EVALUATING IMPLEMENTATION SCHEDULES FOR INVESTMENTS IN STRATEGIC INFORMATION TECHNOLOGIES: FRAMEWORK AND APPLICATION TO EDI

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Abstract

We develop a framework based on "project networks" and net present value analysis in order to help managers evaluate investments in infrastructural and strategic information systems that require significant amounts of time and money to implement. The framework, which we term "value networks", supports decomposition of investment projects into separate increments, offers a means to represent crucial dependencies that affect the creation of IT business value, and provides a basis for devloping a measurement methodology which can be used from the planning through the implementation stages. This enables the user to identify the implications of choosing among different implementation schedules. We illustrate these ideas by examining how our framework can used to evaluate investments in Electronic Data Interchange (**EDI**) and Cash Management Systems (**CMS**).

1. Introduction

A great deal has been written lately on new techniques for how to evaluate information technology as a capital investment. Many observers seem to increasingly agree that the "bloom is off the rose" of strategic information systems; the ideas are not new, and the time has come for managers to take a hard look at just how much of a contribution information technology (**IT**) can make to a firm's profitability.

1.1. Information Technology Valuation Problems

Among the best known of the new techniques for IT evaluation are Paul Strassmann's "management productivity" [25] and Parker and Benson's "information economics" [20]. These newer techniques tend to reject "capital budgeting" approaches (e.g., net present value (**NPV**) and discounted cash flow analysis) *in isolation*; they are flawed because they do not adequately capture the value of "soft" benefits. Such benefits include better decision making and dissemination of important information within a firm, a tighter link to customers and markets, and better coordination within work groups and across departments and divisions. Admittedly, none of these potential sources of value is easily quantified, yet, the capital budgeting approach is still widely used in practice.

Still, a survey of the finance literature finds strong support for NPV, especially as a vehicle for investment analysis and managerial decision making. In the context of short-term financial management, which we will examine in more depth shortly, capital budgeting techniques have been used to structure the basic aspects of a firm's financial operations to ensure that they are congruent with its objective of maximizing profits. For example, Lieber and Orgler [18] present an accounts receivable management model whose objective is to maximize the net present value of accounts receivables earnings. Kim and Atkins [15] add robustness to this approach by linking accounts receivables investment evaluation with pricing policies. Hill and Riener [10] use an NPV model for determining a firm's credit policy. A common theme from this literature is that the robustness of the NPV approach depends on whether the model fully incorporates the functionally interdependent elements which determine the wealth of the firm. Thus, to the extent that we are able to identify the relevant elements, it should be worthwhile to examine how the newest ideas in IT business value measurement can be used in conjunction with capital budgeting to gauge the economic impact of IT on short-term financial management operations in a firm.

Consider some of the general problems associated with measuring the business value of IT. The outputs of an IT investment are normally much harder to measure than in the case of other capital investment projects. IT outputs tend to fall outside of existing measurement capabilities in most organizations' accounting systems. "Soft" impacts may not only be hard to measure, they may simply not be considered based on current management views of how IT impacts should be conceptualized. A second problem is that it is hard to know what to compare an IT investment against to establish a baseline. Should another IT or a previous manual system be used as a baseline for comparison [6]? A third problem arises when many ITs are linked to each other. This makes it next to impossible to assess the share of benefits accruing to each. Yet the related investments are often individually thought of as "projects", and attempts are made to ensure that each appears likely to beat the firm's hurdle rate for "similar" investments.

These problems carry over into the measurement techniques for investments in IT. Some of the recently publicized techniques are not refined enough to address the measurement problems associated with infrastructural, infor-

mational and operational ITs [13]. They also fail to distinguish between tactical impacts (for maneuvering and fine-tuning operations) and strategic impacts (for repositioning and redirecting a firm's efforts). Finally, they may not take into account the time at which the value analysis occurs, for example, prior to making an investment, after some portion of a larger investment has been made and the related systems have been partially implemented, or after the completed systems related to an investment are in place.

1.2. Organization of the Paper

A useful framework for evaluating and measuring the business value of a strategic IT investment must adequately resolve some of the problems we discussed above. In this paper, we focus on the problem of measuring IT business value for technologies that create a new infrastructure for the firm and help to reposition it relative to its competitors. We develop a framework for IT investment analysis which identifies the business value implications for managerial choices about how to schedule implementation and carry out long-term IT investment plans. The basis of our framework is "project scheduling networks" from the literature in operations management. Recent work in this area has focused on scheduling activities to maximize the value created by a production scheduling network [17]. We utilize strategic investments in "electronic data interchange" (**EDI**) and short-term financial management to illustrate these ideas.

