Drivers of Software and Maintenance Sourcing Strategies: Economic, Psychological, and Social Factors

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Abstract

This paper reports in-progress research on factors driving software and maintenance sourcing decisions. It proposes that software and maintenance sourcing decisions are interrelated, and that these decisions, while driven primarily by economic factors posited by Transaction Cost Theory, are moderated by psychological and sociological factors such as those identified in technology adoption and diffusion theories. The model development will be informed by case studies, and the constructs and causality tested by survey. The validated model will serve as the theoretical foundation for development of an analytical model and associated decision-support tool for aiding sourcing decisions as well as simulation models for understanding emergent behaviours among software and maintenance service providers and clients.

Keywords: IS outsourcing, software sourcing, maintenance sourcing, transaction cost theory, psychological factors, sociological factors

1. Introduction

Information systems (IS) are now integral to most organisations’ infrastructure, serving as the organisational “operating system”. Acquiring IS is no longer a “yes/no” decision but rather a question of “how”. In addition, the objective of software maintenance has shifted from keeping systems operational to enhancing business operations and achieving business benefits. The focus is no longer on minimizing costs but rather deriving maximum benefits. These changes in the IS sourcing and maintenance landscape have resulted in extensive commoditisation of software as well as the availability of many third party IS support/maintenance services. Organisations are consequently now faced with complex choices when making IS sourcing and maintenance decisions. Figure 1 depicts some of the combinations of software sourcing and maintenance.

Figure 1. Space of software and maintenance sources
choices (Gable, Chan, and Tan 2001).

While external sources of software and maintenance present many viable and potentially economical alternatives for organisations, choosing the best alternative is a complex decision process that is not yet well understood nor supported. As application acquisition and maintenance constitute a majority of the present-day IT budget of most organisations (software maintenance alone accounts for approximately 60% of most organisation’s IT budget - Middlemiss, 2004), application sourcing and maintenance decisions deserve careful research attention. Building on Transaction Cost Theory, this research conceptualises each software sourcing and maintenance sourcing decision as a transaction. We postulate that choosing from the various alternatives is equivalent to choosing the right strategy for the transaction, as defined by the degree of integration, allocation of control, and performance duration, with the aim of maximising the benefits-cost difference. In building upon existing theories and literature in IS outsourcing, we aim to contribute to the field of IS outsourcing in two ways: (1) By advancing existing theoretical models for understanding sourcing decisions through the integration of factors from the psychological and sociological literature, and (2) By explicitly considering software and maintenance sourcing decisions as separate but inter-related decisions—an important relationship which to-date appears not to have been accounted for in the IS outsourcing literature (see Dibbern, et al., 2004 for a recent and thorough review).

This paper reports on research-in-progress that seeks understanding of software and maintenance sourcing phenomena, particularly in Australia, in the following ways:

• Empirically investigate and describe the state-of-the-art of software and maintenance sourcing in Australia
• Develop and validate new theoretical constructs critical for capturing the fundamental relationships between software and maintenance sourcing decisions
• Develop an integrated theoretical model that predicts organisations’ decisions on software and maintenance sourcing based on economic, psychological, and sociological factors
• Develop an economic model for predicting organisations’ software and maintenance sourcing decisions
• Develop a simulation model for investigating emergent patterns in the software and maintenance sourcing market

2. Related Literature

Theoretical Framework

Transaction Cost Theory (TCT). The foundation theory for our research is Transaction Cost Theory (Williamson, 1975; Williamson, 1985)\(^1\). TCT has had tremendous influence in several fields of research; particularly economics. Based on TCT, we conceptualise software sourcing and software maintenance decisions as decisions on software acquisition and maintenance transactions that an organisation must effect. And following Lee et al., 2004 in applying Residual Rights Theory (Grossman and Hart, 1986; Hart and Moore, 1990), a sourcing decision is essentially a choice among strategies defined by three dimensions: degree of integration, allocation of control, and performance period.

In the context of software sourcing and maintenance decisions, TCT proposes that whether the software is to be sourced internally or externally depends on three characteristics of the transaction: (1) whether a specific asset (which could be a human, site, or physical asset such

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\(^1\) Resource-based theory of the firms (Barney, 1991) is an alternative foundation theory but the asset specificity factor in the Transaction Cost Theory provides a good proxy for the constraints placed by resources on organizational decisions.
as equipment) is required for carrying out the transaction; (2) whether the transactions will be frequently performed; and (3) whether there is uncertainty surrounding the transactions (such as uncertain future requirements, small number of suppliers, complexity in formulating contracts) leading to the threat of opportunism.

