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ABSTRACT

The trend for businesses to outsource information technology (IT) resources remains a relevant topic among IS researchers (Hirschheim and Lacity 2000, Kern & Blois 2002, Yost & Harmon 2002, Dibbern et al. 2004). While much has been written about outsourcing, the literature is relatively sparse when contemplating the issue of how organizations actually make their IT sourcing decisions. These sourcing decisions present the firm with opportunities such as abandonment, expansion, and deferment, that provide management the flexibility to improve their sourcing portfolios in the future. Real options theory has proven useful for valuing investments in IT infrastructure because it assigns value to future potential (Benaroch and Kauffan 1999, Taudes et al. 2000). This real options approach (ROA) is a promising technique for obtaining insights to sourcing decisions under uncertainty. This paper will relate the benefits of using real options analysis to evaluate the 5 stages of the IS outsourcing decision identified by Dibbern et al. (2004).

Keywords

Real options, IS outsourcing, IS valuation

INTRODUCTION

Intelligent arguments have been made for the outsourcing and the insourcing of IT functions (Hirscheim and Lacity 1998, Lacity and Hirscheim 1993, Ang and Straub 1998). While both sides of the sourcing argument can justify their positions, cost remains a constant theme throughout the outsourcing studies. Dos Santos (1991) found that executives undertook IT investments based upon a "gut feel" or "intuition". If this is the case, evaluating an IT sourcing decision from a cost perspective may best be achieved using financial theories.

Using transaction cost theory, Clark, Zmud, and McCray (1995) studied the structure of the outsourcing decision but failed to identify the primary motivating force in the outsourcing decision. Transaction cost theory states that companies will behave in a cost-economizing way and may still have merit when studying the outsourcing decision. The problem may lie in the fact that IS outsourcing decisions entail a portion of uncertainty. Tallon, Kauffman, Lucas, Whinston, and Zhu (2002) suggests traditional appraisal techniques do not adequately handle risk and uncertainty; therefore executives are forced to rely on instincts when making IT decisions. The real options approach to valuation is based on uncertainty which makes it more appropriate to evaluate sourcing decisions.

Outsourcing

Similar to a manufacturing company outsourcing the fabrication of a part to a third party, businesses have steadily accepted the approach of outsourcing Information Systems (IS) services to outside vendors. IS outsourcing dates back to the early 1960s when Ross Perot's EDS provided data processing services to Blue Cross/Blue Shield of Pennsylvania. The popularity of IS outsourcing continued to grow through the 1970s and 1980s culminating in an outsourcing agreement between Eastman Kodak and IBM worth $1 billion. The significance of the Kodak/IBM deal is the fact that it "legitimized" IS outsourcing as a strategic option for firms (Loh & Venkatraman 1992).

Dibbern, Goles, Hirschheim, and Jayatilaka (2004) developed a framework for studying IS outsourcing by applying Simon's decision making model (1960) to the phases involved in the outsourcing decision. First is the decision phase and encompasses the 'why, 'what', and 'which' stages of the sourcing decision. Next is the implementation phase and involves the 'how', and 'outcomes' stages of the decision. These stages reflect the thought process used by firms when making IS outsourcing decisions and are illustrated in figure 1.
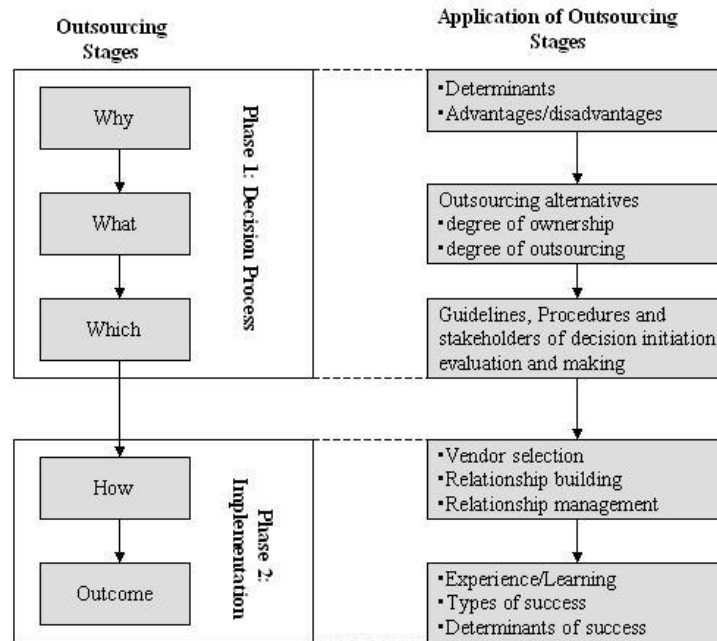
Figure 1: Dibbern, Goles, Hirschheim, and Jayatilaka's (2004) stage model of IS outsourcing