Section 2 presents the background of our new evaluative framework for strategic IT investments. We also discuss the IT business value literature in more detail in order to identify methods which seem better suited to gauging infrastructural and strategic IT impacts. Section 3 applies our framework to investment analysis of EDI and short-term financial management systems. Section 4 discusses some other applications of our evaluation framework and points out some of its limitations that will need to be examined in future research.

2. Project Networks for Investment Analysis of Infrastructure and Strategic ITs

Similar to King, Grover and Hufnagel [16], we define a *strategic information technology* as an IT that is capable of being used towards achieving a sustainable comparative advantage. There are important differences between investment analysis for strategic and non-strategic ITs. The purpose of investment analysis for a non-strategic IT usually centers on deciding whether to invest. But investment analysis for strategic ITs involves multiple decisions:

- Should the overall investments be made?
- How much should be invested?
- How should the investments be scheduled?
- How should implementation be carried out to maximize the value of the new IT?

2.1. IT Business Value Analysis for Infrastructure and Strategic ITs

Infrastructure and strategic IT investments tend to be made over a long term so it is crucial when doing this kind of investment analysis to assess the relationship between the timing of costs and benefits. While the issue of cost/benefit timing fits well with net present value and discounted cash flow analysis, capital budgeting evaluations fail to represent the set of relationships and dependencies among earlier investments and later benefits. By boiling down a complex set of inter-relationships among managerial investment scheduling and implementation choices to a set of dollar figures, rich and potentially useful information is lost. Moreover, as Chismar and Kriebel [8] have pointed out elsewhere, reliance on this kind of approach often leads to underinvestment, since so many of the softer benefits are ignored in the process.

Our review of the IT valuation literature turned up two interesting, quite different perspectives, published recently in a book entitled *Measuring the Business Value of Information Technology* [7]. Both have guided our thinking. Paul Berger, a noted consultant and past president of the Society for Information Management, has focused on "enterprise-level" measures of IT value [6]. In addition to providing a useful framework for matching categories of IT investments to appropriate measures, Berger distinguishes among the processes for measuring IT value for a new business initiative and existing IT efforts. For investments in "strategic/competitive" ITs, he notes that:

> [d]eveloping measures for IT business value is not akin to the search for the Holy Grail. It is a pragmatic, realistic way to help business people view the value of IT in a business situation. Using IT is not a fad, nor is it an end in itself. The only reason for a company to use IT for competitive or strategic purposes is to accomplish management's goals. If those goals are realized with IT as a necessary, direct and major part of the business implementation, then IT value would be positive as measured by positive business accomplishment. If the goals are not realized with IT, a necessary and major part of the implementation, then IT value would be negative as measured by lack of business accomplishment.

While we concur with this general view, it is worth noting that this approach does not pinpoint the contribution of IT. In contrast to Berger's view, Burton Swanson [26] points out that:

> [t]o measure the business value of information technologies in terms of putting a number on it in the conventional sense is problematic, as all but the most naive will agree. The resolution of this problem, both in principle and in practice, is based upon a persuasive, justificatory argument. In the absence of such an argument, measurements are essentially meaningless ... the two should be integrated.

Swanson suggests that *arguments* related to the business value of information technology require the integration of *assumptions* and *facts* from which *conclusions* may be drawn. This is an especially useful perspective in our view; solid arguments must underlie qualitative and quantitative estimates for the likely impacts of investments in strategic ITs. There is an increasing premium on doing this well as the time horizon of the investment lengthens: the assumptions need to well-founded, a firm's position relative to the competition will be hard to predict, and the conclusions that managers reach today will have uncertain future consequences.

The work of Berger and Swanson leads us to an important conclusion. Having a mechanism at hand which represents where the critical "business value linkage" for IT [14] will occur over time, as implementation of a strategic IT investment proceeds, is likely to help managers structure their arguments and suggest business value measures for IT.

