

TCT goes ABSS: Can Agent-Based Social Simulation be helpful in understanding economic theories?

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Abstract. The topic of IT outsourcing has been around in academic research for the last fifteen years. Despite the lack of commonly accepted interpretation of outsourcing outcomes, the practice of outsourcing in modern corporations is proliferating. This trend forced both practitioners and academics to theorize and speculate on the underlying momentum towards outsourcing. Past research on IT outsourcing has mainly focused on the transaction itself, without investigating the strategic characteristics of the organization not to mention a built-in social framework of the firm or social context a firm is located in. This captures the widely held perception that organizational members make sourcing decisions based upon an economic rationale and regard social factors as negligible in their influence on the overall picture of outsourcing. This paper introduces a novel approach for investigation of various theories used to account for make-or-buy decisions. It goes down the line of Agent-Based Social Simulation and represents actors of the outsourcing process as heterogeneous agents. This approach is contrary to a widely held perception of economic standard literature with its assumption of homogeneous actors.

Keywords: transaction cost theory, agent-based social simulation, outsourcing, offshoring.

1 Introduction

The topic of Information Technology/Systems (IT/S) outsourcing has been around in academic research for the last fifteen years (Dibbern 2004). A huge body of academic literature and research has emerged in that time and is continuing to evolve rapidly. Partly the research was initiated by the disappointing effects of the first outsourcing attempts in the early nineties and continues to be stimulated in recent years by inexplicable successes and failures of firms. Despite the lack of commonly accepted interpretation of outsourcing outcomes, the practice of outsourcing in modern corporations is proliferating. The IT/S outsourcing phenomenon has been expanding

during the past decade, and this growth is likely to continue (Tettelbach 2000). This trend forced both practitioners and academics to theorize and speculate on the underlying momentum towards outsourcing (Ang&Strab 2002).

Most of the research is however highly speculative as will be shown on the example of the Transaction Cost Theory (TCT) below. There are no true metrics which can be used for managing the project and the guidance that is available is very subjective and/or ambiguous. Admittedly it can be argued that the nature of the issue (outsourcing/offshoring) itself is more or less anecdotal – sourcing projects have to deal with intangible assets. Though there is much work done by practitioners in order to compensate for the shortcomings of the measurement issue. These include benchmarking, service level measurement models and dissemination of the best practices by consultants involved (Ackerman 2007) and account for standardization of mega contracts. This trend helps to perceive the coordination processes with respect to IT as increasingly commoditized (Poppo&Lacity 2002).

IT outsourcing is often prized as an attractive business performance tool for improvement of firm's performance, reduction of costs and increase of competitiveness (Tettelbach 2000). However, there is enough evidence accumulated to suggest that outsourcing of IT is not achieving these expected outcomes on regular basis (Aubert 2001, BCG 2003).

Past research on IT outsourcing has mainly focused on the transaction itself, without investigating the strategic characteristics of the organization (Aubert 2005) not to mention a built-in social framework of the firm or social context a firm is located in. This trend captures the widely held perception that organizational members make sourcing decisions based upon an economic rationale and regard social factors as negligible in their influence on the overall picture of outsourcing. Therefore a representative strand of research on IT/S sourcing has used the TCT to investigate make-or-buy decisions.

The bulk of IT outsourcing research involved quantitative studies into IT/S outsourcing based on count of the proportion of respondents indicating that they obtained various benefits or outcomes from outsourcing their IT services (Aubert 2001) and matching of the results to one of the economic theories afterwards. There was some account that people may weight outcomes in different ways or use same metrics with different measurements. Nevertheless, this strand was not persuaded by main stream authors further. However, it is rather crucial for TCT e.g. to understand what is meant by asset specificity to make a credible statement whether the given theory accounts for empirical evidence or not. Dissatisfaction with different measures, dimensions or metrics used in TCT or for its evaluation is not new to outsourcing research (Aubert&Weber 2001, Aubert 2001, Aubert 2005).

This paper introduces a novel approach for investigation of various theories used to account for make-or-buy decisions. It goes down the line of Agent Based Social Simulation (ABSS) and tries to represent actors of the outsourcing process as autonomous and heterogeneous agents that can act according to changes in the environment they are located in. This approach is contrary to a widely held perception of economic standard literature with its assumption of homogeneous actors.

