# VENDOR SCREENING IN IT CONTRACTING WITH A PILOT PROJECT[1]

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The past decade has seen an explosion in information technology (IT) outsourcing for building basic computer applications, systems maintenance and support, routine process automation, and even strategic systems. Many companies have found that purchasing IT components from external contractors allows them to enjoy the benefits of specialization and lower costs, while redeploying internal staff on projects that must be developed in house.[2] The market for IT services has grown in both size and complexity. Recent estimates place the market at $350 billion by 2002, up from $140 billion in 1997 (King 1998). The Yankee Group claims that of the 1,000 largest publicly traded companies in the U.S., nearly 40% contract for significant IT functions (Harris 1995). While in the past companies would purchase off-the-shelf software or tailor vendors' applications to their own needs, today outsourcing represents a continuum of activities from purchasing "shrink-wrapped" applications through complete divestiture of the IT function. As the range of possibilities has expanded, the market overall has shown a trend toward longer-term and increasingly complex outsourcing deals (DiRomualdo and Gurbaxani 1998).

The increased reliance on large and complicated outsourcing arrangements places ever increasing demands on the vendor selection process. The Gartner Group claims that vendor screening is becoming a very real problem in IT contracting. More than 60% of outsourcing clients are expected to choose the wrong vendor by 2003. Vendor incompetence and other outsourcing errors will lead to a doubling of failed projects, from 5% to 10% of outsourced initiatives (Bartram 1999). For all except the largest IT projects, there are potentially hundreds of possible vendors, only a small subset of whom have the capabilities to deliver a given system on time and within specifications. Because IT is an intangible product that may be heavily customized to each company, it may be very difficult to assess objectively whether a particular firm has the required capabilities during the bidding process. Equally important, it is difficult to assess vendor performance objectively, even after project completion, preventing the use of outcome-based contracts.[3] While the performance in the contract is often clearly visible to the client, it may be opaque to a third party, limiting the ability to utilize third parties (e.g., courts or arbitration) for contractual enforcement.

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[2]These may be systems that embed the sources of a firm's competitive advantage and therefore cannot be safely outsourced, or represent systems where it is necessary for internal staff to gain expertise.

[3]Mike Keller, senior vice president of business and partner management at Bank One succinctly argues that contracting on specific performance measures "took a substantial amount of negotiating....It wasn't so much that the providers were reluctant to do it, but that it's fairly complex to compare pricing on one outsourcing arrangement to others, or to benchmark certain things like the efficiency of our IT infrastructure" (Violino and Caldwell 1998).

Vendors may have incentives to misrepresent their abilities to win lucrative contracts or may have insufficient information at the time of bidding to assess their own capabilities accurately.[4] For whatever reason, these difficulties increase the possibility that a firm will choose the wrong vendor, thereby reducing the benefits of the system. As William Synwoldt, Vice President of IT and CIO at Niagara Mohawk Power Corp. realized after an outsourced client database project failed, the vendor *"hadn't implemented a system like that before and didn't understand the complexity of the applications....The problem was they didn't understand what they didn't know. They couldn't see the pitfalls in front of them"* (Violino and Caldwell 1998).

The downside of insufficient vendor screening can be devastating not only to the outsourced project, but also to the client's entire line of business. Geophysical Systems, a young oil exploration company, decided to outsource the data analysis of its new invention, a seismic data acquisition device, to Data General Corp., a unit of the highly reputable Raytheon Company. The integrated system was to be sold to large oil exploration companies. Data General proposed to develop the system for $15 million in four months, half the estimated time for in-house development. However, after beginning the project, it became clear that Data General was not capable of meeting the contracted performance criteria, and ongoing delays and low quality began to drive away Geophysical's flagship clients (including Texaco, Superior Oil and Hunt Energy). Ultimately, losses reached $50 million and Geophysical Systems filed for Chapter 11 bankruptcy and sued Data General for contractual non-performance (Moad 1989).

On the other hand, careful attention to the vendor selection process and vendor screening can reduce risk of project failure and enhance the quality of the delivered system, even when pursuing leading edge technology. When USAA began the first implementation of its $10 million image processing integration project, it screened multiple vendors including FileNet and 3M, finally choosing IBM as its provider. The vendor screening phase included pilot projects with some of the vendors and was an important reason for the project's success (Harvard Business School 1992; Moad 1989).

While this problem appears to be important in practice and has received attention in the academic literature on IT outsourcing (see Lacity and Hirschheim 1993; Moad 1989; Rothfeder 1988), there has been little theoretical discussion of how to avoid or address this problem without eliminating the outsourcing option altogether. However, this problem is a special case of a general class of problems of *adverse selection* and the subclass of *screening* problems that has been studied extensively in the economics literature (see, e.g., McAfee and McMillan 1987; Rogerson 1996). Screening is an issue of "hidden type," where a client or regulator must contract for services from a vendor without critical information about the characteristics of the vendor. For example, a regulator needs to set a price for a public electric utility, not knowing how much the actual production cost for electricity should be. Too low a price leads the utility to underinvest in capital improvements or cut service, while too high a price will be consumed in perquisite consumption. The challenge is to reveal the utility's true cost through careful contracting (see, e.g., Laffont and Tirole 1993).

