects at the same time and further take situational factors into account, which leads us to proposition 7.

Proposition 7: Content, process and organization of IT-investment selection must be managed concurrently, while recognising situational characteristics, in order to realise high-quality decision-making.

This paper has presented some empirical support for this proposition and further suggested a number of variables which should be considered by managers and by researchers, trying to develop new approaches or evaluate existing ones. Attention should especially go out to comprehensive methodologies, enabling practitioners to manage decision processes adequately, rather than to techniques which focus on parts of selection. These methodologies should be sensitive for context-variables, influencing selection.

Although in all cases rather detailed information could be distilled on various aspects of the decisions, not every aspect could be studied profoundly in each case. This was especially due to the involvement of many people within the investment, a lack of (accessible) documentation or quickly changing organizational structures and thus responsibilities. Through feedback of interview- and case-reports, however, we were able to create realistic descriptions.

6 Conclusions

Based on the model which was presented in section two, it has been attempted to describe the role of selection in decision-making on strategic IS-investments. It seems as if the model has enabled to demonstrate the close relationship between aspects of content, process and organization for this type of decisions. It was shown that selection-activities are spread over the decision process and are of a very diverse nature. Their use depends on who is involved and why. Urgency and the formal decision-procedures seemed to play an important role and the relation between the IS-strategy and IS-investments was shown, often intertwined with prioritisation. Qualitative criteria and cost-considerations were found to be important in each case. The determination of benefits in financial terms appeared secondary, although this may not be neglected.

Selection of strategic IS-investments is the result of a complex interaction of content-aspects, the decision-process and the organization. Urgency, the IT-strategy and the organization do influence selection. Decision-making quality should be measured in terms of decision-quality, commitment and efficiency, although it proved difficult to relate these aspects. It is suggested here that the attention in research, when the selection of strategic IS-investments is considered, should be focused less on the development of techniques which are based only on criteria to justify decisions, since these criteria are very much diverse and can hardly be standardised.

A suggestion would be to develop a 'tool' to assess the 'quality' of selection at a certain moment. Starting with characteristics of the context (organization, urgency, IS-strategy), an assessment should be made if a decision has been developed sufficiently or not, focused on the question "is the organization ready to commit itself to a certain investment?" Attention can be focused then on the aspect which deserve further study or on aspects which should be 'handled with care' during the implementation.

Acknowledgements

The author is very grateful to the four companies who participated in this project.

References

Bacon C J (1992) The Use of Decision Criteria in Selecting Information Systems/Technology Investments. *MIS Quarterly*, September, 335-353.

Barua A, Kriebel C H and Mukhopadhyay T (1991) An Economic Analysis of Strategic Information Technology Investments. *MIS Quarterly*, September, 313-331.

Bedell E F (1985) *The computer solution.* Dow Jones-Irwin, Homewood.

Bierman H Jr and Smidt S (1990) *The Capital Budgeting Decision.* Macmillan Publishing Company, New York.

Butler R J, Davies L, Pike R and Sharp J (1993) *Strategic investment decisions*. Routledge, London.

Clemons E K and Weber B W (1990) Strategic Information Technology Investments: Guidelines for Decision Making. *Journal of MIS*, 2, 9-28.

Cohen M D, March J G and Olsen J P (1972) A garbage can model of organizational choice. *Administrative Science Quarterly*, 17, 1-25.

Copeland D G and McKenney J (1988) Airline Reservations Systems: Lessons From History. *MIS Quarterly*, 353-370.

Currie W L (1989) The Art of Justifying New Technology to Top Management. *International Journal of Management Science*, 17(5), 409-418.

Deitz R M H (1994) Deciding on IT-investments: Multiple case description of current practice and implications. In *Proceedings of the first European conference on information technology investment evaluation* (Brown A and Remenyi D, Eds.). Operational Research Society, Henley on Thames, 79-89.

