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OUTCOME-BASED CONTRACT MODEL FOR IT OUTSOURCING: A SYSTEM DYNAMICS APPROACH

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ABSTRACT

The notion of outcome-based contracting originated from the manufacturing discipline and has evolved as one of the most desirable business models in service science. Although previous Information Systems (IS) studies have glimpsed the role of outcome-based contracting as a driver for system thinking and value co-creation, there are not many studies that examine fundamental issues arising from an outcome-based contract for IT outsourcing. This research examines the mechanism of IT outsourcing contracting processes at two levels, namely, environmental factors of contracting strategy and solution value. It proposes a comprehensive framework to derive value co-creation using a system dynamics approach.

Keywords: Outcome-Based Contracting, IT Outsourcing, Value Co-Creation, IT Value, System Dynamics

INTRODUCTION

As the notion of outcome-based contracting receives greater attention, it has gained more support in the academic literature and the professional press. However, available documented examples indicate that the theoretical underpinnings of outcome-based contracting in the context of IT outsourcing are still under development. Some view outcome-based contracting as a contracting mechanism that allows the customer to pay based on outcomes, rather than merely activities and tasks (Ng and Yip, 2009). Others consider outcome-based contracting to be a way of reducing the detrimental effects of supply-risk events rather than a method of reducing the likelihood of a detrimental event (Zsidisin and Ellram, 2003). In other cases, outcome-based contracting is viewed as a vehicle for delivering positive outcomes through collaborative processes and practices with the customer in a value creating system (Ng et al., 2012). It is, therefore, not surprising to see that there is not much consensus on what exactly outcome-based contracting can deliver especially in the context of an IT outsourcing contract.

Considering the importance of IT outsourcing in today's business environment (Haag and Cummings, 2012), a model that captures the complexities of outcome-based contracting while permitting a systematic exploration of alternative strategies would be invaluable. Using the design science research methodology outlined in Gregor and Hevner (2013) and Peffers et al. (2008), which draw from ideas outlined in Hevner et al. (2004), this study further develops a dynamic model that allows managers to examine the effects of alternative outcome-based contracting strategies based on our previous report in this research stream (Choi and Cummings, 2015).

The rest of the article is organized as follows. The importance of the problem and the motivation for pursuing an artifact-based solution is outlined next. The objectives for the proposed solution approach are then specified, coupled with the design and development of a dynamic model describing the mechanics underlying outcome-based contracting. The model is applied to a case scenario to examine the implications of alternative contracting strategies. A multipronged approach to the evaluation of the model is also included. Communication of the results, in terms of research and the managerial implications of the findings, are discussed.

PROBLEM CHARACTERISTICS

Numerous approaches to cope with inter-organizational contracts have been proposed in the academic literature since Eisenhardt's (1985) seminal study where the notion of behavioral-based contracts and outcome-based contracts were introduced in the context of agency theory. In an IT outsourcing context, a behavioral-based contract rewards the vendor based upon the agreed job behavior such as devoted time. Customers use behavioral-based contracting to monitor vendors' efforts which otherwise are unknown to customers (Zu and Kaynak, 2012). Alternatively, with outcome-based contracting, the vendor is rewarded based on outcomes such as profitability or other IT value measures. A critical assumption embedded in outcome-based contracting is that both principals (customers) and agents (vendors) can observe outcomes (Ekanayake, 2004). Outcome-based contracting largely ignores how the agents (vendors) achieve the agreed outcome (e.g. IT value) (Choi and Liker, 1995). When the level of outcome uncertainty or the cost of measuring outcomes is increased, behavioral-based contracting is preferred (Eisenhardt, 1985). Subsequently, studies explored more dimensions, examining how the choice between the two types of contracting can be affected by the embedded assumptions; e.g. the level of risk aversion of the agent (vendor) or principal (customer) (MacCrimmon and Wehrung, 1986), and the principal's costs associated with moral hazard (Eisenhardt, 1988).

It is important to recognize that merely introducing outcome-based contracting into an IT outsourcing relationship will not improve the value of the delivered solution. The problem addressed in this research is the impact of outcome-based contracting strategies on the value of IT and overall firm performance. Given the sizeable investment needed for new IT projects, failure or incomplete success can have serious consequences.

SOLUTION CHARACTERISTICS

Solution Objectives

The predictive capability of the model is the primary objective as in other studies that use a system dynamics approach. The ability to examine the impact of alternative contracting strategies under a variety of environmental and organizational conditions would provide managers with clear guidance when faced with the many decisions involved in an IT outsourcing contract. "The solution approach must adequately represent the real-world situation, and be robust and reliable (Choi et al. 2010)." Since an IT outsourcing relationship between clients and providers is dynamic in nature, the artifact proposed in this research is a model suite that will allow decision makers to evaluate the impact of alternative contracts (i.e. outcome-based contracts and behavior-based contracts) regarding IT outsourcing under varying environmental and organizational conditions.