This paper will focus on using a real options approach to evaluate the 5 stages of the IS outsourcing decision. An analogy between using ROA to evaluate investments in IT infrastructure and IS outsourcing will be used to explain how executives can cope with sourcing decisions.

Real Options

Dos Santos (1991) states that traditional valuation approaches, such as net present value (NPV), are inadequate for making IS decisions. NPV is an approach used in capital budgeting where the present value of cash inflows is subtracted by the present value of cash outflows (Weitzel, Gellings, Beimborn, König 2004). NPV is used to analyze the profitability of an investment or project by comparing the value of a dollar today versus the value of that same dollar in the future, after taking inflation and return into account. Conventionally, if the NPV of a prospective investment is positive, then it should be accepted. However, if it is negative, then the investment probably should be rejected because cash flows are negative (Weitzel et al. 2004).

The appealing characteristic of options is that it gives the option holder to "right" but not the "obligation" to conduct a future transaction at a price known today. In finance, options are derived from an asset (usually stock) to provide a means of managing financial risk. An American call (put) option gives the buyer the right to purchase (sell) the underlying asset at the strike price any time prior to the expiration date of the option. A European option is like an American option except it can only be exercised at the expiration date (Chance 2003). Likewise, real options are the right (but not the obligation) to acquire future business assets or opportunities.

Deriving the price of an option is not a trivial task. In their 1973 paper, Fischer Black and Merton Scholes published an options valuation formula known as the Black-Scholes model. The Black-Scholes model is the foundation on which most option valuation techniques are based (Chance and Peterson 2002) and will be the only approach discussed for the purpose of this paper. The idea behind ROA is that 'real' decisions can be valued using the Black-Scholes formula by mapping the appropriate cash flows onto the Black-Scholes parameters. The technique of mapping inputs from a 'real' decision into the Black-Scholes model has been used in evaluating IT infrastructure investments (Benaroch and Kauffan 1999, Taudes Feurstein, and Mild 2000) and more recently for determining thresholds for in/out sourcing the IT function (Lammers Weitzel, and Lucke 2005). The Black-Scholes model uses the following mathematical formula with input parameters listed in table 1: $C_o = S_oN(d1) - Xe^{-rT}N(d2)$ where $d1 = [\ln(S_o/X) + (r + \sigma2/2)T] / (\sigma T1/2)$ and $d2 = d1 + (\sigma T1/2)$

Table 1: Real option parameters to the Black-Scholes Model (Chance and Peterson 2002)

Parameter	Option on a real asset
P	The present value of cash flows from the investment opportunity (e.g. reduced IT expenditure)
X	The present value of delayed capital expenditure or future cost savings
r	The continuously compounded risk-free rate of interest
σ	The volatility (i.e., standard deviation of the project's relative value)
T	The option's life
N(d)	Probability that a random draw from a normal distribution will be less than d