2.2. Framework Requirements

Before suggesting some basic requirements for a strategic IT investment analysis framework we first want to point out some important aspects of the analysis process. It is worthwhile to keep in mind that how the analysis is done significantly influences the structure and quality of implementation that follows. Since they are carried out over relatively long time horizons, strategic IT investments can be decomposed into incremental investment stages, each capable of being evaluated separately on its own merits. Additionally, the more decomposition that occurs, the more tangible and reliable the estimates of costs and benefits are likely to be.

Thus, in order to support the development of strong arguments and measures for the strategic value of IT investments before implementation, a useful evaluation framework needs to:

- support decomposition of the investment problem into separate and distinguishable increments;
- offer a means to represent the crucial dependencies that will affect the creation of IT business value;
- accurately align the timing of costs and benefits;
- provide a basis for developing a measurement methodology which remains consistent before, during and after implementation;
- be consistent with the firm's goals of maximizing profit and minimizing cost.

However, our survey of the information systems literature did not turn up any papers which adequately treat these issues. Barua, Kriebel and Mukhophadhayay [4] discuss an approach called "path analysis" for assessing the impacts of IT. However, their method is intended to structure the path along which IT influences intermediate production in order to identify in detail the mechanisms by which the economic outputs of the firm are leveraged by IT.

2.3. Project Networks for IT Evaluation

The cornerstone of our strategic IT investment analysis framework is the use of project scheduling networks (such as PERT), as a means to develop business value arguments. This involves using a network to lay out the project costs, dependencies and benefits, and then using NPV analysis to quantify the value of the investment. NPV analysis has recently been used by Lawrence [17] to synthesize the results of solutions to various subproblems in production scheduling, which are also modeled using networks. To our knowledge, however, the use of NPV analysis together with project scheduling networks has not been investigated previously in the information systems literature. "Value networks", as we will call them in the remainder of this paper, are complement NPV analysis, in isolation, and other valuation methods for a number of reasons.

First, a value network enables the analyst to represent as much detail as is necessary to support a justificatory argument for IT business value. The justification exists in that the network accurately decomposes the investment problem by identifying logistical, organizational and resource dependencies and by identifying the timing of benefits and costs that drive firm's profitability. Second, value networks provide a framework for evaluating a myriad of decision options associated with an IT, such as what incremental investments will best leverage the investment base and how to prioritize investment increments based on limited implementation resources. Third, value networks

provide a framework to carry forward in support of actual implementation of the IT. It suggests the linkages that must be represented in constructing a measurement system to use during and after implementation.

We next turn to an illustration of how to apply the *value network* framework to improve management's understanding of investments in EDI.

3. Application to Electronic Data Interchange Investment Evaluation

Phyllis Sokol, in a recent book entitled *EDI -- The Competitive Edge* defines *electronic data interchange* as "intercompany, computer to computer communication of data which permits the receiver to perform the function of a standard business transaction and is in a standard data format" [22].[1] Bernell Stone stresses that "interchange in EDI generally suggests data exchange between organizations rather than within organizations" [24]. He also points out that EDI is commonly referred to by several names: electronic business data interchange, business data interchange and business data exchange. *Financial EDI*, meanwhile, "pertains to invoicing, payment, remittance advice, the resolution of differences relating to these transactions, and the updating of accounts receivable and payable.[2]

Electronic funds transfer is one narrow form of EDI. Other examples include SWIFT message formats in international funds transfer, cash management products which deliver formatted balance and transaction reports to corporate treasurers, and computerized airline reservation systems which provide for automated ticket booking. Sokol suggests that by 1993 about 70% of all U.S. companies will be involved in EDI and that early implementors may be poised to gain significant competitive advantage. In fact, today about 50% of the Fortune 1000 companies are involved, but the great majority of these are still in the initial stages of setting up EDI pilots. The actual dollar investments are quite large, exceeding $200 million in 1988. These estimates are expected to grow by a factor of ten to nearly $2 billion by 1993.[3]

Consultants in the area are quick to point out the key differences between EDI investments and other more traditional IT investments. For example, making EDI investments productive frequently requires: industry cooperation on the creation of standards; coordination with a firm's legal department on how to handle disputes in electronic document sharing; coordination among departments which have automated processes that were never linked before; training of personnel in-house and at buyer and supplier firms; and phased discontinuation of parallel manual processes, without disrupting business relationships.

In evaluating EDI as a strategic investment in a firm's IT infrastructure, it is important to think broadly about the range of issues a manager must consider with respect to the technology. For example:

- EDI implementation is normally spread out over many years; it is not a short-term investment with a rapid payback [21].