More specifically, an IS application can be characterized by (1) the level of special skills, hardware, and software resources required for their sourcing and maintenance, (2) the frequency of necessary software maintenance, and (3) the uncertainty surrounding the future requirements for modifications or enhancements to the software. In example, TCT posits that an infrequent transaction that does not require a specific asset for performing the transaction, and for which there is no uncertainty involved in completing the transaction, would be carried out through the market mechanism (i.e. purchased externally). This proposition clearly describes many organisations’ decisions to adopt standard, standalone word-processing packages, such as Microsoft Word for the organisations’ word processing needs: an organisation’s requirements of the word processing package are quite stable and hence the need to maintain the word processing package or purchase new word processing packages is infrequent; the acquisition or upgrade of word-processing packages do not require any special skills or investments; and the software licensing associated with such packages is simple and straightforward.

Inadequacy of TCT. However, like other organisational decisions, software sourcing and maintenance decisions aren’t entirely rational; hence the implicit assumption of rationality underlying TCT may be violated thereby rendering TCT propositions inaccurate. An example is that of the ERP adoption decision. ERP is a complex enterprise-wide package the implementation of which requires not only detailed knowledge of the system but also detailed knowledge of the organisation. To adopt an ERP, an organisation must invest in the recruitment or training of staff with knowledge specific to the ERP system, or turn to a third-party service provider for assistance. The engagement of a third-party service provider is itself a transaction that is often not well defined nor understood (it is not clear for example, who is responsible if system implementation fails, or how much and what kind of knowledge needs be transferred to the organisation for subsequent maintenance purposes) and is the root of many implementation failures (Fonseca and Scannell, 2002; Nash, 2002). In addition, ERP, like any business application, must undergo frequent maintenance and enhancements to cope with the changing business needs of the organisation. Furthermore, once implemented, the cost of switching to another ERP or system is usually prohibitive—resulting in a relationship in which the ERP-adopting organisation faces the potential threat of opportunism from the vendor. Recent studies in ERP maintenance (for example, Ng, 2002) reveal that an ERP-adopting organisation is sometimes “forced” into upgrading to a new version of the ERP, as the vendor withdraws support for earlier versions. Despite these circumstances which, when viewed through the TCT lens appear to argue against ERP adoption, ERP is a growing multi-billion dollar business in the software and maintenance market.

Although it has been found that other economic factors, such as production costs, could explain adoption behaviour better than transactions cost (Ang, 1998), it is our central thesis that due to the long-term nature of software maintenance, transaction costs do play a part in influencing software sourcing and maintenance decisions but that its impact is moderated by non-economic factors. More specifically, we propose that psychological and social influences play a critical role in moderating the impact of asset specificity, frequency, and uncertainty on software and maintenance sourcing decisions:

Psychological factors. As proposed in the Theory of Reasoned Action (Fishbein and Ajzen, 1975) and its IT-variant Technology Adoption Model (Davis, 1989; Davis, Bagozzi, and
Warshaw, 1989), the psychological factor of perceived usefulness has been found to be the most critical factor in explaining adoption behaviour (see, for some recent examples, Legris, Ingham, and Collerette, 2003; and Thong, Hong, and Tan, 2002). We propose that in making a software or maintenance sourcing decision, a similar construct would play a role in determining the decision: that of perceived level of benefits from adopting a particular sourcing or maintenance strategy. Specifically, we hypothesise that the higher the level of perceived benefits, the lower will be the impact of transaction costs on the sourcing and maintenance decision. Thus, in our example of ERP-adopting organisations, we hypothesise that these decisions could be potentially explained by the perception that ERP offers benefits not realisable by other sourcing strategies.

**Sociological Factors.** We propose that social influence as captured in the theories of technology diffusion (Rogers, 1995; Wejnert, 2002), and which have been extensively applied to the study of technology adoption (Loh and Venkatraman, 1992a; Wejnert, 2002) also play a role in affecting the sourcing decision. In particular, this study proposes that the decision to choose a particular software sourcing and maintenance strategy is impacted by the level of adoption of the same technology by other similar organisations. Indeed, this phenomenon, the so-called “bandwagon” effect, has been observed specifically in IS outsourcing (Lacity and Hirschheim, 1993). We hypothesise that the higher the level of adoption of a sourcing strategy by other organisations, the lower will be the impact of perceived transaction costs of the same sourcing strategy on the sourcing and maintenance decision. Thus, in our example of ERP-adopting organisations, a potential influence on their decisions, despite the high transaction cost, is that many other similar organisations have adopted the technology (and hence the perception that, ERP must be good enough to outweigh the transaction cost).

**Interaction between Software and Maintenance Sourcing Decisions.** Most importantly, unlike the domain considered in most TCT related literature, which usually considers only one type of transaction, software sourcing and maintenance decisions are two separate but interacting transactions. Specifically, the choice made regarding software source has an impact on the choices available for sourcing maintenance. For example, an organisation that acquires and implements an ERP, in addition to incurring costs for specific customisations that the organisation does, must also pay the vendor annual maintenance charges to ensure that their system remains current with the vendor’s supported versions, That is, for the overall sourcing and maintenance strategy to be optimal, the factors that may affect the maintenance sourcing decision should be considered when overall sourcing strategy is decided. Thus, we hypothesise that organisations, being rational decision-making units (March, 1997), will take into account this interaction. However, such interaction has not been considered in the existing theoretical models that account for outsourcing decisions.