Solution Design

Before adopting a system dynamics approach to study the dynamic relationship between the constructs associated with an IT outsourcing contract, a variety of available modeling techniques (e.g. optimization, heuristic search, and simulation) were considered. A previous study (Choi et al. 2010) was used as a basis to examine the suitability of aforementioned techniques. Optimization techniques are appropriate only to select the best solution from a set of well-defined alternatives (Chong and Zak, 2008). However, they are not particularly useful for the problem of IT outsourcing contracts due to the multiplicity of objectives and the dynamic relationship between the constructs in the current problem domain. Heuristic techniques such as genetic algorithms (Holland, 1992), simulated annealing (Kirkpatrick et al., 1983), tabu search (Glover, 1990), swarm optimization (Kennedy and Eberhart, 1995), and ant colony optimization (Dorigo et al., 1996) are preferred in situations where the research questions demand iteratively improving the quality of a solution. This is not characteristic of the IT outsourcing contract problem though.

Discrete event simulation models the system as it evolves over time and the changes that occur at specific points in time (Law, 2007). The relationship between variables needs to be precisely defined and not expected to change significantly over time. This approach is set aside due to the fact that the relationship between constructs associated with an IT outsourcing contract is rather robust and dynamic. System dynamics (Forrester, 1980) represents a

preferred technique since it is well suited to modeling an IT outsourcing contract. System dynamics approaches permit the problem to be studied over several time periods and appropriate actions to be taken within a time period based on prevailing environmental and organizational conditions (Choi et al. 2010). An overview of system dynamics approaches including the application areas is summarized in Choi et al. (2010) as follows.

"The system dynamics approach was designed to study business and social systems (Forrester, 1980). It has proved helpful for testing macro-sociological theories (Jacobsen et al., 1990), including environmental policy, corporate strategy, health care, operations management, change management (Coyle and Exelby, 2000), and strategic management (Sastry, 1997), among others. It has not been used extensively in the IS field, though some researchers have advocated its use (Sharif, 2005), particularly in cases involving novel representations of real-world situations. Some examples include applications for network services business planning (Dutta, 2001), diffusion of the Internet in developing countries (Dutta and Roy, 2004), offshore outsourcing (Dutta and Roy, 2005), agile software development (Cao et al., 2010), IT skill management (Choi et al., 2012), and software project management (Abdel-Hamid, 1989; Abdel-Hamid et al., 1999) among others. As with any modeling approach, concerns exist about the potential use of simplifying assumptions, possible inaccuracies in modeling vis-à-vis the real-world, and a lack of comprehensiveness in the final model. These can be alleviated with validation of the model through multiple strategies (Sterman, 2000)."

DEVELOPMENT OF THE OUTCOME-BASED IT OUTSOURCING CONTRACTING MODEL

The model is designed to assess the ability of alternative IT outsourcing contracting strategies to provide the intended solution value. It considers contracting strategies (i.e. behavior-based contracts (BBC) and outcome-based contracts (OBC)), the environmental conditions surrounding the sourcing contract (i.e. outcome uncertainty and information asymmetry), and solution characteristics such as IT-Business alignment and implementation cost represented by price. The model was developed in an iterative manner. Alignment between business and IT has long been considered important for value realization (Choi et al., 2013). Accordingly, this research elects to model IT-business alignment as one of the major determinants in delivering the business value of an IT solution. IT-business alignment represents a core enabler of delivered solutions.

The business value of the solution is used as a basis for solution price estimation when OBC is selected as the preferred form of sourcing contract, but does not play a role in the solution price estimation process in the case where BBC is preferred. BBC mainly concerns the time devoted to development relevant to solution development effort. The size of the solution project, which represents project complexity, is considered to be the major determinant of the development effort. The model reflects technical and environmental factors and captures the complexity of the solution project. The system dynamics model for outcome-based IT outsourcing contracting is depicted in Figure 1.