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[1]For a sampler of definitions which relate EDI to the recent literature on *interorganizational information systems*, see [5].

[2]For a concise, highly readable introduction to EDI as it relates to corporate trade payments, we recommend Stone's monograph on EDI recently published by CoreStates Banks [24].

[3]E. J. Joyce, "Tales of EDI Trailblazers", *Computer Decisions*, February, 1989, p. 62.

- There are often many implementation alternatives for EDI that should be considered as part of the initial analysis [19, 21, 22].
- In evaluating EDI as an investment, the issue usually is not *whether* to invest, but usually *how* to invest and *how much* to invest.
- EDI is a complex IT to implement in which many of the benefits are linked to other ITs and organizational changes. The logistical, organizational and resource dependencies need to be mapped out at the initial stage of the investment analysis [21].[4]
- Since EDI requires a major commitment of corporate resources most firms which are getting involved in EDI are forced to wrestle with how to do it right.

We think that use of a value network along with NPV represents is a particularly viable evaluation approach for EDI.

Overall, short-term financial management is a functional area receiving increased consideration for IT investments. Gentry [9] presents the case that corporate strategy and improved efficiency and effectiveness of the cash management function are strongly linked to investments in a firm's IT. Hill and Ferguson [11] have argued that EDI/EFT systems may also have a significant impact on short-term financial management because they can cause a shift in the timing of short-run cash flows. Additionally, Srinivasan and Kim [23] have examined the variety of ways that decision support systems can be used to improve decision making in the corporate treasury.

A strong case can be made that investment evaluation for short-term financial information systems should be conducted in conjunction with planning for EDI. First, EDI fully automates the invoicing function which is a fundamental component of accounts receivables management. A short-term financial information system linked to the EDI invoice may provide additional leverage in the area of analysis. Second, EDI may enable short-term financial management benefits to be achieved that currently are not feasible.

3.1. Decomposing the EDI and Cash Management System (CMS) Investment Problem

Our approach for decomposing EDI for investment analysis is based on the value-added chain (**VAC**) [12]. Figure 1 below shows a VAC and a hypothetical company's span along it. The VAC depicts the flow of raw materials through various stages of production where value is added until the product is delivered to the consumer.

From the company's point of view there are three components of the VAC that require management's attention:

- **Supplier-side**: On the supplier side of the VAC, the company is concerned primarily with lowering or minimizing the cost of materials it purchases for transformation by its production processes.
- **Production/transformation-side**: In this portion of the VAC, the company's main concern is efficiently transforming material inputs into finished goods. This includes minimizing waste and maximizing labor productivity.
- **Customer-side**: On the customer side the company's main concern is with increasing sales and the margin on the company's products.

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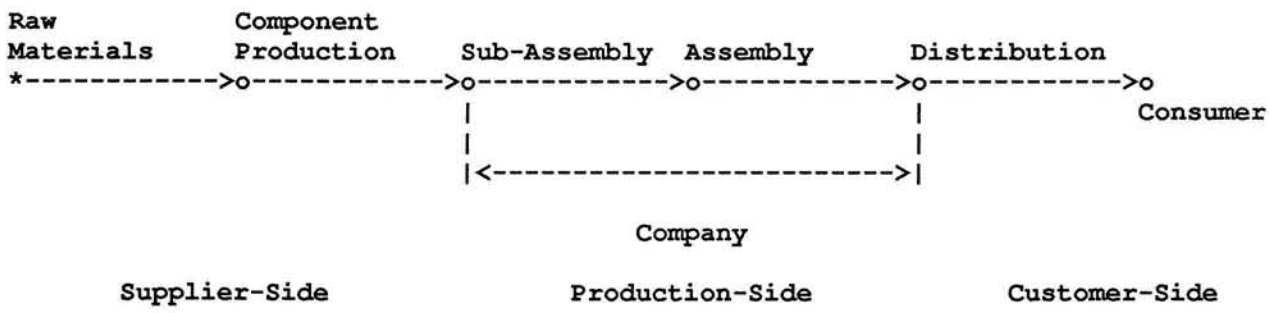
[4]Telephone conversation with Bernell Stone, February 9, 1989.

Figure 1: Value-Added Chain Decomposition for EDI



These three segments of the VAC provide a good starting point for decomposing the EDI investment analysis problem. Existing company internal systems tend be organized in parallel with the VAC structure; they are often decoupled, for example, into logistics, production and sales systems. Internal systems also have different missions in support of organizational goals, depending on which side of the VAC they support. This difference implies that operational performance measurement methodologies may be different for different internal systems.