As proposed by Edmonds (Edmonds 2001) a methodological process of developing a simulation can be thought of as having different stages¹:

- *Abstraction*
Abstraction of the target system and development of the conceptual model incorporating the relevant aspects of the target system relevant to the study.
- *Design*
Formalization of the abstraction developed in the previous step in accordance to some theoretical framework(s) chosen and consequent development of the computer model.
- *Inference*
Execution of the model and exploration of the results
- *Analysis*
Analysis/Interpretation of the results obtained during previous inference step; enhancement/clarification of model understanding
- *Conclusion*
Round up with discussion of possible inferences about the investigated target system from the analysis of the simulation.

The presented paper can be classified as a pre-inference stage. Abstraction of the system is partly done due to the usage of a theory (which is an abstraction itself). Chosen theory is formalized by means of model development thus initiating the stage of model execution.

2 Theoretical basis and outsourcing research

Since the 1990s an increasing variety of theoretical perspectives that inform current outsourcing research has been developed. Still, despite proliferating IT/S research, no satisfactory coherent theory is currently proposed (Klein 2002). Next section gives an overview over theoretical and methodological foundations used in IT/S outsourcing research up to date.

2.1 Outsourcing Research

Research offers a wide variety of issues which have been examined over time including for example, understanding of the decision making, risk analysis and mitigation, contractual relationships and proportion of IT to be outsourced. However they all can be reduced to two key issues which unavoidably arise if one is talking about IT outsourcing: *how to decide which IT activities should be outsourced with respect to their characteristics?* and *how should IT outsourcing contracts be structured?* (Aubert 2005).

Still there is some consensus about the theoretical foundations used in the research. In a majority of the mainstream papers on outsourcing some theory is chosen as a research methodology. Alternatively, data gathered in a survey is analyzed to

¹ The footnote numeral is set flush left and the text follows with the usual word spacing.

conclude which framework succeeded or failed to describe outsourcing decisions. In the case of data anomalies produced, these are reinterpreted with different metrics to make them fit into one of the theories from the mainstream thinking such as TCT or resource based view just to mention some. Thus a predominance of these theories is gradually developing.

Notwithstanding, the literature research up to the present day did not reveal a tendency of contemporary science to bring more clarity in the field by creating a uniformity of metrics used. Instead a more common practice is to introduce conducted surveys and try to distil best practices out of them with an attempt to generalize the results obtained for a wider range of projects.

In general, the study of outsourcing research is theoretically many-sided and is pluralistic at the same time. As one can see from Table 2 in the appendix, there are numerous different theories used to examine IT outsourcing. The depicted theories can be vaguely grouped into three distinct categories: strategic, economic and social/organizational. The primary theoretical approach to IT outsourcing is economic, followed closely by a strategic perspective (Dibbern 2004). This sad evidence shows that social issues in theoretical observation of the IT outsourcing have not much weight. As economic theories in general, and TCT in particular, are widely used in outsourcing research (Dibbern04) I will comment on it briefly. I will introduce the TCT framework and argue about its applicability for the outsourcing research.

2.2 Transaction Cost Theory

A representative strand of research on IT sourcing has used the transaction cost theory to investigate the make-or-buy decisions. The foundation for TCT was laid by the seminal work of Coase (Coase 1937). He looked at the market and the firm as two alternative mechanisms that could be facilitated to conduct a transaction between parties. This proposition by Coase has been theorized, refined and used extensively in the last two decades (Aubert 2005).

TCT's major constructs as defined by Oliver Williamson (William 1975) are costs, transaction type, threat of opportunism, uncertainty and information impactedness. A fundamental assumption of TCT is that the parties involved in a transaction ought to be able to measure the quality and the quantity of the exchanged goods for completing a transaction (Aubert 2005).