In summary, we draw upon theoretical foundations from three disciplines: economics, psychology, and sociology, to formulate our theoretical model for understanding software sourcing and maintenance decisions, as depicted in Figure 2.

**Theoretical model**

**TCT constructs.** The constructs of asset specificity, frequency, and uncertainty will be developed based on the existing wealth of literature that operationalises TCT constructs (see David and Han, 2004 for an exemplary list). The perceived transaction cost constructs, however, will be developed anew. These are the constructs that measure respondent’s perceptions of transaction costs against the baseline case of internal sourcing. This is a critical construct

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2 While Lacity and Hirschheim (1993) have alluded to this phenomenon of bandwagon effect, this effect has neither been formally treated nor validated.
in our model as it allows us to assess the moderating impact of psychological and sociological factors more parsimoniously.

**Psychological constructs.** While we are prepared to uncover more psychological factors affecting sourcing decisions through case studies, our *a priori* model will include a perceived benefits construct. This construct will be developed based on an existing validated construct of perceived usefulness (e.g. Thong, Hong, and Tan, 2002) but will be refined to include measures of contemporary benefits such as business process and technology improvement.

**Sociological constructs.** Similarly, while we are prepared to discover further social influence constructs, the initial constructs guiding our research will include those measuring internal and external influences driving diffusion of technology (e.g. Loh and Venkatraman, 1992a).

**Dependent variables.** In our model, maintenance sourcing decisions will be measured by three dimensions: degree of integration, allocation of control, and performance period, while software sourcing will be measured by only the degree of integration and allocation control dimension. Degree of integration measures the extent to which software or maintenance is sourced externally (the x-axis and the y-axis in Figure 1, for example, represent the degree of integration for maintenance sourcing and software sourcing decisions respectively). Allocation of control measures the extent to which the control of assets is allocated to the external parties. Performance period measures the period by which contract agreements are renewed. These constructs will be developed based on the existing literature (e.g. Lee, et al., 2004).

**Variables informed by evidence.** While our *a priori* model is grounded in theory, its development will also be informed by evidence that we will initially gather through case studies of large client organisations, software vendor, and third party service providers.

**3. Research Design**
The research program comprises of the following stages: **Construct identification.** Further literature review will be conducted to identify the full list of constructs and possible measurements for the constructs in the research model. **Case studies.** Our model is grounded in theory and informed by evidence. The development of the theoretical constructs and identification of further constructs of relevance will be informed by qualitative evidence to be gathered from case studies of two client organisations, one third-party service provider, and a large software vendor. **Survey instrument development.** After the complete list of measurements is gathered, the measurements deemed the most appropriate for our study will be used to design a survey instrument for collecting empirical data to test the study model. **Data**
The unit of analysis is the software sourcing and maintenance decision. Thus, each business application that is currently under maintenance in any organisation is a potential sample data point. The survey will target appropriate senior managers (such as CIO or IT manager) in the BRW’s Australia top 500 private organisations, as well as more than 300 state, federal, and semi-government agencies and organisations.

Data analysis and model testing. As several of our constructs are new and critical, they will be subjected to rigorous validity testing procedures: (1) Exploratory factor analysis will be used to eliminate spurious measurement items. (2) Confirmatory factor analysis will be applied to: (a) test for convergence, ensuring that the construct achieves an acceptable level of goodness of fit, (b) test for discriminant validity against validated and potentially related constructs (e.g., against perceived usefulness) to ensure that our perceived transaction cost construct is indeed a new and distinct construct, and (c) further trimming of measurement items. (3) Assess the nomological validity of the construct by testing its power to predict sourcing decision.

Model refinement. Based on the result of the analysis, a refined model for explaining and predicting software sourcing and maintenance decisions will be developed.

Validation of new model. This model will be validated and fine-tuned by testing its ability to predict the software sourcing and maintenance decisions from the validating set.

Development and validation of economic models. Based on the new model and the measurement of the constructs, a prescriptive model for aiding client organisations in determining the optimal software sourcing and maintenance decisions will be developed. Furthermore, using economic and game-theoretic modelling, we will develop an analytical model to determine what would be a vendor or service provider best-response to the decisions made by the client organisations. The model will be validated via data collected through experimental economics methods.

Development and testing of decision support tools. The prescriptive model will be used as the basis for the development of a decision support tool. In particular, the pitfalls identified in the unsuccessful decisions will also be incorporated to help ensure that an organisation not only consider the costs and factors that would affect the outcome of a decision, but also to avoid the pitfalls.

Development and testing of simulation environments. The models will be used to simulate behaviour of organisations as buyers and vendors and service providers as suppliers in an agent-based computational environment (Macy and Willer, 2002).

4. References