Using these three segments of the VAC enables us to decompose EDI and Cash Management System investment analysis into multiple phases. An initial "threshhold" phase is added to account for the initial planning, learning, coordination, and pilot testing required.[5] Table 1 categorizes many of the typical benefits of EDI and CMS based on where they occur in each of the four phases [1, 5, 19, 22].

Suggesting specific methodologies for assessing the magnitude of these benefits as they occur is beyond the scope this paper, but it is important to point out that the methodologies may be different for each phase and may incorporate some of the techniques published in IT value literature (e.g., path analysis [4], hypothesis testing for resource waste reductions [2], hierarchical regression [13], and econometric tests for the presence of a business value linkage for IT [14].)

3.2. Application of PERT Network to EDI Investment Analysis

> **SCENARIO:** *Company ABC is evaluating a strategic investment in EDI. In evaluating EDI, the company is concerned with which area to focus initial investments and how to implement the technology in a way that maximizes the value of the firm. The company, however, is also considering implementation of a CMS. The company has recently conducted an investment analysis of a proposal to install a non-integrated CMS and estimated the NPV to be $ 30. Management wants to know if they should invest in this proposal or wait to invest in CMS until after the EDI infrastructure is more mature and enables development of a better CMS at a lower incremental cost.*

[5]Telephone conversations with Bernell Stone, Brigham Young University, February 9, 1989; Ned C. Hill, Brigham Young University, February 16, 1989; and Jack Shaw, EDI EXECUTIVE, February 17, 1989.

Table 1: Illustrative List of Potential EDI and CMS Benefits by Phase

Threshhold Investment Phase

* Lower ordering costs-clerical
* Lower order processing costs-clerical
* Reduced mailing costs
* Reduced telecommunication costs from less clerical staff
* Reduced overhead-office supplies
* *Reduced cash management personnel*

Supplier-Side of VAC

* Reduced inventory costs
* Reduced costs of handling returnable containers
* Reduced transportation costs
* Reduced shipment receiving handling costs
* Reduced purchase prices resulting from order consolidation
* *Improved management of payables*

Production-Side of VAC

* Increased product quality/quality control
* More efficient production runs
* Reduced spillage/waste
* Enhanced CAD/CIM capability
* Reduced production planning/management staff costs
* Reduced reworking of product

Customer Side of VAC

* Reduced shipping costs
* Reduced transportation costs
* Reduced inventory costs
* Reduced warehousing costs
* Increased sales volume
* Improved customer satisfaction-reputation/goodwill
* Experimentation with sales capability
* Reduced markdowns (quick response capability)
* Reduced advertising costs due to better information
* *Improved management of accounts receivables*

Figure 2 contains a hypothetical PERT *value network* for EDI investment analysis. The network represents a strategic planning group's first cut at analysis. The four phases -- threshhold investment, supplier-side benefits exploitation, production-side benefits exploitation and customer-side benefits exploitation -- are overlaid on the network, which portrays the timing of costs and investments associated with EDI and CMS. Below the network the timing of benefits associated with specific EDI investment phases are shown. We assume that the benefits associated with a phase cannot begin to flow until the investment and implementation "activities" (upon which the creation of the benefits depends) are completed. The network also portrays the interdependencies between EDI and CMS and how EDI serves as an enabling technology for CMS. Activities 7,11, and 16 represent activities unique to the CMS while the remainder activities represent those associated with building the EDI system. D1, D2, D3 and D4 are dummy activities used to depict dependencies which have no explicit resource cost.