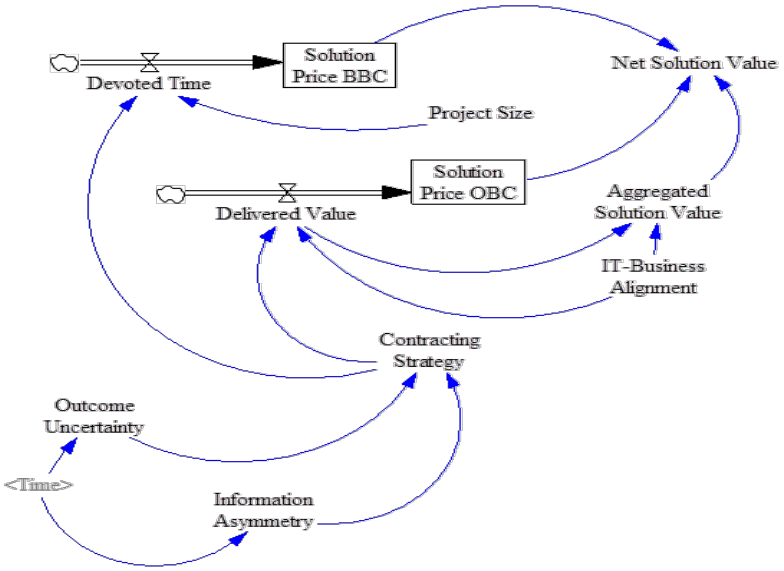

Figure 1. The Outcome-Based IT Outsourcing Contracting Model

The choice of contracting strategy is less a function of isolated one-party factors, than it is the relationship between the solution provider and the relevant project characteristics. Agency theory identifies contracting choices between those that are based on how the agent behaves (BBC) and those that are based on measured outcomes (OBC). The appropriate choice considers the trade-off between the cost of information acquisition for monitoring the solution vendor's behavior and the cost of determining how much of the realized value comes from the solution (Rungtusanatham et al., 2007). Based on prior literature, we can identify outcome uncertainty and information asymmetry as factors that shape the decision on how best to formulate the type of contracting. Low levels of outcome uncertainty permit easier assessment of the relevant solution value, favoring outcome-based contracting as the preferred alternative. Conversely, monitoring vendor behavior is too costly and ineffective when the level of information asymmetry is high, making BBC an unviable option. After considerable analysis of different situations involving outcome uncertainty and information asymmetry, it was determined that a rule-based approach to recommending a contracting strategy decision would be too simplistic, and would not cover the likely spectrum of scenarios effectively. Instead it was determined that a multi-dimensional approach should be adopted. A grid search of the two-dimensional space generated through outcome uncertainty and information asymmetry was performed, and after several rounds of experimentation, a partitioning of the space evolved, as depicted in Figure 2. The x-axis reflects the level of information asymmetry, and the outcome uncertainty appears on the y-axis. These constructs have been normalized for simplicity, though recalibration would enable the use of more standard metrics. Another advantage of using normalized values is that these constructs can now be formulated as a contiguous variable rather than a few discrete categories.

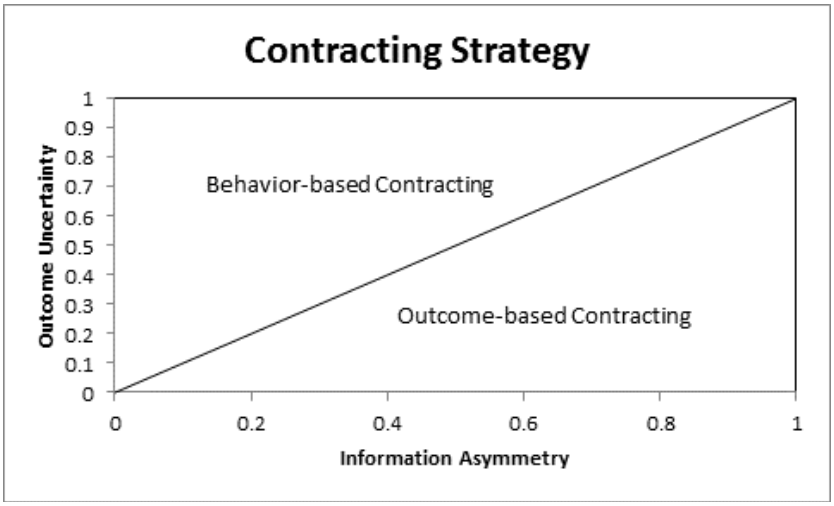

Figure 2. The Contracting Strategy Decision Space

In its present formulation, the space is divided into two areas based on the linear relationship between outcome uncertainty and information asymmetry. Other relationships are viable, and can be easily accommodated. Application to other organizations will involve recalibration to reflect the organization's propensity to select different contracting options based on the trade-off between costs, risks, and existing policies, to name a few. Partitioning the problem space in this manner also permits flexible decision making. It is possible to see the changing decision patterns as one of the constructs is varied. For example, selecting a scenario with moderate outcome uncertainty and lower information asymmetry would favor BBC. As the level of information asymmetry increases, OBC may be preferred. In a similar manner, if the information asymmetry is held constant, adjustment in the levels of outcome uncertainty will entail different contracting strategies.

