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Development of a framework to assess and guide IT investments: An analysis based on a discretionary–mandatory classification

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Abstract

Assessing the economic feasibility of information technology (IT) projects remains a challenge for most organizations. On one hand there are concerns for the rising IT costs, on the other hand organizations may lose significantly if they do not make an appropriate investment in IT. Considering the range of IT projects, a single, standardized capital budgeting approach may not serve the best interests of organizations. This paper presents a framework to help evaluate different IT projects through a mix of suitable methods. The framework is based on the classification of IT projects along a discretionary–mandatory dimension into four types: purely discretionary, mainly discretionary, mainly mandatory, and purely mandatory. A set of factors are identified that may influence the final classification of an IT project into one of the four types. This classification is used to arrive at suitable IT evaluation techniques and methods. Use of strict financial evaluation criteria is suggested for discretionary projects. The need for analyzing financial risks associated with IT projects is also identified and it is suggested that higher standards of project acceptance be used for riskier projects that are not deemed mandatory in the earlier analysis. The framework should be useful for information systems researchers and practitioners in streamlining the assessment of IT projects.

Keywords: IT evaluation; Information systems; IT investment; IS strategy; IS policy; IS project; Project management; Feasibility analysis; Risk analysis

1. Introduction

Information technology (IT) presents major opportunities and challenges to organizations in today's turbulent and globally competitive environment. In a survey of 213 CEOs, Kearney reported that IT-related issues top the CEO agenda, ahead of issues such as product quality, quality staff, and customer orientation (Kearney, 1998). While it is generally agreed that IT investments are beneficial to an organization, evaluating and measuring the contribution of IT to the bottom line can be difficult. A Computerworld survey of CIOs also reports that in the years to come, business executives will force IT management to pay even greater attention to the value IT brings to the business. Similarly, findings of IT research firms like Gartner and Meta Group Inc. and other authors suggest that IT departments will have to more clearly demonstrate how their investments impact both the organization and its customers (Jeffery & Leliveld, 2004; Saia, 1999; Wagle, 1998). Consequently, IT evaluation and project feasibility analysis has been a major theme of IS research (Bacon, 1992; Bennett, Robert, & Hendricks, 1987; Clemons, 1991; Kaplan, 1986; Kearns, 2004; Kleist, 2003; Kumar, 2003; Ragowsky, Ahituv, & Nemann, 1996; Ranta & Tchijov, 1990; Riel, 1998; Santos, 1991; Schell, 1986; Shank & Govindrajan, 1992; Willcocks, 1992).

With evolution in the role of IT in organizations and enhanced deployment of technology, IT evaluation process has become more complex and difficult. There has also been a proliferation in the number of IT projects and investments. Many such projects form a vital link in a series of steps to achieve the target strategy or architecture. This makes it very difficult to assess the costs and benefits of a single project with any degree of accuracy. Further, as

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projects change in focus from cost reduction to strategic benefits like competitive and cooperative advantage, diversification, access to new markets, and customer relationship management, quantifying benefits becomes a challenge (Callon, 1996; Farbey, Land, & Targett, 1993; Gleckman, 1993; Jeffery & Leliveld, 2004; Marks & Frolics, 2001; Sabherwal & King, 1991; Venkatraman, 1994). Many infrastructure projects and projects aimed to meet regulatory requirements also do not permit easy quantification of benefits. Yet, many of these projects may be very important for the firm. Frequently, traditional financial methods such as return on investment (ROI) are not suitable for such IT projects.

Some firms follow a well-defined, quantitative evaluation approach for all IT projects. However, this approach may lead to a significant but unnecessary expenditure of resources. In many cases, MIS and user departments are forced to resort to creative estimates to get needed project approved. As all projects are handled through a standard capital budgeting procedure that is generally focused on detailed quantitative analysis, much effort is spent on cost and benefit estimates for projects that must be approved irrespective of the financial numbers involved.

In this paper, we propose a framework for evaluating IT projects with the objective of streamlining the evaluation process and making it more efficient. To better understand the issues and practices used in the field, we interviewed some executives involved in evaluating and approving IT projects, in addition to a review of the relevant IS literature. Specifically, we interviewed Vice President (MIS) of a retail chain, IS Director of a utility company, and Managing Director of an IT consulting firm. The framework for IT evaluation is thus developed on the basis of a logical analysis of the feedback received from the executives and a review of IS literature.

As an important first step in the IT project evaluation process, the framework proposed in this paper focuses on identifying the degree of discretion that an organization may have in implementing an IT project. This analysis can be used to classify IT projects, and to determine appropriate evaluation processes and to make the resulting evaluation more efficient, streamlined, and accurate.

The rest of the paper is structured as follows: in the next section we review existing research and identify some research issues related to IT investments. The following section presents an overview of IT evaluation methods. In the subsequent sections we develop a scheme for classifying IT projects and suggest organizational processes for such classification. This is followed by a section where we develop a framework for evaluating IT projects that relies on the above classification and give examples of the application of the framework. The paper concludes with a summary and discussion of the usefulness of this work, implications for practitioners, and directions for future research.

2. Issues in assessing IT investments

Information systems researchers have focused on the benefits of IT investments for a long time. Beginning in 1990s the issue of productivity paradox was raised, which dealt with the absence of a strong relationship between IT investments and beneficial effects, e.g., an increase in productivity, which was expected to be seen in organizations that made IT investments (Brynjolfsson, 1993). Researchers found that while investment in IT grew at a fast pace, consequent gains in IT-related productivity were meager and unimpressive. Subsequent studies, however, did find some correlation between IT investment and increase in productivity (Marks & Frolics, 2001). On the general issue of IT investment evaluation research, two distinct streams can be identified in literature. One stream deals with *ex post* analysis, which focuses on the study of relationship between IT investments and their beneficial effects on organizational performance (Mahmood & Mann, 1993; Mandel, Naughton, & Burns, 1997). The second stream of research focuses on techniques for *ex ante* analysis to assess the economic feasibility of IT projects. Various analytical techniques have been proposed to assess IT investments including net present value, pay back period and ROI calculations (Kearns, 2004; Kumar, 2003).