In practice the production and transaction costs are often difficult to assess. Williamson however, provides a heuristic model for estimating costs based on the inherent nature of the transaction type which favors insourcing or outsourcing. Transaction type is classified based on two dimensions – the frequency of occurrence and the degree of asset specificity. Using these two dimensions Williamson creates a framework for categorizing the most efficient mechanism of governance– in the case of outsourcing it is a classical contract, neo-classical contract or relational contract. However his framework assumes that degree of certainty exists. The framework also assumes that there are a large number of providers in the marketplace. Table 1 points

out the dependencies between the two types of cost and dimensions of the transaction type.

Table 1. influence of the transaction dimension on the costs² (▼ decrease / ▲ increase in costs)

	asset specificity	uncertainty	frequency
Production Cost	▼	n/a	▼
Transaction Cost	▲	▲	▼

The term *asset specificity* needs to be explained a bit further at this point as it ought to be one of the central objectives of the model presented later on. Probably the most comprehensive way of explaining asset specificity is to draw parallels with the usage of an asset in the organization. When the value of the next best use of some asset is less than the value associated with its primary use, a lock-in between parties exists thus creating a risk associated with the investment of the specified asset (Aubert 2005).

The choice of the services and activities to outsource is purported upon the matching of the IT/S activities to optimal governance form. Whereas IT/S activities differ in attributes they possess and governance forms differ in the performance they offer (Williamson 1991).

The central question with respect to outsourcing IT/S which bothers organizational economists is how to choose which activities or services to outsource to maximize performance (Poppo&Lacity 2002). Thus the concepts of TCT seems to be plausible in the sourcing context allowing to facilitate the framework as supporting tool in the decision making process.

2.3 Caveats and Need for Action

According to the TCT proponents it provides a logically consistent and ubiquitous framework. However, it is subject to certain anomalies and after a closer look at the theory's roots mentioned above, one will find major difficulties in operationalizing this theory with respect to IT/S outsourcing domain.

It is argued that TCT provides a potentially useful framework for several reasons. First, TCT specifically addresses sourcing decisions, that is, the decision to produce goods or services internally or purchase it externally from the vendor. Second, TCT captures the widely held perception that organizational members make sourcing decisions based upon an economic rationale. Third, many practitioners use terminology consistent with transaction cost theory to explain why outsourcing is predicted to reduce IT/S costs. Fourth, TCT enjoyed an abundance of empirical and theoretical academic attention by leading academics and thus remains an attractive choice for other research into interpretation of organizational reality.

² It is assumed that the dependence of the costs in accordance to the transaction dimensions is observed in the exclusive relationship between two transaction partners.

Even if the reasons above are sound and TCT seems to be a Jack of all trades one should not go far to find the first stumbling block – the terms uncertainty and asset specificity exact definition are not clear enough, if not impossible to make at all. Williamson's framework assumes that a degree of certainty exists thus ruling out the uncertainty (presumably he was not able to measure it). Nevertheless, asset specificity remains a long-running issue with wide usage of the concept in the empirical studies (Lacity&Willcocks 1995, Aubert&Weber 2001).

A second bone of contention comes from the side of social scientists – it is a strong disregard of social aspects by TCT. Williamson argues (William 1979) that decision makers use cost efficiency as the sole criterion. He recognizes that politics play a role in organizational process, though he argues that economizing is a more super ordinate construct than political strategizing. Thus Williamson's framework does not allow for any kind of social effects to be considered. According to Williamson and TCT proponents, transaction costs become the sole criterion for the outsourcing decision if production costs are comparable to a vendor. This argument however is contradictory to the findings in the recent reports coming from non-academic research as these reports exhibit that one should not simply disregard social factors in outsourcing considerations. Even on the contrary, these studies stipulated through evidence that social factors proved to be the most crucial factors in the outsourcing/offshoring projects (BCG 2003).

Although TCT is widely regarded as a classic contribution to the study of organizations, economics and law and in particular, to sourcing decisions it is hard to accept this theory due to the following shortcomings: language ambiguity and transaction as a unit of analysis. As stated by Williamson (1985, p.85), asset specificity is the most important dimension of the transaction, followed by uncertainty and frequency. Thus having a valid and reliable (these concepts are highly subjective) measure of asset specificity, is central to undertake some robust tests of TCT (Aubert 2001). In any case these arguments seem to leave lots of space for justification of TCT even in cases where anomalies in the results are encountered. It is always possible to argue that the measurements of assets specificity were inappropriate or the measures of uncertainty (which in my opinion is not measurable quantitatively with any of the current metrics³) were wrong.