Outcome uncertainty is currently modeled as a continuously increasing function, representing the increasing difficulty of assessing outcomes as project requirements frequently change and become complicated. In its present form, it is a linear function, though that can be easily revised to reflect other scenarios. Information asymmetry is currently treated as a continuously decreasing function as communication between the principal and solution vendor becomes more effective. It is assumed that the type of agreed upon contracting strategy can change over time even within a single project in order to effectively capture contrasting effects.

DEMONSTRATION OF THE ARTIFACT

Vensim© PLE, a fully functional system dynamics software package from Ventana Systems, Inc., was used to conduct the simulation. Core processes involving the stocks were assembled first. The equations for this segment were created and validated systematically. Next, segments involving loops were added. Assembly of these equations was a little trickier, and the model was run to see if the behavior corresponded to expectation. Validation of this segment entailed some restructuring and recalibration of equations. Next, the value portion of the model was assembled. Since this primarily represents outcome measures and is based on deterministic relationships, validation was relatively straightforward. Finally, the input converters were added to the model. These take on very specific patterns which determine the equation structures.

The equations were calibrated by executing the model for different combination of scenarios, to ensure stable performance. After satisfactory performance of the model during the iterative construction was achieved, it was used to study the effect of various decision making options under a variety of conditions. The patterns confirm that the model follows expectation and serves to demonstrate that it is functioning competently. It generates results that are consistent with expectations, and the performance is stable with no wild fluctuations noted.

The model was run for a period of 36 months, representing a medium-term planning horizon. The simulation for shorter periods does not provide full insight into the impact of alternative contracting strategy options over the whole period of the project. Two objectives drive the simulation runs – validation of the model and a deeper understanding of the impact of alternative outsourcing contracting strategies.

On the validation front, the findings mirrored expectations. They confirm that the model follows theoretical expectations and fulfills a partial requirement of validation, namely, the behavioral reproduction test, which examines how well the model-generated behavior matches observed behavior of the real system (Dutta, 2001; Forrester and Senge, 1980).

This research explored two distinct areas of interest. These include IT outsourcing contracting strategies and the impact of IT-business alignment. While it is possible to vary all parameters within a set of simulation runs, the impact of each can only be effectively assessed by varying it and keeping the others constant. Accordingly, this research varied each dimension of interest ad seriatim, while holding the others to their normal range of values.
The level of IT-business alignment served as the basis for representing different solution characteristics. Three different conditions were considered – low, medium, and high. In reality, the solution price with BBC can be estimated as the project is being implemented while the solution price in OBC can be assessed only as value is realized after the delivered system is put into use. However, the temporal difference of price estimation is not considered in the model so that two cases can be effectively compared.

The key decision in the simulation is the contracting strategy selection, and is represented by the **Contracting Strategy** in the model. As currently formulated, this can assume one of two values, representing BBC and OBC respectively during this period. Outcome uncertainty and information asymmetry dictate which option will be used. For the conditions simulated, with increasing outcome uncertainty and decreasing information asymmetry over the course of simulation, the actual decisions made are depicted in Figure 3.

Figure 3. The Contracting Strategy Decision

The values of 1 and 2 on the y-axis represent the different contracting options of BBC and OBC respectively. Initially, with low values of outcome uncertainty and high information asymmetry, the preferred option was OBC. With the passage of time, BBC becomes the preferred choice as outcome assessment consumes more and more resources and both parties start to share critical information on projects and solution characteristics. At the outset, solution price is estimated based solely on the realized value since OBC is the preferred contract choice. At month 27, the solution price starts to be assessed by measuring the effort devoted to the project as BBC becomes the preferred choice. However, the value estimation in both cases follows an identical process regardless of contracting options. Eventually, the net solution value based on the difference between delivered value and price is monitored to contrast the two available alternatives and the trends are depicted in Figure 4 through Figure 6.