BENEFITS OF APPLYING ROA TO THE OUTSOURCING DECISION

Consider the valuation of a sourcing decision where management is contemplating outsourcing part of the IT function. Using a traditional method, management would attempt to estimate future cash flows (or in the case of outsourcing, cost savings) that may result when the IT function is outsourced (Chance and Peterson 2002). Missing from traditional methods is the ability to capture flexibility that a firm has to: delay the outsourcing, expand the outsourcing portfolio, and to abandon the outsourcing contract. Chance and Peterson (2002) recommend supplementing tradition methods with a Real Options Approach (ROA) that applies option-pricing methods to the valuation of capital investments in real decisions.
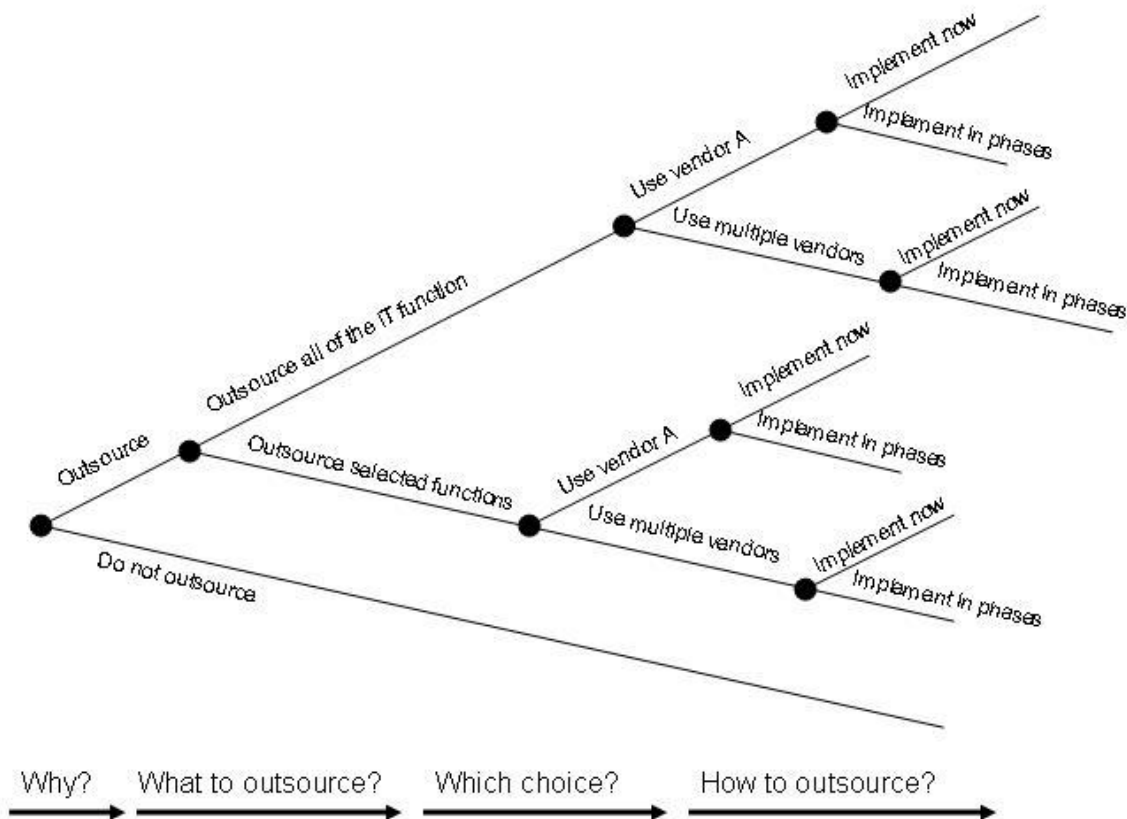
Figure 2: IT outsourcing decision tree

The Dibbern et al. (2004) model is appropriate for valuing IS outsourcing decisions because at each stage of the process management must choose a course of action that will alter future cash flows (i.e. future IT expenditures). This collection of sequential choices is isomorphic to a decision tree analysis. Each fork in the decision tree represents a choice where management must assess value and select a course. Figure 2 illustrates an example of an IT outsourcing decision tree. For simplicity, each fork was limited to 2 courses of action but in reality there could easily be multiple branches for each fork since management could consider multiple IT functions, multiple vendors, and multiple implementation strategies. An options pricing model is especially suitable for evaluating a decision tree analysis (Thorogood and Yetton 2004) because it accounts for the value of managerial flexabilty.

Decision Process: Why outsource?