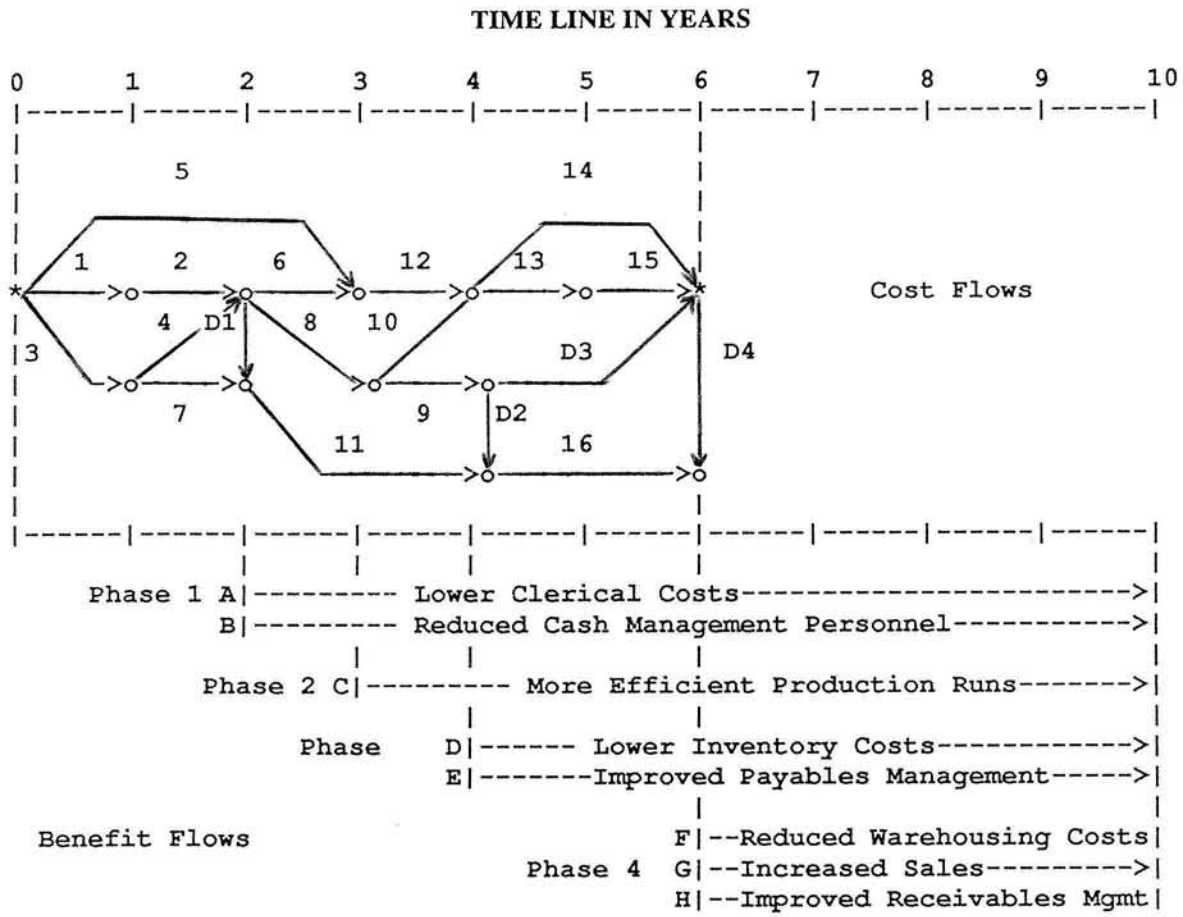
This kind of representation enables us to explore in greater depth the investment issues facing Company ABC's management discussed in the above scenario. Table 2 shows an NPV analysis of the costs and benefits associated with the phases of the EDI value network as a whole. It presents information on the estimated cost and benefit flows identified by Company ABC's EDI planners, arranged according to the four phases, with phase and overall NPV estimates. Note that the costs and benefits in Table 2 are meant to describe in more detail the arcs representing costs in the value network, and their accompanying benefits depicted below the network. Senior management can use the table to assess from which side of the VAC the major net investment gains will flow. In this illustration, major gains lie on the customer and supplier sides, with NPV's of $ 26 and $ 25 respectively. Only minor gains are associated with the production side with an NPV of $ 7.

This hypothetical analysis provides useful information for management and the EDI implementors. One possible conclusion that an EDI planner might reach is that it would be worthwhile to explore implementing Phase 3 prior to Phase 2. Although the natural place to start would seem to be in-house with the firm's own production activities, the planning group's first cut at the value network reveals that much larger benefits are likely to flow from automating the suppliers' side. Since production-side and supplier-side EDI investments are decoupled, rearranging them could potentially increase the overall NPV of the infrastructural IT investment.

NPV analysis applied to the value network also points out that the benefits on the customer side are substantial, but they occur quite late and so are heavily discounted. Management should study the dependency relationships to determine whether Phase 4 benefits can be acquired earlier by decoupling them from Phase 2. Clearly, phases which appear likely to yield high NPVs should be the focus of initial pilot tests. Perhaps a different ordering of the phases could be explored to see if those with high positive absolute cash flows can be implemented sooner.