However, accurately quantifying IT benefits remains an area of concern, as many benefits of IT are intangible. There may also be losses in not keeping up with the technology and competitors' initiatives in the use of IT that may be difficult to quantify. Thus the problem of assessing IT investments poses a challenge. Organizations that use an appropriate framework of analysis to evaluate IT investments should be able to make better IT investment decisions. Furthermore, the optimum level of IT investment is also an important issue for the overall effectiveness of IT for the organization as under- or over-investment in IT may fail to provide the most productive results for the organization (Kleist, 2003).

In the next section, we provide a brief review of different IT evaluation methods discussed in the information systems literature.

3. IT evaluation methods

IS literature classifies methods and techniques for evaluating IT projects into two broad categories, namely: (1) where the IT benefits are easily quantifiable and (2) where the benefits are primarily intangible and, therefore, not easily quantifiable (Farbey et al., 1993; Riel, 1998; Sweat, 1998). Quantifiable benefits are also referred to as "hard benefits" and methods for evaluating such benefits treat investment in IT as any other capital expenditure. These methods focus on estimating net increase in cash flow arising from IT project investments and their costs. We have termed these quantitative methods as first-order methods. Major methods that are used to assess IT investments include payback period and ROI.

Payback period method involves calculating the number of years required for recovering the initial investment through net annual cash flow generated by the project. Accept–reject decisions are based upon whether or not the payback period is lower than the maximum acceptable payback period. This method is popular because it is easy to use, considers cash flows rather than accounting profits, and it is well suited for *ex ante* analysis (Meggison, 1997; Turban, McLean, & Wetherbe, 2004).

ROI methods focus on computing the rate of return from an investment by considering depreciation adjusted cash inflows produced by that investment. There are various refinements to this method like calculating return on equity (ROE), calculating the net present value (NPV) of IT projects, and calculating the internal rate of return (IRR) (Gitman & Maxwell, 1987; Shank & Govindrajan, 1992). Generally, these methods have the advantage of providing management a measure of the monetary value of a project. The main disadvantage of these methods is that they focus on financial numbers, while neglecting the intangible benefits of IT. Consequently, it is possible that organizations may find themselves in situations where they end up rejecting some otherwise important IT project because it could not be justified financially.

In many instances, benefits of modern IT are difficult to estimate with any degree of accuracy. Such benefits may include better customer service, improved product quality, and higher employee morale. NPV and ROI methods are not very suitable in such situations and organizations need to employ some other evaluation methods. Two prominent methods that are frequently employed for estimating intangible benefits of IT are value analysis and information economics.

Value analysis helps organizations in evaluating investment in information systems whose benefits are intangible and, therefore, not easy to quantify. Value analysis is a detailed method comprised of eight steps grouped in two phases that is focused on assessing intangible benefits of IT. Overall, the value analysis approach allows users to evaluate intangible benefits on a low-cost, trial basis before deciding whether to commit to a larger investment in an IT project (Keen, 1981). On the other hand, the Information Economics approach is similar to the concept of the critical success factors that deals with organizational success factors while planning for a firm's information systems (Rockart, 1979). This method focuses on key organizational objectives and incorporates the familiar techniques of scoring methodologies, which are used in many evaluation situations. Essentially, this approach relies on deciding which organizational objectives to incorporate, which factors to include, and what weights to assign them while assessing the value of information systems (Meredith, 1988; Turban et al., 2004). We have termed the methods that focus on intangible benefits as second-order methods.

The methods described above are summarized in Table 1.

Table 1
A classification of IT evaluation methods/approaches based on the order of analysis

First order methods (hard cost/benefit figures)	Second-order methods (consideration of intangible benefits and their risks—estimation and realization are the key issues)

• Payback period calculation
• Return on investment
  ○ Internal rate of return
  ○ Net present value
  ○ Calculation
	Value analysis
	Information economics

Before organizations decide upon a suitable method (or a combination of methods) for evaluating their IT investments, it is important for them to understand the nature of an IT project itself. For example, if the nature of the project is such that a firm does not have much discretion in implementing the project, it need not spend considerable time, effort and resources in the evaluation process. In the next section, we develop a typology for classifying IT projects on the basis of the discretion that organizations may have in adopting them.

4. A typology of IT projects on discretionary vs. mandatory dimension

One important aspect of IT projects is the degree of choice available to the organization in undertaking a project. As we discuss shortly, this factor may play an important role in the IT evaluation process in organizations. The concept of discretionary expenditure and investment (as opposed to required, mandatory expenditure) has been recognized in the literature. For example, researchers have examined R&D expenditure, capital budgeting and capital rationing, and consumer expenditure using this context (Bloom & Korenman, 1986; Mande, File, & Kwak, 2000; Truitt & Nunamaker, 1987). Likewise, researchers have classified IT use in to voluntary and mandatory in the context of task-technology fit as a predictor of performance (Staples & Seddon, 2004). However, the issue of discretionary vs. mandatory IT expenditure has not been explored in the IT project evaluation literature. Consideration of this issue may help inform and improve the IT project evaluation process.