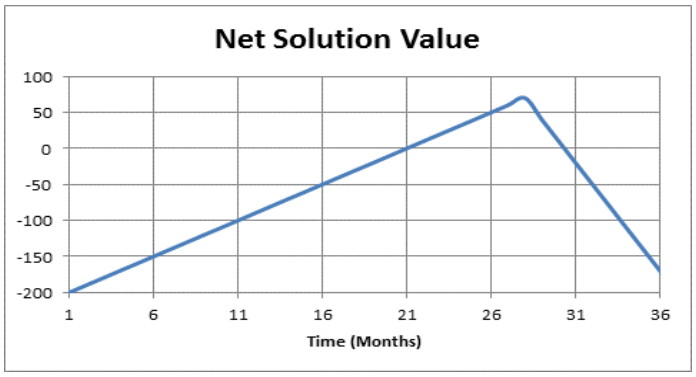

Figure 4. The Net Solution Value with Low IT-business Alignment

Figure 4 presents the net solution value when the delivered solution is not properly aligned with the principal's business processes and strategies. Until month 21, the trend displays a negative net value as price exceeds accumulated solution value. However, over time accumulated value offsets price and eventually realizes a positive net value as of month 21. Although delivered value is minimal in the case where IT-business alignment is very low, the level of price is also determined as a proportion of delivered value, leading to a constant value surplus no matter what. The trend up to month 27 clearly demonstrates that OBC is a viable and effective contracting strategy when facing low IT-business alignment and a resulting minimal value realization. At month 27, however, the prevailing conditions favor the use of BBC as an alternative contracting strategy and the depicted trend is more telling. It starts to erode as price is assessed based on the effort contributed to the project without considering the realized value which is extremely low due to IT misalignment. Apparently, BBC is not a viable option when the implemented solution fails to deliver desired levels of IT-business alignment and underperforms.

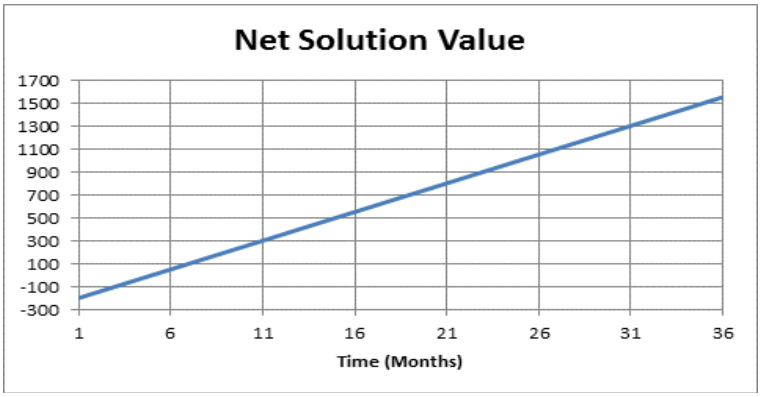

Figure 5. The Net Solution Value with Medium IT-business Alignment

Figure 5 depicts a case where IT-business alignment of a delivered solution is only mediocre. The rendered curve follows a pattern similar to the previous case up to month 27. Although delivered value is still moderate given that IT-business alignment is only medium, the price level is again determined as a proportion of delivered value, leading to enough surplus of value to cause the net solution value to trend upward. From month 27 when BBC is adopted, the trend shows a starkly contrasting pattern. Net solution value is continuously rising even with BBC. While solution price is still independently estimated without considering realized value, the level of aggregated value cultivated from the solution system is high enough to increase net solution value. Under the condition where the delivered solution and business are only mildly aligned, BBC is at least as effective as OBC.

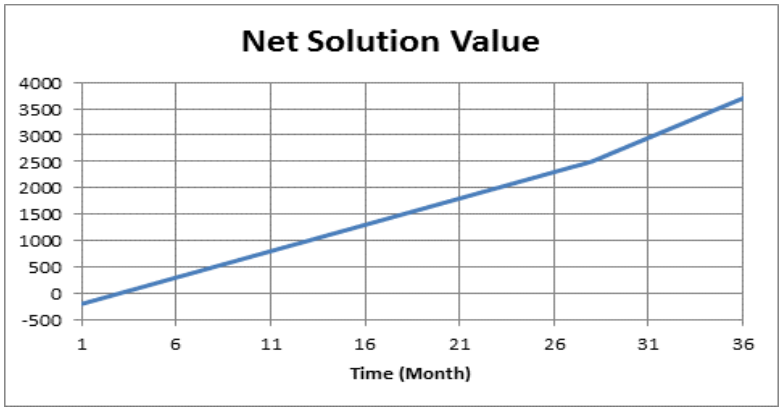

Figure 6. The Net Solution Value with High IT-business Alignment

A case involving the high level of IT-business alignment is presented in Figure 6. As in previous cases, the choice of OBC shows the trend of net solution value to be increasing. With higher IT-business alignment, though, aggregated value offsets price much more quickly and causes a positive net solution value after only the second month. From month 27, BBC's independent price estimation works for the benefit of the principal. Although much higher solution value is being cultivated, price does not reflect the strongly improved value realization and keeps the same level of price as in previous cases where only a marginal level of value was realized. As a result, the slope of the curve with BBC is steeper than that with OBC, indicating that BBC is a more effective choice when high IT-business alignment is expected.