Soon after the Kodak/IBM outsourcing agreement in 1988 other companies took notice and began to evaluate outsourcing decisions (Dibbern et al. 2004). This trend of outsourcing the IT function became know as the "Kodak effect" and IS researchers began studying the phenomenon. McLellan, Marcolin, and Beamish (1995) found that perceived financial gains inspired most of the IS outsourcing decisions. Reducing costs has remained a constant theme in the IT outsourcing literature (Ang and Straub 1998, Dibbern and Heinzl 2002) but others have found that outsourcing is not a "silver bullet" for reducing costs. Clark et al. (1995) found that not only did outsourcing the IS functions always lead to reduced costs but in some circumstances led to increased expenditure because of unexpected costs. Hirschheim and Lacity (2000) found that poor IS outsourcing decisions can often lead to "back sourcing" or having to reconstruct the internal IT functions.

Of course, there are other reasons to consider outsourcing besides cost reduction such as: faster application development, gaining access to leading-edge technology, and reducing technological risks (Clark et al. 1995). The traditional method of using net present value (NPV) to evaluate IS sourcing decisions seem inappropriate because NPV assigns no value to the future benefits mentioned above (Taudes 1998). The major value of IS sourcing decisions does not stem from the initial decision but rather from future opportunities. Real options analysis would be a helpful technique for assessing IS outsourcing decisions because it values flexibility and allocates value to future potential cash flows (Weitzel et al. 2004). Taudes et al. (2000) used the ROA valuation method for evaluating the IT infrastructure investment to upgrade from SAP R/2 to SAP R/3. They found that since software platforms do not directly generate value NPV-based analysis suggested abandoning the idea because of negative returns. Further analysis using a real options approach and assigning value to future opportunities (EDI applications, workflow management, document management, and e-commerce) convinced the firm that switching to SAP R/3 was an advantage.

Decision Process: What to outsource?

Most outsourcing decisions involve what Lacity and Hirshheim (1993) refer to as 'selective sourcing' where some of the IS function is retained internally and the rest is outsourced to one or more vendors. De Loof (1995) and Venkatraman (1997) developed frameworks to differentiate sources of value during the sourcing decision process. Differentiating sources of value is important in the sourcing decision but traditional valuation approaches, like NPV, do not capture the value of different management options or future investment opportunities (Weitzel et al. 2003).

Similar to the 'why outsource' stage, deciding what to outsource can be evaluated using a real options approach. Separate IS functions can be identified using the frameworks from De Loof (1995) and Venkatraman (1997) then examined using ROA. Dos Santos (1991) argued for using real options to determine the potential value of new technologies. An analogy can be made for using ROA to evaluate new technologies and evaluating the benefits of outsourcing an IS function. The decision of which function to outsource is comparable to the earlier example from the Taudes et al. (2001) study concerning the SAP R/2 to R/3 upgrade. In the Taudes' example, the firm was considering two courses of action – stay with SAP R/2 or purchase R/3. IT functions that are candidates for outsourcing are evaluated using ROA then management can make a quantified decision.

Decision Process: Which choice to make?

Even though there could be considerable benefits from outsourcing, Willcocks, Fitzgerald, and Lacity (1996) noted an issue with companies trying to assess vendor bids. The main issue was comparing vendor bids with in-house capabilities where the benchmark was cost-savings. The real options approach is based on grounded financial theory which makes it appropriate

for evaluating cost based decisions. Benaroch and Kauffman (2000) found that traditional valuation approaches would have led management to make wrong IT investment decisions.

While a formal real options approach is not necessary to compare multiple vendor bids, it could be worthwhile to employ ROA in the decision. Fichman (2004) found ROA was especially valuable on projects or situations with competing investment scenarios. Beyond the SAP example above, ROA has been applied to investments in DSS (Kumar 1999), IT infrastructure (Panayi and Trigeorgis 1998), ATM banking (Benaroch and Kauffman 1999), and object-oriented middleware (Dai, Kaufmann, and March 1999).

Implementation: How to outsource?

A serious problem with traditional valuation approaches, like NPV, is that it does not consider the flexibility that the firm has in managing the integration of new approaches such as IS outsourcing (Dos Santos 1991). For example, the final sourcing decision may involve a selective sourcing decision implemented over a period of time and divided into multiple phases. The NPV approach implicitly assumes management is committed to undertake the entire project, even though the commitment is based on the outcome of previous phases.