IT project investments can also be viewed from a discretionary–mandatory lens, permitting a better understanding of the choices and the opportunities and constraints associated with them. For some IT projects, organization may have little choice and a limited timeframe for their implementation, due to technical, legal, regulatory, or other issues related to the business environment (McAfee, 2003). In considering such mandatory projects, organizations have little choice or discretion. On the other

Table 2
A representative list of examples of IT projects along the PD–PM dimension

Purely discretionary	Mainly discretionary	Mainly mandatory	Purely mandatory
In-house desktop publishing	ERP and CRM implementation	Database management systems	Year 2000 problem
Application downsizing efforts	Data warehousing projects	Upgrades to networking and connectivity infrastructure	Euro currency conversion
Change in operating systems platform (e.g., UNIX to Windows XP)	Client–server architecture	Upgrades to software in use	Government regulations, e.g., HIPPA and Sarbanes-Oxley
Knowledge management for small and medium size firms	Changing database platform	EDI usage mandated by business partners	IRS requirements
E-procurement enhancements beyond traditional purchasing systems		Web site development and reservation of web address	Auditor recommendations and accounting standards
Intranet applications		Paperless airline tickets	Data backup and recovery support
		Facility for the direct deduction of monthly mortgage/bill payments	Airline reservation system
		ERP upgrade	Basic network infrastructure
		Online banking for small banks	
		Desktop software and hardware upgrades	

hand, there may be IT projects that are fully discretionary and an organization can choose whether or not to undertake them, as well as select a timeframe for their execution.

Thus a classification of IT projects based on the degree of discretion may be useful in evaluating them. We propose a classification of IT projects along the discretionary–mandatory dimension, into the four categories outlined below. Examples of projects in each category are provided in Table 2:

1. purely discretionary (PD) projects,
2. mainly discretionary (MD) projects,
3. mainly mandatory (MM) projects,
4. purely mandatory (PM) projects.

4.1. Purely discretionary projects

Unless there are some strong reasons, all IT projects can be assumed to be purely discretionary (PD). In such cases organizations have complete flexibility in undertaking these projects as well as in choosing the timeframe for their execution. Conversion of applications from one platform to another is one such example. There may be other projects where the organizations have a great degree of discretionary flexibility, although industry trends and advances in IT may prompt organizations to consider adopting them. For example, many organizations are switching from Unix to Windows XP platform in response to advances in technology, lower cost of software compatible with Windows XP, and availability of people skilled in the operating system. Application downsizing efforts from mainframe computers to mid-range or mini computers can also be considered purely discretionary issues that can be decided on economic merits of various alternatives. Some office productivity enhancement tools such as a pooled scheduling, calendar, and contact list software that go beyond ordinary e-mail functionality can also be discretionary. These projects will be undertaken if they are justified on economic grounds and can be postponed indefinitely or dropped altogether if not economically attractive.

4.2. Mainly discretionary projects

Some projects may be considered to be mainly discretionary (MD) in nature, with some factors other than purely economic issues affecting their choice. These projects may relate to frontline technical developments and industry trends that are not absolutely necessary for a firm to emulate. A good example in this category is that of enterprise resource planning (ERP) systems. Adoption of ERP systems is mainly discretionary for most organizations, although such adoption by major competitors and other players in the same industry creates a push for their implementation by a firm. Similarly, adoption of client–server architecture or construction of a data warehouse can also be considered mainly discretionary. These technologies have been adopted by many organizations, and therefore, there is a pressure on other organizations to consider adopting them. Still, it is mainly a discretionary decision. Such projects can be postponed indefinitely or for a significant length of time.

4.3. Purely mandatory projects

Some IT projects are purely mandatory and organizations have no choice, but to undertake them with in a defined narrow timeframe. When IT projects are PM, or non-discretionary in nature, too much effort on detailed economic analysis may not be warranted or be very helpful in arriving at the investment decision. For example, consider regulatory requirements for a power plant. Non-discretionary requirements may also exist in cases involving defense contracts, compliance with internal revenue service (IRS) guidelines, and in fulfilling recommendations of external auditors. Recent government regulations

regarding accounting standards defined in the Sarbanes-Oxley bill should also be considered purely mandatory (Swartz, 2003). Some infrastructure projects, such as network links, backup and recovery systems may also be purely mandatory. In many industries, certain levels of customer service and types of systems for customer support and operational management may already be a norm and IT projects that support such requirements need to be considered purely mandatory. One such example is the airline reservation systems. Generally, such IT projects cannot be postponed.

4.4. Mainly mandatory projects

In the case of mainly mandatory (MM) projects, organizations may have some choice, particularly in terms of the timeframe for implementation, yet there are overwhelming factors that demand the implementation of these projects. Some of these projects may even represent investments that may be too good to pass by and for which a classical financial analysis would not give an accurate picture. Some of these investments may also have no immediate payoff, but they provide future options to the organization by creating a marketing presence or by creating specific technological competencies. For instance, consider the case of setting up a web site for electronic commerce. In many cases such a site may not turn in profits, but investment in such a site gives the organization the flexibility and options to deal with changes in buying patterns of customers. Another example may be that of an industry-wide supply chain initiative in the grocery industry. This industry has developed a supply chain system called efficient consumer response (ECR) initiative. Although manufacturers and retailers are not required to join the ECR, still there are factors like ability to participate in industry-wide operations and ability to remain competitive that demand their joining the initiative. Similarly some infrastructure investments like database software, software upgrades, Electronic Data Interchange (EDI) linkages, and network enhancements may also be considered mainly mandatory. These IT projects may have to be undertaken, but an organization may be able to postpone them for some length of time. The above typology is summarized in the grid of Table 3.