COMMUNICATING THE RESULTS-MANAGERIAL AND RESEARCH IMPLICATIONS

The model and the accompanying simulations illustrate that IT-business alignment has definite implications for the choice of IT outsourcing contracting strategies. A number of clear inferences can be made through analysis of the various possible scenarios using the model. Since the level of IT-business alignment is often mandated by external factors like the lack of communication between business and IT divisions, existing legacy IT architecture, a lack of support for IT, or organizational change (Choi et al., 2013), it is challenging to envisage the level of alignment embedded in the future system. This is one of the reasons why many organizations are forced to use the newly implemented solution system with less than a desirable level of IT-business alignment. With a relatively lower level of IT-business alignment, the implemented solution delivers minimal value overall, leading to a distinctly lower net solution value as depicted in Figure 7. Although the low level of IT-business alignment constantly produces the lowest net solution value throughout the simulation period, the difference between alternative contracting strategies is starkly pronounced. When BBC is adopted, the trend decreases and eventually drops below zero, marking a negative net solution value. The result suggests that when a misaligned solution is implemented, BBC is not an attractive option for the principal.

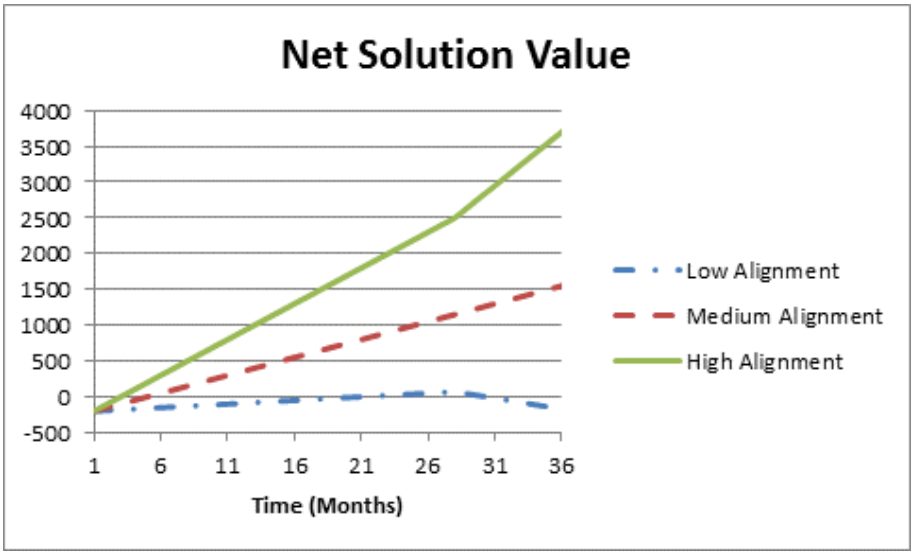

Figure 7. The Net Solution Value Contrasting Three Levels of IT-business Alignment

When mediocre IT-business alignment is assumed, the overall level of the net solution value is noticeably higher than in the case of low IT-business alignment. This time, it constantly increases at the same rate regardless of the choice of contracting strategy, implying that the contracting type decision is irrelevant. With the tightest IT-business alignment, the highest level of net solution value is realized, as compared to lower IT-business alignment cases. In this case, the preferred choice of contracting strategy for the principal should be BBC which renders a steeper gain curve than OBC.

Several observations are readily apparent. The choice of contracting strategy can play a large part in achieving the desired results. OBC is a clear winner for the principal when the target project does not have the tightest IT-business alignment. However, when the project requirements mandate a clear set of IT-business alignment goals and technical specifications of IT agility, BBC may be the preferred choice. Consequently, this introduces a number of managerial decisions, ranging from strategic decisions on contracting options, to technical decisions concerning the implementation of IT-business alignment. The choice of alternative contracting options is largely shaped by mutual agreement between the principal and IT solution provider based on a number of criteria including information asymmetry and outcome uncertainty. More often, when a particular option is clearly preferred by one party, agreement can be difficult to reach. The level of expected IT-business alignment can serve as a deciding factor in a conflict ridden negotiation process. For instance, in the case involving tight IT-business alignment and a resulting high net solution value, the customer can cultivate a superior solution value with both the OBC and the BBC options. Although BBC might yield a slightly greater benefit for the customer, the benefit cannot be achieved if the customer and IT solution provider cannot agree. Further, BBC might yield disastrous consequences if the promised IT-business alignment does not materialize as depicted in Figure 4. On the other hand, the IT solution vendor would prefer OBC in high IT-business alignment situation which renders much greater profit than lower alignment cases. Accordingly, OBC can serve as a vehicle to maximize mutual benefit for the parties when the shared goal of tight IT-business alignment is realized.