Experience in the first stage of a project can provide management with options for dealing with latter stages. At the end of the first stage, management will be in a better position to determine the value of the second phase (Dos Santos 1991). The firm has the option to abandon, expand, reduce, or delay subsequent IS outsourcing phases. By investing in the early phases, the company obtains the option to carry out future phases. Recall that an option is the "right" but not the "obligation" to conduct a future transaction. Using ROA, firms should be more likely redirect or terminate failing projects thus letting their option expire unlike NPV which can lead management to escalate commitment to troubled projects (Fichman 2004).

In addition to the flexibility that can be gained from ROA, there is also issue of timing the sourcing decision. Benaroch and Kauffman (1999) studied Yank 24, an electronic banking firm, and their decision to enter the point of sale (POS) debit services. By postponing the decision to enter the POS market, Yank 24 was able to learn more about the potential returns and reduce the uncertainty of the investment. More notably, if they waited too long competitors would enter the market. Using the Black-Scholes option pricing model, Benaroch and Kauffman were able to quantify the market timing decision. Likewise, ROA can be used to evaluate the timing of IS outsourcing decisions.

Implementation: Outcomes.

After (and during) the implementation of IS outsourcing, firms must evaluate the results of their decision (Dibbern et al. 2004). As stated above, the lessons learned from each step (phase) of the sourcing process creates options for management. While ROA provides insights into IS outsourcing decisions, it can also be used as a metric for evaluating those decisions. Weitzel et al. (2004) gave an interesting example where the Italian internet provider Tiscali went public with an IPO of €46 calculated using traditional methods. Concurrently, the theoretical IPO price was calculated to be €309 using real options that included the following options: enter the eCommerce market, expanding into Europe, and entering the Universal Mobile Telecommunications System (UMTS) market. While the value computed by the real options method seems overstated, Tiscali shares reached €309 within two months of its IPO.

CONCLUSION

Trejo (2000) observed that business decisions resemble a series of options instead of a single projected cash flow. As has been argued in this paper, traditional appraisal techniques are inadequate for option-like decisions such as the IS sourcing decision; this forces management to base decisions on intuition rather than quantitative analysis. Because of the nature of information systems, opportunities from outsourcing (or insourcing) can be difficult to quantify monetarily to management (Taudes et al. 2000). The initial decision to outsource is an investment to realize benefits later. Using real options in the decision process, adds to the quality of sourcing decisions because ROA assigns value to future opportunities and the stream of benefits can be obtained by making the right sourcing decision. A future direction for the application of ROA to IS outsourcing is to further explore the opportunities sourcing decisions provide such as abandonment, expansion, and deferment.

REFERENCES

1. Ang, S. and Straub, D. (1998) Production and Transaction Economies and IS Outsourcing: A Study of the U.S. Banking Industry, *MIS Quarterly*, 22, 4, 535-552.

2. Benaroch, M. and Kauffan, R. (1999) A Case for Using Real Options Pricing Analysis to Evaluate Information Technology Project Investments, *Information Systems Research*, 10, 1.

3. Benaroch, M. and Kauffan, R. (2000) Justifying Electronic Banking Network Expansion Using Real Options Analysis, *MIS Quarterly*, 24, 2, 197-225.

4. Black, F. and Scholes, M. (1973) The Pricing of Option and Corporate Liabilities, *Journal of Political Economy*, 81, 637-653.

5. Chance, D. (2003) An Introduction to Derivatives & Risk Management 6th edition, South-Western, Mason, Ohio.

6. Chance, D. and Peterson, P. (2002) Real Options and Investment Valuation, The Research Foundation of AIMR, Charlottesville, Virginia.

7. Clark, T., Zmud, R, and McCray, G. (1995) The Outsourcing of Information Services: Transforming the Nature of Business in the Information Industry, *Journal of Information Technology*, 10, 221-237.

8. Dai, Q., Kauffman, S., March, S. (1999) Analyzing Investments in Object-Oriented Middleware, *Workshop for Information Technology Systems (WITS)*, Charlotte, NC.

9. De Loof, L. (1995) Information Systems Outsourcing Decision Making: A Framework, Organizational Theories and Case Studies, *Journal of Information Technology*, 10, 281-297.