The placement of IT projects along the PD–purely mandatory (PM) dimension on the basis of the four level classification presented above can be a useful step for organizations in evaluating their IT projects. Such placement provides an opportunity to consider and analyze a range of project related issues for arriving at an appropriate classification of the project. Furthermore, after the classification of a project along the PD–PM dimension is completed, appropriate strategies and methods for project evaluation can be suggested. These issues are discussed in the following subsections.

5. Factors that may influence the placement of IT projects along the PD–PM dimension

5.1. Technical factors

There are many trends and developments in technology that force organizations to consider and undertake new IT projects (McComb & Smith, 1991; Schwartz & Zozaya-Gorostiza, 2003). Consideration of such trends and developments can be helpful in the placement of a project along the PD–PM scale. For example, consider the Y2K problem that organizations faced a few years ago. Projects related to this issue were purely mandatory and organizations had no choice but to undertake them to fix those problems (Leach, Whitman, Rogers, & Underdown, 1999; Phillips, 1999). Many technical developments such as software upgrades, development of relational databases, application downsizing, movement towards client–server architecture, development of Java and thin clients (network computers), distributed processing, GUI interfaces, and trends in programming languages and operating systems (e.g., shifts from mainframes to Unix, and from Unix to Windows XP) present organizations with new decisions and different degrees of choice. A database management system (DBMS) and network upgrades are mainly mandatory for modern IS environments, particularly if the organization plans to participate in e-commerce, ERP, supply chain management (SCM), customer relationship management (CRM) and other frontline applications. It may further be noted that the influence of technology on the classification of an IT project on the PD–PM scale will depend on the organizational context. For some organizations with large volumes of interconnected data, DBMS may be purely mandatory, while for others it may be mainly mandatory or even mainly discretionary.

Furthermore, while some new technologies may not have immediate applicability in an organization, they may have great potential for future use (e.g., Electronic Commerce or

Table 3
Project classification grid

Level of discretion	Purely discretionary	Mainly discretionary	Mainly mandatory	Purely mandatory
Project characteristics	Complete flexibility in undertaking these projects and the time frame for completion	Some non-economic compulsions like competitor action for project adoption	Some choice in the time-frame for implementation—otherwise overwhelming compulsions for project adoption	No flexibility in terms of project adoption or their time frame

XML). Even if organizations do not wish to invest heavily in them at the current time, it may be necessary to initiate projects and develop in-house experience in the use of such technologies to create an option for the organization. For a proper consideration of this issue, IT forecasts can also help organizations identify areas where they may wish to create such options.

Similarly, many IT investments have significant leveraging effects that may not yield many benefits to a current project. However, once the basic infrastructure is built, it can be used beneficially in down-stream projects. These requirements can push the project toward mandatory status. For example, a project to create a large centralized customer database in a financial institution may yield few immediate benefits for the current project. However, this investment can be leveraged to a significant advantage in future business strategy and related IT projects to offer new products and services to the customer base, for which the infrastructure arrangements are already in place.

5.2. Functional requirements

Many functional requirements of the business also push IT projects toward the mandatory status to different degrees (Karimi, Gupta, & Somers, 1996). For example, the adoption of euro currency by the European Union has made it mandatory for organizations that deal in European currencies to undertake projects to upgrade their systems. Thus, for most companies affected, euro projects are purely mandatory. On the other hand EDI projects are required for different organizations with different degrees of choice. For major suppliers of a large organization that transacts business largely through EDI, related EDI projects can be purely mandatory. While other organizations that operate in industries with predominant use of EDI, it can become mainly mandatory. For example, managers of one regional pharmaceuticals company that we spoke with told us that they were required to invest in EDI in order to transact business with a large producer of consumer goods alone: They do not have any other EDI connections or plans to have EDI connections with other producers.

5.3. Relationship of IS plan and objectives to business strategy

An organization's business strategy plays a crucial role in determining the criticality of its IT projects (Jeffery & Leliveld, 2004; Lai & Mahapatra, 2004; Teo & King, 1997). Several different contexts are possible. For example, the organization may have a strategy of leading the market with the help of innovative new technology-based business approaches. In such cases IT projects need to be evaluated jointly with the business strategy for their economic viability. Once the overall strategy is decided upon and accepted for execution, evaluation of individual IT projects directly related to the strategy may become mandatory in line with a firm's business plan. Examples include American Airline's Sabre system, Amazon's e-commerce initiatives and Citicorp's targeted database marketing approach.

Organizations that focus on differentiation may consider leading edge, innovative technologies mainly mandatory for them to lead in the market and to set new standards of service. On the other hand, organizations with a cost focus may consider innovative, leading edge technologies purely discretionary, and adopt them only if they are economically justified. For example, a customer relationship management system (CRM) could be mainly mandatory for a retailer focused on competing through differentiation on service and products for high-end customers, but the same project may be purely or mainly discretionary for other retailers who compete on the basis of cost.

An organization's IS plans are prepared on the basis of its business strategy (Lai & Mahapatra, 2004; Teo & King, 1997). These plans identify the necessary technical infrastructure requirements and standards that need to be met to enable the organization to achieve its objectives. Thus IT projects can be examined on the basis of their criticality to meet key IS plan objectives. This can make some projects mainly or purely mandatory.