However, how can we achieve and maintain the target level of IT-business alignment? In terms of the delivered solution, IS agility and IS architecture play a critical role in achieving and maintaining IT-business alignment. The project team might want to consider architectural frameworks to improve IS agility such as component-based development, web services, and service oriented architecture (Choi et al., 2013). However, it is important to recognize that the adoption of agility enhancing technologies does not always yield the promised level of IT-business alignment (Choi et al., 2010). Close cooperation between the principal and IT outsourcing provider is necessary.

OBC creates a structure of mutual orientation and elicits the desired behaviors from the IT solution vendor, facilitating a mutually shared goal like IT-business alignment, (Ng et al., 2012). In the current IT outsourcing environment where companies deal with a small number of vendor partners, have a long-term commitment, and a deep understanding of the business domain (Mocker et al., 2013), OBC presents new opportunities and frameworks for value co-creation.

CONCLUSIONS

This paper examined managerial decision problems in the IT outsourcing contracting paradigm, focusing on the project characteristics concerning IT-business alignment and its impact on the choice of alternative contracting options. Employing a design science research paradigm, it created a detailed model to capture contracting strategies. It employed agency theory and a modeling approach based on system dynamics, permitting managers to explore the implications of alternative strategies when seeking to source a solution system. The model can be calibrated to reflect different organization contexts. As currently formulated, many variables in the model are dimensionless, facilitating comparison between cases and easier interpretation of results. When applied to a specific organization, this will entail a reformulation to include measures that are meaningful to that organization, as well as recalibration to conform to the specific relationships observed within that environment.

As with any model, there is always room for refinement. The choice of alternative contracting options can be shaped by a number of criteria beyond information asymmetry and outcome uncertainty. The next version of the model will utilize a multi-dimensional decision space to include the cost of information gathering, difficulty in measuring outcomes, agent's risk aversion relative to the principal, and principal-agent goal conflict. In reality, solution price estimation with OBC can be done only after the delivered system is deployed. Future research will investigate the implication of temporal differences. Despite these limitations, this modeling suite provides managers with an opportunity to engage in a what-if analysis of many competing scenarios. While a systematic and complete exploration of all possible combinations of conditions is beyond the scope of this paper, the fundamental tools are available for additional examination. These insights should prove invaluable to managers when assessing strategies to outsource IT solutions.

REFERENCES

Abdel-Hamid, T. K. (1989). The Dynamics of Software Project Staffing: A System Dynamics Based Simulation Approach. *IEEE Transactions on Software Engineering, 15*(2), 109-119.

Abdel-Hamid, T. K., Sengupta, K., & Swett, C. (1999). The Impact of Goals on Software Project Management: An experimental Investigation. *MIS Quarterly*, *23*(4), 531-555.

Cao, L., Ramesh, B., & Abdel-Hamid, T. (2010). Modeling Dynamics in Agile Software Development. *ACM Transactions on Management Information Systems*, 1(1), 5:1-5:26.

Choi, T., & Liker, J. (1995). Bringing Japanese continuous improvement approaches to US manufacturing: the roles of process orientation and communications," *Decision Science*, *26*, 589-620.

Choi, J. & Cummings, M. (2015). A System Dynamics Model for IT Outsourcing Contracting Strategies. Proceedings of the Tenth Midwest Association for Information Systems Conference, Pittsburg, Kansas, May 14-15.

Choi, J., Nazareth, D. L., & Jain, H. K. (2010). Implementing Service-Oriented Architecture in Organizations. *Journal of Management Information Systems, 26*(4), 253-286.

Choi, J., Nazareth, D. L., & Jain, H. K. (2012). Information Technology Skill Management Strategies for Implementing New Technologies: A Case of Service- Oriented Architecture. *IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans*, *42*(4), 838-853.

Choi, J., Nazareth, D. L., & Jain, H. K. (2013). The Impact of SOA Implementation on IT-Business Alignment: A System Dynamics Approach. *ACM Transactions on Management Information Systems*, *4*(1), 3:1-3:22.

Chong, E. K. P., & Zak, S. H. (2008) *An Introduction to Optimization*. Hoboken, NJ: John Wiley & Sons.

Coyle, G., & Exelby, D. (2000). The Validation of Commercial System Dynamics Models. *System Dynamics Review*, *16*(1), 27-41.