10. Dibbern, J., Goles, T., Hirschheim, R., and Jayatilaka, B. (2004) Information Systems Outsourcing: A Survey and Analysis of the Literature, *Database,* 35, 4.

11. Dibbern, J. and Heinzl, (2002) Outsourcing of Information Systems in Small and Medium Enterprises: A Test of Multi-Theoretical Model, In *Information Systems Outsourcing: Enduring Themes, Emergent Patterns, and Future Directions*, Springer-Verlag, Berlin.

12. Dos Santos, B. (1991) Justifying Investments in New Information Technologies*, Journal of Management Information Systems,* 7, 4, 71-89.

13. Fichman, R. (2004) Real Options and IT Platform Adoption: Implications for Theory and Practice, *Information Systems Research*, 15, 2, 132-154.

14. Kern, T. and Blois K. (2002) Norm Development in Outsourcing Relationships, *Journal of Information Technology*, 17, 33-42.

15. Kumar, R. (1999) Understanding DSS value: An Options Perspective, *Omega*, 27, 3, 295-304.

16. Lammers, M., Weitzel, T., and Lucke, C. (2005) Sourcing Decisions under Uncertainty, (Work in Progress).

17. Hirschheim, R. and Lacity, M. (1998) Reducing Information Systems Costs Through Insourcing: Experiences from the Field, *Proceedings of the 31st Annual Hawaii International Conference on System Sciences,* Hawaii, 644-653.

18. Hirschheim, R. and Lacity, M. (2000) The Myths and Realities of Information Technology Insourcing, *Communications of the ACM*, 43, 2, 99-107.

19. Lacity, M. and Hirschheim, R. (1993) The Information Systems Outsourcing Bandwagon, *Sloan Management Review*, 35, 1, 73-86.

20. Loh, L. and Venkatraman, N. (1992) Diffusion of Information Technology Outsourcing: Influence Sources and the Kodak Effect, *Information Systems Research*, 3, 4, 334-358.

21. McLellon, K., Marcolin, B., and Beamish, P (1995) Financial and Strategic Motivations Behind IS Outsourcing*, Journal of Information Technology*, 10, 299-321.

22. Panayi, S. and Trigeorgis, L. (1998) Multi-stage Real Options: The Cases of Information Technology Infrastructure and International Bank Expansion, *Quarterly Review of Economics and Finance*, 38, 4, 675-692.

23. Simon, H. (1960) The New Science of Management Decision, Harper, New York.

24. Thorogood, A. and Yetton, P (2004) Reducing the Technical Complexity and Business Risk of Major Systems Projects, *Proceedings of the 37th Hawaii International Conference on System Science*, Island of Hawaii, pp. 80253b.

25. Tallon, P., Kauffman, R., Lucas, H., Whinston, A., and Zhu, K. (2002) Using Real Options Analysis for Evaluating Uncertain Investments in Information Technology: Insights from the ICIS 2001 Debate, *Communications of the AIS*, 9, 136-167.

26. Taudes, A. (1998), Software Growth Options, *Journal of Management Information Systems*, 15, 1, 165-185.

27. Taudes, A., Feurstein, M., and Mild, A. (2000) Options Analysis of Software Platform Decisions: A Case Study, *MIS Quarterly*, 24, 2, 227-243.

28. Venkatraman, N. (1997) Beyond Outsourcing: Managing IT Resources as a Value Center, *Sloan Management Review*, 38, 3, 51-64.

29. Weitzel, T., Gellings, C., Beimborn, D., and König, W. (2004) IS Valuation Methods: Insights from Capital Markets Theory and Practice, *Proceedings of the 7th Annual Pacific Asia Conference on Information Systems*, Adelaide, South Australia, 1590-1608.

30. Willcocks, L., Fitzgerald, G. and Lacity, M. (1996) To Outsource or Not? Recent Research on Economics and Evaluation Practice, *European Journal of Information Systems*, 5, 3, 143-160.

31. Yost, J. and Harmon, W. (2002) Contracting for Information System Outsourcing with Multiple Bidders, *Journal of Information Systems*, 16, 1, 49-59.