5.4. Competitors' actions and industry trends

Some organizations may find themselves in a catch-up mode to match the offerings provided by their competitors. Such organizations do not lead with IT, but follow the trend set up by early adopters of IT. This factor may push the related IT projects from discretionary towards mandatory status (Callon, 1996). For example, electronic ticketing is catching on in the airline industry and many leading airlines have already introduced it. In view of the flexibility and convenience that electronic ticketing provides to customers, there is a clear pressure on other airlines to follow. In such cases the project may be mainly mandatory or purely mandatory depending upon the perspective of the airline management. Organizations would also do well to keep abreast of the latest trends in their industry in the use of existing and emerging information technologies. Adoption of a new technology on a wide scale in the market place creates a push for its use within an organization (Wang, Head, & Archer, 2002). Thus these factors can push projects that may be purely discretionary toward the mainly discretionary or mainly mandatory status.

5.5. Timeframe for project completion

The timeframe required for completing an IT project can also influence the placement of the project on the PD–PM scale. When there is no pressing time limit, projects can be considered to be discretionary because the flexibility of the timeframe can permit organizations to postpone the project and match its implementation to the availability of internal funds. Thus projects that have a relaxed timeframe can be classified as mainly discretionary. However, when there is a

strict time limit for completing a project, then the project becomes mandatory. Some IT projects move from the discretionary to the mandatory end of the scale over time. For example, software upgrades or desktop replacement programs may move from discretionary to mandatory after a certain period.

5.6. Government, regulatory, contractual, and legal requirements

In several industries, there are regulations and government requirements for systems and reporting that make certain IT projects mandatory (Swartz, 2003). Consider the requirement for deduction of various taxes like income and social security taxes at the source of a person's income and issuance of various forms such as W-2 or 1099 to employees, vendors and to the internal revenue services (IRS) in pre-specified formats. These requirements make the related projects purely mandatory. Similarly, there may be requirements for reporting environmental data, tax and accounting data, employment data, cost and production data to meet federal, state, or local government regulations, contractual obligations (e.g., defense), and conditions imposed by auditors.

6. Classifying IT projects along the PD–PM dimension

In order to make use of the PD–PM classification, it is necessary for organizations to develop processes and structures to assess and classify IT projects along the PM–PD dimension. In the prior section, we have identified factors that should be analyzed in this process. This process would require initial proposal and analysis of the factors by the initiating department. The department that initiates an IT project is likely to depend on the organizational context. For IT infrastructure projects, the initiating department is likely to be an IS department. IT projects focused on user requirements can be initiated by a user department(s) or the IS department. After the user department(s) and IS department have made their analysis of IT projects, they may be presented to the IS steering committee for a final determination of project classification. Such analysis would also require some clarity on the organizational business and IS strategy, as IT projects generally cannot be evaluated in a vacuum. Where such strategy is not clearly articulated, IT project evaluation and analysis provide a useful context and opportunity to consider and specify appropriate strategies. Classified IT projects and related rationale along with financial and risk analysis may be presented to the capital budgeting committee (or authority) for a final decision.

In the prior section, we have identified factors that may be useful in determining the classification of a project along the PM–PD dimension. In the analysis process, initially, all IT projects may be assumed to be purely discretionary. Then each project should be analyzed on the relevant factors as illustrated in Table 3, where the horizontal dimension of the framework identifies the four categories into which an IT project can be placed along the PD–PM dimension. Each factor should be analyzed to determine to what extent it pushes an IT project from the purely discretionary state toward the mandatory side of the scale. After all factors are analyzed, the final determination of the project classification should be made of the basis of its farthest placement toward the mandatory side of the PD–PM scale by any of the relevant factors. Note that we are not recommending an averaging of factors, as most factors may not be relevant for each project. Moreover, even one factor may be critical in making the project mandatory, and that determination is regardless of the influence or relevance of other factors. For example, IT projects designed to meet Sarbanes-Oxley regulations would be purely mandatory, regardless of the evaluation on other factors such as technical factors or industry trends. This analysis process is illustrated in the following examples.

Example 1. A retailer's move to relational database management system.

Table 4 presents the evaluation results for an IT project undertaken by a major retailer in 1999/2000 (The details were obtained from Vice President (MIS)). The project involved a change over from a traditional file processing system to a relational database environment. In the past, the main strengths of this conservative retailer have been effective marketing and merchandizing strategies, focus on high-quality products and services, and a well-established brand image. Most of the systems were mainframe/terminal based. However, in the late 1990s, the retailer's business and information systems plans called for e-commerce and supply chain management initiatives. It was in this context that an IT project to change over to a mainframe-based relational database was considered. Scores indicate the mandatory nature of the project based on the need to meet IS and business plans.

Example 2. An E-procurement project.

An electric utility services company considered implementing E-procurement system in 2001 (the details were obtained from MIS Director). At that time the company already had a well-established computer-based purchasing system that had served the company well over the years. However, developments in technology presented new opportunities for implementing Intranet-based requisitioning process and Internet-exchange-based e-procurement system that permitted features such as reverse auctions and customized vendor catalogs for all material requirements. The management viewed the project as purely discretionary on all dimensions identified in Table 4. The existing purchasing process was running smoothly and serving the needs of the company for several years. Therefore, the E-procurement project was put through a very rigorous quantitative analysis. In the end, the project was approved due to the significant cost saving that the project offered through lower prices, reduced lead time, elimination of

Table 4
Factors affecting an IT project's classification on the PD–PM scale for a retailer's RDBMS system

Relevant factors in determining the IT project status ↓	Purely discretionary	Mainly discretionary	Mainly mandatory	Purely mandatory
Technical factors			X	
Functional factors				
Relation of IS plans to business strategy			X	
Competitors actions and industry trends				X
Time frame available	X			
Government, regulatory, contractual, and legal requirements	X			
Final project status based on the largest influence from the above factors				**X**

Scores indicate the evaluation of an IT project undertaken by a major retailer to convert from a file environment to a relational database environment in 1999/2000 to effectively meet the requirements arising out of business strategy and IS plans for eCommerce and supply chain management initiatives.

paper flow, lower transaction costs, simplified payment process, and increased visibility of the purchasing process to its users.