Dorigo, M., Maniezzo, M. V., & Colorni, A. (1996). Ant system: optimization by a colony of cooperating agents. *IEEE Transactions on Systems, Man, and Cybernetics Part B*, *26*(1), 29-41.

Dutta, A. (2001). Business Planning for Network Services: A Systems Thinking Approach. *Information Systems Research*, *12*(3), 260-283.

Dutta, A., & Roy, R. (2004). The mechanics of internet growth: A developing country perspective," *International Journal of Electronic Commerce*, *9*(2), 143-165.

Dutta, A., & Roy, R. (2005). Offshore Outsourcing: A Dynamic Causal Model of Counteracting Factors," *Journal of Management Information Systems*, *22*(2).

Eisenhardt, K. M. (1985). Control: Organizational and Economic Approaches. *Management Science*, 31(2), 134-149.

Eisenhardt, K. M. (1988). Agency and institutional explanation of compensation in retail sales. *Academy of Management Journal, 31*, 488-511.

Ekanayake, S. (2004). Agency theory, national culture and management control systems. *The Journal of American Academy of Business*, *4*(1/2), 49-54.

Forrester, J. W. (1980). *Principles of Systems, Cambridge*. MA: MIT Press.

Forrester, J. W., & Senge, P. M. (1980). Tests for Building Confidence in System Dynamics Models. *TIMS Studies in the Management Science*, *14*, 208-228.

Glover, F. (1990). Tabu Search: A Tutorial. I*nterfaces*, 20(4), 74-94.

Gregor, S., & Hevner, A.R. (2013). Positioning and Presenting Design Science Research for Maximum Impact. *MIS Quarterly*, *37*(2), 337-355.

Haag, S., & Cummings, M. (2012). *Management Information Systems for the Information Age*. McGraw Hill/Irwin.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly*, *28*(1), 75-105.

Holland, J. H. (1992). *Adaptation in Natural and Artificial Systems: An Introductory Analysis with Applications to Biology, Control, and Artificial Intelligence*. Cambridge, MA: MIT Press.

Jacobsen, C., Bronson, R. D., & Vekstein, D. (1990). A Strategy for Testing the Empirical Adequacy of Macro-sociological Theories. *Journal of Mathematical Sociology*, *15*(2), 137-148.

Kennedy, J., & Eberhart, R. (1995). Particle swarm optimization. Proceedings of IEEE International Conference on Neural Networks, Piscataway, NJ, 1941-1948.

Kirkpatrick, S., Gelatt, C. D., & Vecchi, M. P. (1983). Optimization by Simulated Annealing. *Science,* 220(4598), 671-680.

Law, A. M. (2007). *Simulation modeling and analysis*, Boston, MA: McGraw-Hill Higher Education.

MacCrimmon, K., & Wehrung, D. (1986). *Taking Risks: The Management of Uncertainty*. New York: Free Press.

Mocker, M., Ross, J., & Shetty, D. (2013). Get Ready for A New Breed of Outsourcing Partner. Research Briefing, MIT Center for Information Systems Research,*i*(9).

Ng, L. C., & Yip, N. (2009). Identifying Risk and its Impact on Contracting Through a Benefit Based-Model Framework in Business to Business Contracting: Case of the Defense Industry," CIRP Design Conference, Cranfield, UK.

Ng, L. C., Ding, X., & Yip, N. (2012). Outcome-based Contracts as a New Business Model: The Role of Partnership and Value-driven Relational Assets. WMG Service Systems Research Group, Working Paper Series, Paper number 04/12.

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2008). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems*, *24*(3), 45-77.

Rungtusanatham, M., Rabinovich, E., Ashenbaum, B., & Wallin, C. (2007). Vendor-owned Inventory Management Arrangements in Retail: An Agency theory perspective. *Journal of Business Logistics*, 28(1), 111-135.

Sastry, M. A. (1997). Problems and Paradoxes in a Model of Punctuated Organizational Change. *Administrative Science Quarterly*, *42*(2), 237-275.

Sharif, A. M. (2005). Can Systems Dynamics be Effective in Modeling Dynamic Business Systems?. *Business Process Management Journal*, *11*(5), 612-615.

Sterman, J. D. (2000). *Business Dynamics: Systems Thinking and Modeling for a Complex World*. New York, NY: Irwin McGraw-Hill.

Zsidisin, G. A., & Ellram, L. M. (2003). An agency theory investigation of supply risk management. *The Journal of Supply Chain Management*, *39*(3), 14-31.

Zu, X., & Kaynak, H. (2012). An agency theory perspective on supply chain quality management. *International Journal of Operations and Production Management, 32*(4), 423-446.