The problem is similar in IT outsourcing: a client must assess the productivity or capability of the vendor, which is only known to the vendor. Through the design of a careful vendor screening and contracting process, the client can often improve the likelihood of getting a high quality vendor. This paper provides an analytical screening model (in the spirit of Rogerson 1996) to examine the client's problem of contracting for building a custom software application[5] to one of many prospective vendors. Vendors are assumed to have better information about their capabilities to deliver the system than the client. Clients are able to assess the benefits they receive from the system during implementation, but these benefits cannot be verified by a third party (and thus cannot be a condition of a contract).[6]

The client is assumed to have all the bargaining power, and thus proposes a single contract to all prospective vendors. Under these information conditions, we show that by using a two-stage contract, clients are able to improve their chances of selecting the

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[4]The Gartner Group estimates that the difficulties of measuring IT benefits will lead to disputes in 20% of incentive-based contracts, where the contract stipulated measurable performance levels, with a third of these requiring intervention by courts (Bartram 1999).

[5]While this paper discusses the problem of outsourcing software development, the results apply to some other IT contracts, such as maintenance of hardware or software.

[6]This type of formulation is relevant even to contracts where some, but not all, aspects of performance can be measured. As long as there is a significant component of performance that can be observed by the client but not verified by the court, our analysis is relevant.

optimal vendor. In the first stage, the "pilot" phase, the vendor builds a prototype of the desired software and the client analyzes the proposed solution. The performance of the pilot can be used to screen potential vendors and better assess their type. If the pilot is of sufficiently high quality, the client opts to complete the project with the chosen vendor; otherwise, the client cancels the project. The client's optimization problem is to maximize expected benefits, subject to participation by the most efficient vendor. The client's proposed contract includes three parameters: the completion threshold (an observable, but non-verifiable performance level), compensation for the pilot phase, and a agreement on compensation for full project completion (contingent on success in the pilot).

The crux of the screening mechanism is that payment for the pilot is below vendor cost, while reimbursement for the completion of the project compensates the vendor for his initial losses, in expectation. This contract, when structured optimally, entices only high quality vendors to bid. Low payment for the pilot phase provides sufficient penalties for low quality vendors. Knowing (privately) that their probability of completion is low, and with insufficient compensation for their initial investments, low quality vendors do not compete for the project. Under circumstances where the project creates sufficient value, the client can always select the highest quality vendor. For very low quality projects, perfect screening cannot be obtained because compensation for the pilot project attracts all vendors in the pool.

The screening decision incorporates an inherent trade-off for the client in setting the threshold. By using a high threshold and selecting only high quality vendors, the "type 2" error of inadvertently canceling the project increases. On the other hand, by lowering the threshold, the client raises the chance of "type 1" error, contracting with an inefficient vendor. Because a properly designed contract has a chance of terminating a contract if a high quality vendor gets "unlucky", this type of contract is not perfect, but does substantially improve project performance over contracting approaches that do not utilize pilot projects.

After identifying the screening contract proposed by the client, we explicitly evaluate the client's tradeoff from screening vendors. It is not always in the client's interest to screen potential vendors. The cost to the client from screening vendors arises from the threshold for completion. When differences in the distribution of the pilot outcome are small, the client has to set a high threshold to screen the best vendor, increasing the type 2 error of terminating profitable projects and reducing the client's expected profit from the project. To mitigate this problem, the client may choose to lower the threshold, incurring a type 1 cost of contracting with an inefficient vendor. The model identifies conditions required for screening to be in the client's best interest and the way this choice is influenced by characteristics of the situation. An important and intuitive result from the analysis is that as the variance in the vendor pool increases, the client's value of screening increases. Similarly, as the value of the contract or the importance of having an efficient vendor increase, screening potential vendors becomes critical. In those instances where the client chooses not to screen vendors perfectly, she may opt to screen out only a certain group of vendors and choose randomly from the remaining vendors.

The analysis integrates the concepts of uncertainty in vendor quality with the inability to contract on the project's benefits (Rogerson 1989). It is shown that a pilot phase and contingent completion of the project provide a contractual mechanism to mitigate both these problems. While previous work in the IT area has examined non-contractible investment by agents (Clemons and Kleindorfer 1992; Richmond, Seidmann and Whinston 1992), auction design for IT services (Chaudhury, Nam and Rao 1995) and optimal decisions to continue or cancel projects (Whang 1992), vendor selection with hidden vendor quality and non-contractible outcomes has not been previously discussed. We identify the specific conditions under which this contract is likely to appear: the project is highly valued by the client, the variance in vendor quality is high, or the vendor's investments are critical to the project's success (similar to Richmond, Seidmann and Whinston 1992). While vendor screening is not always in the client's interest, the proposed set of contracts, for any given information condition, does at least as well as the random selection from a seemingly equally qualified pool of vendors that differ along unobserved quality dimensions.[7] In addition, our contract shows a rational, economic basis for the observation that vendors often are underpaid for early stages of a contract and make up for this deficiency later. While this observation has often been attributed to vendor misbehavior (Klein, Crawford and Alchian 1978), it can also be an outcome of an optimal screening process.[8]

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[7]Our results are compared to the base case of vendor selection after the client has already collected as much information as possible. Given that information condition, we examine whether the two-stage contract can increase efficiency.

[8]The critical difference is whether the payments were established at contract outset (in which case it is consistent with screening) or result from renegotiation (in which case it may be vendor misappropriation of surplus).

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