Example 3. Adoption of online banking by a small credit union.

Many credit unions operate in a very competitive environment. Large, well-funded financial institutions and banks have introduced many new customer friendly innovations through IT investments. These innovations permit customers to conduct all their banking transactions through the Internet. In this environment, the management of a small credit union was faced with evaluating an IT project to offer Internet banking to its customers (the details were obtained from Managing Director of an IT consulting company). On various dimensions such as technical factors, functional factors, relation to business strategy, timeframe, and regulatory requirements, the project was considered purely discretionary. However, on the issue of the competitors' actions and market trends, the project was evaluated to be mainly mandatory. Thus overall the project was considered mainly mandatory, and the credit union decided to undertake the project, even though it could not be justified with hard numbers.

IT projects can also move along the discretionary–mandatory dimension over time. For example, consider the case of a company that needs to evaluate IT investment for organization-wide desktop upgrade. In early stages the project may be mainly discretionary. However, over time the project would move to mainly mandatory status and eventually it may become purely mandatory. The same holds true for software upgrades. For example, when a new module or upgrade is released for an ERP package (such as SAP R/3), it is mainly mandatory for organizations as the vendor immediately stops supporting the older version. Within few months the project for upgrading the software becomes purely mandatory, particularly when no other IT enhancement project can be undertaken in view of the integrated nature of the ERP package.

Above examples illustrate application of the framework to classify an IT project on the PD–PM scale. Initially many of the IT projects may be viewed to be discretionary in most organizations. For discretionary projects the process for economic evaluation is well understood and established in a large number of organizations. Our analysis and examples show how projects can be evaluated to be mandatory upon consideration of relevant factors. The accompanying examples help illustrate the relevance of the discretionary–mandatory dimension in the IT investment decision. In the next section we develop a detailed framework for evaluating investments in IT projects, after the project has been classified on the PD–PM dimension. It is to be noted that the classification of IT projects along the PD–PM dimension provides a means for assessing the urgency of the project and is not meant to be a finer decision criteria. For example, a company faced with the Y2K problem could have either fixed the Y2K bug in its existing systems or taken the opportunity to scrap its legacy systems and start with a new system. The final decision of the firm notwithstanding, the project to address the Y2K issue was a mandatory one for firms.

7. A framework for evaluating IT project investments

As stated earlier, the problem of IT evaluation remains a complex issue for most organizations. Organizations can benefit from a framework for evaluating and presenting IT projects for top management approval.

The first step towards creating such a framework is to create an inventory of major methods of evaluation based on a review of the information systems literature. Additionally, an analysis of the literature and discussions with MIS managers suggested that there is a significant preference in organizations for hard numbers to justify any investment, including IT investments. Sometimes, estimates of costs and benefits are adjusted creatively to create such a justification. Clearly, if an IT project can be justified through hard numbers involving relevant costs and benefits, then it is the most preferred option. In cases where an IT project cannot be justified on the basis of hard numbers, there is a need to consider other methods of analysis like value analysis and information economics that focus on intangible benefits and the criticality of the investment to meet an organization's strategic goals.

Consideration of the criticality of IT projects in terms of their being mandatory or discretionary can be very useful in improving the evaluation process. This determination should have a major impact on the choice of evaluation techniques and the administrative procedures used to evaluate and approve IT projects. Finally, the issue of assessing project risk is also important in evaluating IT projects. This issue naturally assumes greater significance for discretionary projects. In the following discussion, we identify some relevant issues to be considered in developing a framework for IT evaluation.

7.1. Use of hard and soft methods of evaluation

As discussed earlier and summarized in Table 1, we have classified IT evaluation methods into two groups. The first order methods consist of evaluation techniques that rely on hard cost and benefit estimates. These include calculations based upon payback period, internal rate of return, and net present value. When a project is found to be acceptable based on the first-order methods, then there is no significant need to carry out additional analysis. However, projects that fail to qualify in the first-order analysis need to be considered through second-order evaluation methods. First-order methods represent a high level of bar for the acceptance of projects, while second-order methods provide an opportunity for additional analysis. This permits an additional consideration of projects that do not qualify directly on the basis of the first-order analysis, but may hold promise to benefit the organization.

We also recommend that organizations evaluate residual costs from the first-order analysis to use them as a point of reference in judging the offset provided by non-tangible or second-order benefits. For example, if a major marketing IT project involves hard costs of $4 million and total tangible benefits of $3.5 million through lower finished goods inventories, the residual cost will be $500,000. This residual cost of $500,000 can then be compared with non-tangible benefits such as providing up-to-date status on orders, better customer service, faster response to changes in sales trends, etc. The residual cost of $500,000 in this case provides a better reference point than the total cost of $4 million in examining the non-tangible benefits.

7.2. Consideration of methods of analysis for IT projects

Once a project has been placed on the PD–PM scale, it may be possible to identify suitable evaluation methods. Clearly, projects that are considered purely discretionary should withstand a higher standard of approval. Hard data about costs and benefits should be used to justify these projects. Purely discretionary projects also have flexibility in terms of the timing of their execution. Therefore, an organization may decide to postpone the project until resources are available to undertake it. For purely discretionary projects, first-order techniques like payback period, internal rate of return, and net present value analysis seem to be appropriate. Such IT projects should compete with other investment opportunities available to the organization. Thus, even if a project has favorable net present value, it may not be undertaken if other more rewarding and less risky non-IT projects are available to the organization.