Table 3 depicts an NPV analysis for the incremental costs and benefits which are unique to the CMS, in the context of the larger EDI investment project. The contents of this table represent a subset of the information presented in the larger table, to reflect that the costs and benefits of creating a workable cash management system in the firm is a subproblem from the perspective of the EDI planner. It suggests that waiting to invest in CMS, based on the implementation of EDI as an enabling technology, is a better investment decision for Company ABC because of the higher NPV.

Figure 2: Project Management Network for EDI/CMS Costs and Benefits



LEGEND: Activity Breakdown by Phase

Phase 1: Threshhold Investment -- Activities 1, 2, 3, 4 and 7

Phase 2: Production-Side Benefits Exploitation -- Activities 5 and 6

Phase 3: Supplier-Side Benefits Exploitation -- Activities 8, 9, 10 and 11

Phase 4: Customer-Side Benefits Exploitation -- Activities 12 through 16

Table 2: Spreadsheet Example of NPV Analysis of EDI and CMS Costs and Benefits

		Year									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Phase 1											
Costs:	**1**	20	0	0	0	0	0	0	0	0	0
	2	0	20	0	0	0	0	0	0	0	0
	3	15	3	0	0	0	0	0	0	0	0
	4	0	10	0	0	0	0	0	0	0	0
	7	0	18	2	0	0	0	0	0	0	0
	ON-GOING	0	2	3	4	4	4	4	4	4	4
Benefits:	**A**	0	0	5	10	20	30	30	30	30	30
	B	0	0	5	10	15	15	15	15	15	15
Cash Flow:		-35	-53	7	16	31	41	41	41	41	41
PHASE 1 NPV = $ 62											
Phase 2											
Costs:	**5**	0	15	7	0	0	0	0	0	0	0
	6	0	0	12	0	0	0	0	0	0	0
	ON-GOING	0	0	0	0	1	2	2	2	2	2
Benefits:	**C**	0	0	0	6	9	12	12	12	12	12
Cash Flow:		0	-15	-19	6	8	10	10	10	10	10
PHASE 2 NPV = $ 7											
Phase 3											
Costs:	**8**	0	0	8	0	0	0	0	0	0	0
	9	0	0	3	12	0	0	0	0	0	0
	10	0	0	1	10	0	0	0	0	0	0
	11	0	0	5	10	0	0	0	0	0	0
	ON-GOING	0	0	0	3	6	6	6	6	6	6
Benefits:	**D**	0	0	0	0	6	12	20	20	20	20
	E	0	0	0	0	5	12	12	12	12	12
Cash Flow:		0	0	-17	-35	5	18	26	26	26	26
PHASE 3 NPV = $ 25											
Phase 4											
Costs:	**12**	0	0	0	8	0	0	0	0	0	0
	13	0	0	0	0	10	0	0	0	0	0
	14	0	0	0	0	5	10	0	0	0	0
	15	0	0	0	0	0	20	0	0	0	0
	16	0	0	0	0	20	5	0	0	0	0
	ON-GOING	0	0	0	0	0	0	4	4	4	4
Benefits:	**F**	0	0	0	0	0	0	5	15	20	20
	G	0	0	0	0	0	0	6	30	30	30
	H	0	0	0	0	0	0	2	4	8	12
Cash Flow:		0	0	0	-8	-35	-35	9	45	54	58
PHASE 4 NPV = $ 26											
TOTAL PROJECT NPV = $ 120											

Table 3: Spreadsheet Example for NPV Analysis of Cash Management Portion of Illustration

		Year								
		1	2	3	4	5	6	7	8	9	10
Costs:	7	0	18	0	0	0	0	0	0	0	0
	11	0	0	5	10	0	0	0	0	0	0
	16	0	0	0	0	20	5	0	0	0	0
	ON-GOING	0	0	1	2	3	4	5	5	5	5
Benefits:	B	0	0	5	10	15	15	15	15	15	15
	E	0	0	0	0	5	12	12	12	12	12
	H	0	0	0	0	0	0	2	4	8	12
Cash Flow		0	-18	-1	-2	-3	18	24	26	30	34

NPV= $ 46

NPV OF CASH MANAGEMENT RELATED ACTIVITIES (from Scenario) = $ 30

4. Concluding Remarks

4.1. Other Applications of Value Networks

The value network we have proposed can be generalized to apply to evaluation of other strategic ITs to establish initial decomposition of the investment problem. Other strategic ITs are similar to EDI in that there exist alternative ways the technology can be incorporated into the organization. Project networks combined with NPV analysis provide a framework for assessing these alternatives using a top-down, disciplined approach.