Doll W J (1989) Information Technology's Strategic Impact on the American Air Travel Service Industry. *Information & Management*, 16, 269-275.

Dos Santos B L (1991) Justifying Investments in New Information Technologies. *Journal of Management Information Systems*, 7(4), 71-90.

Earl M J (1989) *Management Strategies for Information Technology*. Prentice Hall, New York.

Earl M J (1993) Experiences in Strategic Information Systems Planning. *MIS Quarterly*, March 1993, 1-24.

Farbey B, Land F and Targett D (1992) Evaluating investments in IT. *Journal of Information Technology*, 7, 109-122.

Farbey B, Land F and Targett D (1993) *How to Assess your IT investment*. Butterworth-Heinemann, Oxford.

Farbey B, Land F and Targett D (1994) A Taxonomy of Evaluating Methods. In *Proceedings of the first European conference on information technology investment evaluation* (Brown A and Remenyi D, Eds.). Operational Research Society, Henley on Thames, 44-70.

Hochstrasser B (1993) Quality engineering: a new framework applied to justifying and prioritising IT investments. *European Journal of Information Systems*, 2(3), 211-223.

Hogbin G and Thomas D V (1994) *Investing in Information Technology: Managing the Decision-Making Process*. McGraw-Hill, London.

Hopper M D (1990) Rattling SABRE: New Ways to Compete on Information. *Harvard Business Revies*, May/June, 1990, 128-125.

Lumby S (1987) *Investment Appraisal*. Van Nostrand Reinhold, Wokingham, Berkshire.

Mintzberg H, Raisinghani D and Théorêt A (1976) The structure of "unstructured" decision processes. *Administrative Science Quarterly*, June, 246-275.

Neumann S (1994) *Strategic Information Systems*. Macmillan, New York.

Parker M M and Benson R J (1988) *Information Economics*. Prentice-Hall, Englewood Cliffs, New Jersey.

Parker M M, Trainor H E and Benson R J (1989) *Information Strategy and Economics*. Prentice-Hall, Englewood Cliffs, New Jersey.

Pool J (1990) *Sturing van strategische besluitvorming*. Vrije Universiteit Amsterdam, Amsterdam.

Sabherwal R and King W R (1992) Decision Processes for Developing Strategic Applications of Information Systems: A Contingency Approach. *Decision Sciences*, 23(4), 917-943.

Sabherwal R and Tsoumpas P (1993) The development of strategic information systems: some case studies and research proposals. *European Journal of Information Systems*, 2(4), 240-259.

Sassone P G (1989) A survey of cost-benefit methodologies for information systems. *Project Appraisal* 2, 73-84.

Scott Morton M S (1991) *The corporation of the 1990s*. Oxford University Press, New York.

Simon H A (1965) *The Shape of Automation.* Harper and Row, New York.

Symons V J (1991) A Review of information systems evaluation: content, context and process. *European Journal on Information Systems*, 1(3), 205-212.

Thompson J D and Tuden A (1959) Strategies, structures and processes of organizational decision. In *Comparative studies in administration* (Thompson J D, Hammond P B, Hawkes R W, Junker B H and Tuden A, Eds.). Pittsburg University Press.

Vroom V H and Jago A G (1988) *The New Leadership: Managing Participation in Organizations*. Prentice Hall, Englewood Cliffs.

Ward J, Griffiths P and Whitmore P (1990) *Strategic Planning for Information Systems.* Wiley, Chichester.

Willcocks, L and Lester S (1993) How do organizations evaluate and control information systems investments? In *Human, Organisational and Social Dimensions of Information Systems Development* (Avison D *et al.*, Eds.). North-Holland, 15-39.

Witte E (1972) Field research on complex decision-making processes - the phase theorem. *International Studies of Management and Organization*, 156-182.

Yan Tam K (1992) Capital budgeting in information systems development. *Information & Management* 23, 345-357.

Yin R K (1991) *Case Study Research: Design and Methods*. Sage, Beverly Hills, California.