For projects that are mainly discretionary, it may be necessary to bring in additional methods of analysis when the first-order methods do not yield a favorable evaluation. Second-order methods based on the analysis of non-tangible benefits and overall value may be suggested for such projects. In such cases it may also be particularly useful to calculate the residual cost based on the first-order analysis. Then the residual cost can be compared with the non-tangible benefits to arrive at a decision. In considering such projects, it may be helpful to study technology forecasts, industry trends, and experiences of companies that have implemented similar IT projects.

When projects become purely mandatory, organizations have no choice in accepting them; these projects have to be given the top priority. In some instances, there may be some flexibility in terms of a timeframe for the execution of projects, which may permit an organization to spread the project over two or more budget cycles. For purely mandatory projects, organizations should avoid spending too much time and effort in the evaluation process as such resources may be better spent on developing cost-effective alternative approaches to meet the project requirements. Where sufficient internal funds cannot be directed to the project, alternative sources of external funds should be explored. For projects that are mainly mandatory, most of the analysis requirements noted above should apply. Such projects may have greater flexibility in the timing of their execution.

7.3. Evaluation of financial risk

In making a final economic determination, it is also necessary to evaluate the factors that may affect the financial risk associated with an IT project (Jeffery & Leliveld, 2004; Schmidt, Lyytinen, Keil, & Cule, 2001; Barki, Rivard, & Talbot, 2001). One such factor is the size of the IT project—arger projects involving many users and functions carry a much higher risk compared to smaller projects. Project structure also affects the associated risk as experimental projects present a higher risk than projects that conform to established structures. Another factor is the nature of technology used. When traditional, well established, mature technologies are used, costs can be estimated with a great degree of confidence. However, where new, developing technologies are used, there is a high risk of cost overruns and unexpected hardware and software costs.

Project risk is also related to the nature of benefits provided by the IT project. Higher risk is likely to be associated with qualitative benefits, as opposed to quantitative benefits. Projects that focus on efficiency can be

Table 5
IT Project characteristics that may influence the project risk

Project characteristic	Lower risk profile	Higher risk profile
Project size	Small, few users, single function/department	Large, many users, cross-functional
Project structure	Well defined	Unstructured, experimental
Technologies	Mature, well established	New, innovative
Nature of benefits	Quantifiable benefits	Qualitative benefits
Timeframe	Current benefits	Future benefits
Project focus	Efficiency	Effectiveness
Goals	Cost focus	Revenue focus

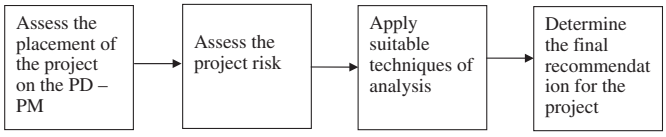

Fig. 1. Procedure for economic evaluation of IT projects.

assessed effectively through the first-order methods. However for projects that focus on effectiveness, quantification of benefits may be difficult, which may lead to higher levels of risk for such projects. Timeframe for the realization of benefits is also a factor in project risk. When the benefits are expected within a short timeframe, it is easier to properly estimate them. However, when the benefits are likely to accrue over a longer time horizon, it becomes difficult to estimate them. Moreover, with changing technologies, reliability of such benefits will be at a higher risk. Finally, projects that focus on cost reduction may be less risky compared to those that focus on increasing revenues, in view of additional external uncertainties that such projects may have to cope with.

All the factors discussed here should be considered in determining the financial risk for a project. This risk assessment should guide the required rate of return for the project. For riskier projects, higher rates of return should be required in the evaluation process. For example, in the case of net present value analysis, a higher cost of capital should be considered for IT projects with greater risk. This will permit comparison of a number of IT projects with different cash flows and risk levels on an equal footing. Table 5 presents some relevant factors that may have a bearing on the level of the financial risk associated with IT projects (Applegate, 1995; Shank & Govindrajan, 1992).

The steps in carrying out the framework are shown in Fig. 1 and the entire framework described in this section is summarized in Table 6.

8. Discussion and conclusions

This paper presents a framework to help guide the evaluation of IT projects. It suggests an alternative

Table 6
Suggested steps for the economic evaluation of an IT project

1. Assess the placement of the project on the PD–PM dimension
(a) Identify the relevant influencing factors for this purpose.
(b) Evaluate the placement of the IT project on the PD–PM dimension based on each of the relevant influences in the context of the organization (see Table 3).
(c) Assess the overall categorization of the project on the PD–PM dimension based on the most dominating influence toward the PM (purely mandatory) side of the scale.

2. Assess the project risk
- Consider project characteristics and assess the financial risk associated with the project and classify the project along the risk dimension into one of the following categories: (a) high risk, (b) medium risk and (c) low risk

3. Apply suitable techniques of analysis

(a) Purely mandatory projects
- Focus on identifying and developing cost effective alternatives, develop detailed cost and budget figures for the administrative approval, identify and evaluate options for external sources of funding where internal resources may not be sufficient. Identify required/permissible schedule.

(b) Mainly mandatory projects
- Use same techniques as noted above.
- Study flexibility in the project implementation timeframe and internal IT budgets. Determine to what extent the project can be delayed.
- Evaluate the project in the framework of the overall IS plan.
- Develop cost-effective alternatives.

(c) Mainly discretionary projects
- Carry out first-order methods of evaluation, identify the residual cost or benefit.
- For projects that are not accepted, use second-order methods to assess the value provided by intangible benefits, compare the value with residual costs and the associated risks in arriving at the final evaluation.
- Consider postponing or putting aside projects with weak or questionable payoff.
- Study the experience of other organizations in the industry, technical forecasts, and industry trends.