Use of project networks for IT investment analysis also opens up other avenues along which an analyst may proceed. If a computerized project network package is used, "Monte Carlo" scenarios can be run to model the effects of crashing certain activities, for example, by bringing in outside consultants to supply the necessary expertise or by purchasing off-the-shelf EDI software from a third party vendor.[6] This modeling could include "what if" analysis to determine whether certain activities could be eliminated.

Project networks can also be used as a management tool to support implementation. This would require further decomposing the first cut network shown in Figure 2 to represent the set of activities which must be carried out at each major node of the value network. Additional decomposition will enable managers to get a clearer picture about how implementation is shaping up to create value. Should management wish to review the progress of the overall

[6]See Joyce's discussion of ABD Sales Inc. and its decision to convert IBM System/34 to handle EDI transaction sets increasingly required by its suppliers, the large food manufacturing firms, Nabisco and Kraft.

implementation effort, it will be obvious from inspecting a more detailed network which parts of the organization represent the potential bottlenecks and where slack is likely to occur. The overall picture that emerges can be used by managers to set up arguments in support of their business value estimates.

The value network approach also allows the organization to model the benefits and costs associated with even tougher management issues, such as organizational design and the computer architecture of the firm. EDI investments are essentially decisions about a firm's software; the EDI standards for data sharing codify the set of capabilities a firm must build into its software on a firm-wide basis. Thus, implementation of EDI sets the stage for an organization to think about automation in its most general terms within the firm.

4.2. Limitations and Future Research

The value network framework we have proposed in this paper provides a sound basis for evaluating strategic IT investments. Berger [6] suggested that the measurement process should be different for strategic than for operational ITs. In addition, Swanson [26] has argued that business value measures need to be built from a logical base of justificatory argument. Based on these ideas, we have identified the usefulness of project management networks as a tool to support strong arguments for the business value of strategic ITs.

There are several limitations inherent in our approach that we will be addressing in future research. First, using NPV analysis in this justificatory framework for strategic IT value does not provide proof about whether value will ensue from the investment. Instead, it represents a "best guess" structured in a way that senior management can examine the dependencies faced by managers in separate functional areas. In the normal course of corporate decision making, departmental managers tend to make department optimal, but usually firm sub-optimal, resource deployment decisions. It remains the role of senior management to make certain that resources are used cost effectively. Thus it would be useful to explore ways in which other modelling approaches for IT value can be used to bolster the evidence that the cash flows which occur at various nodes in the value network are indeed linked to the IT investment. Kauffman and Weill [13] have recently investigated the range of models and theory bases from which evidence of IT value might be derived.

A second limitation is the extent to which data would be available to conduct the kind of analysis we recommend. Banker and Kauffman [3], in their study of the business value of electronic banking technology, argue that evaluating strategic contributions of IT requires management to expand the scope of data it collects to forecast the impacts of IT investments. EDI evaluation is likely to pose similar, if not larger, problems because the range of impacts it can have on a firm's operations is broader. The best way to gain additional insight into the kind of information that will be needed is to experiment by developing models to provide answers to the EDI valuation questions that senior managers are most concerned about.

The framework serves as a starting point to address the operational issues of managing and measuring "in progress" implementation of strategic ITs. Finally, the framework serves as a starting point to develop a measurement system for benefits. Using our framework, decomposition of the overall investment/implementation problem into a set of events and dependencies that are recognized and agreed upon by management is likely to promote organizational learning. We believe that when management considers strategic decisions about an infrastucture IT,

using value networks will facilitate choosing among a set of implementation options. This will also promote the identification of sound, operational-level IT business value measures that are linked to organizational performance along important segments of the value-added chain. In order to show that the projected payoffs of a strategic IT are materializing steps must be taken to put an effective measurement system into place prior to the start of the flow of the benefits. While the framework does not offer explicit measures, it points out *where* measurements need to be made, and *what kinds* of value linkages need to be investigated. This helps ensure the organization is measuring the "right" things from the start.

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