(d) Purely discretionary projects
- Develop detailed estimates of costs and tangible benefits.
- Focus on first-order methods based on the hard data accept the project if approved based on the first-order method after thorough risk analysis.
- IT projects compete with other non-IT projects for funds available for investment based on the organizational criteria.
- Determine the time frame for implementation based on the availability of funds and priorities for the approved projects.
- Postpone or put aside projects with weak or questionable payoff.

4. Determine the final recommendation for the project after considering the level of risk of the project
- Use higher standards of acceptance (e.g., higher required rates of return or shorter payback periods) for riskier projects during the

Table 6 (*continued*)

	economic evaluation. • For risky projects, attempt to lower risk by first building a prototype or a pilot project and reassess feasibility based on experiences gained. Consider postponing or delaying very risky projects until better assessment can be made based on internal and external experiences and maturing of technology. • Where feasible put aside projects with weak or questionable payoff, particularly projects with relatively high-risk profiles.

approach to the traditional, standardized quantitative analysis of all IT projects. The standardized quantitative approach may not be suitable for all IT projects and it may not arrive at the correct decision for some projects. The framework proposed in the paper focuses on analyzing relevant factors and using them to classify an IT project based on a discretionary–mandatory scale in the first stage. Subsequently, appropriate analyses are suggested based on the initial classification of the IT project. Such analyses may also include rigorous, quantitative financial analysis where warranted. Thus the framework presents a streamlined IT evaluation process that uses a customized analysis for each project type and has the potential to be more efficient and accurate.

The framework is based on an analysis of the IS literature and a study of IT project evaluation practices and related problems encountered in the industry. This information was obtained through interviews with several executives involved in evaluating investments in IT. The paper also develops a classification for IT projects on the basis of the degree of discretion an organization may have in undertaking these projects. Consequently, four project types are proposed: purely discretionary, mainly discretionary, mainly mandatory, and purely mandatory. Six major factors that can contribute toward making a project mandatory are identified and analyzed. These six factors are: technical requirements, functional requirements, competitor's actions and industry trends, company's business and IT strategy, needed timeframe, and government/legal requirements.

The framework utilizes the above classification to streamline the evaluation process and proposes suitable and efficient evaluation analysis process for each project type. The framework utilizes an analysis of the factors noted above to help determine a project's placement on the discretionary–mandatory (PD–PM) scale. Project classification is then used to identify suitable evaluation techniques and strategies to minimize costs. For example, it is suggested that for mandatory projects, organizations should focus more on developing cost-effective alternative solutions, and less on making a thorough quantitative analysis. On the other hand discretionary projects should be put through a rigorous quantitative analysis process. The application of the framework is illustrated with the help of three examples from organizations. A traditional assumption for most IT projects is that they are discretionary, and an organization could decide to implement a project if it is economically attractive and justified. Two real-life examples from different organizations show how IT projects may become mandatory. One of the examples also illustrates a discretionary project. Thus there is some support for the classification proposed in the paper and its usefulness in the evaluation process. PD–PM classification should therefore be useful in arriving at the correct IT project evaluation decision for the organization. The framework also identifies characteristics that contribute to increasing the financial risk associated with IT projects. The extent of financial risk should be used to set standards of acceptance for a project. Organizations may decide to postpone or put aside projects that are discretionary and whose payoff is either weak, or questionable given their level of risk.

In many instances, traditional methods of analysis fail to recognize the emerging strategic imperatives of the new information technologies. Organizations that remain focused on the traditional cost/revenue analysis fail to seize the opportunities opened to them by modern IT. At the same time, they may end up spending time and resources in carrying out analyses that may have little relevance to their specific situation. A case in point being that most large booksellers and retail chains failed to recognize the opportunities in Internet commerce for a long time and lost the initiative and market share to Amazon. On the other hand, some organizations make the mistake of taking hasty decisions to invest in projects for which the expected payoffs fail to materialize, while the project costs escalate as in case of some ERP implementations. Thus the need for developing appropriate evaluation methods for IT projects cannot be over emphasized.

Furthermore, the problem of IT investment decision remains complex due to several organizational factors, including a lack of IT knowledge among senior management. IT evaluation processes and methods need to appeal not only to information systems managers but also to other senior management of a company, who generally have a significant influence on the final acceptance or rejection of a project. Our framework provides a simple yet powerful means of analysis as it gives decision makers an opportunity to consider a range of issues pertinent to IT investment decisions before embarking upon detailed, time-consuming financial analysis of IT projects. IT managers should carefully consider factors that may push the status of an IT project from the discretionary to the mandatory end. In most organizations, IT management and management in functional areas are hard pressed for time and intellectual resources. Therefore, any approach that can make the evaluation process more efficient and result in correct decisions should be welcomed. The approach proposed here should also obviate the need for creative adjustments

to cost and benefit estimates to justify and obtain approval for critically needed projects. This is particularly true for projects where quantitative estimates of benefits are very difficult to assess with any degree of confidence.

The framework developed in this paper suggests an alternative approach to the traditional, standardized quantitative financial analysis for all IT projects. However, the framework has not been empirically tested. Therefore, future research should focus on its validation and consider possible refinements. Future research should also focus on theory development that may be applicable to IT project evaluation and capital budgeting processes in other contexts. It may also be interesting to examine and classify different IT projects undertaken by different organizations and the actual evaluation/decision processes employed. Since top management plays a key role in the final approval of IT projects, future research should also examine the degree to which different IT project evaluation methods are viewed to be logically convincing by senior management. The evaluation process proposed in this research can also be compared with other evaluation methods to examine its effectiveness in arriving at the correct investment decision.

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