Many critics of TCT use language ambiguities as a plea for difficult operationalization of the framework. Of particular note, some critics have claimed that TCT is irrefutable because of its ad hoc appeals to language ambiguities can always be used to address any anomalies.

Abundance of empirical and theoretical academic attention by leading economists and huge body of academic literature suggest that other researchers find TCT to be a useful interpretation of organizational reality (Lacity&Willcocks 1995). Nevertheless adoption of theories from other disciplines needs to be critically examined within the discipline it is going to be adopted in. Therefore it is suggested to put forward a methodology of ABSS as a toolkit for critical examination, observation and transformation (formalization) of the theory expressed in the verbal form. The process

³ Discussion about uncertainty is an issue in itself and is beyond the scope of this paper. However a seminal work for further reading on this topic would be the book by Frank H. Knight (Knight21).

of formalization, which is a necessary intermediate step to developing a model, helps to translate textual or verbal description of TCT into a more formal and precise constructs thus helping to gain a better understanding of the theoretical assumptions. Chosen methodological pathway of ABSS and its implications on outsourcing research with respect to TCT are described in the following section.

3 Methodology

Before one accepts certain methodology for the research carried out, one should be convinced of its usefulness in that particular concept. The objective of this section is to give a brief introduction into relevant aspects of social simulation and to identify its strength and weaknesses for investigative issues.

3.1 ABSS

Agent-Based Modeling (ABM) stems from the field of Distributed Artificial Intelligence (DAI). The approach of DAI deals with systems consisting of many interacting entities that possess some level of autonomy. These components are able to perceive their environment and also react to changes in that environment in accordance to their goals.

ABM makes strong use of *bottom-up* paradigm as an approach to system design. Consequently, lower level behaviour rules are specified first, thus preceding the specification of higher level or aggregate layers (Taylor 2003).

A bottom-up approach does not rely on any centralized control or blackboard like systems. The control of the system is supposed to emerge autonomously from the specification of the lower level behaviour rules (specified interaction processes amongst the entities). This appeal to the phenomenon of emergence is representative for ABM thus places the approach, and the techniques used to study it, within the domain of complexity research (Waldrop 1993, Taylor 2003).

The very general purpose of simulations is to understand or illustrate some aspect of the target system of interest. Widely cited definition of a model is given by Gilbert and Troitzsch in their text, often quoted as a good introduction to the field of social simulation modelling, as : “*A model is a simplification – smaller, less detailed, less complex, or all of these together – of some other structure or system.*” (Gilbert&Troitzsch 1999, p.2). The model should be less complex than the real system, and lead to some improved understanding of how the real system functions or might function. The authors also argue that computer-based approaches to social simulation can help researchers achieve a variety of different objectives (Gilbert and Troitzsch 1999, pgs.4-6) (see also Edmonds 2001). Researchers might use social simulation tools in order to:

- Obtain a better understanding of social processes, especially dynamic ones.
- Make predictions about the occurrence of certain social events (e.g. demographic predictions or business forecasting).
- Simulate human abilities by modelling knowledge with expert systems.

- Aid theory development by formalising theories and testing via simulation.

Agent-based modelling aims to employ agents as the core component units that compose the model. In this sense agents can be thought of as intelligent, autonomous programs that interact with other components of the system and their environment in order to affect a certain set of programmed goals.

ABM is clearly distinguished from other kinds of modelling research by this focus on the concept of agents. It is a relatively new and immature research field, and as such there is a lack of established theory and research methodology underpinning the design of models, of standards for programming platforms, verification and validation of models, techniques for comparison of models and for establishing the generality of models. However, agent-based modelling is now rapidly gaining attention in many different areas due to its interdisciplinary appeal. In the field of agent-based simulation therefore there is wide use of ‘toy models’: simple systems which bear little resemblance to reality because they are based on assumptions derived from a more general theory. This type of model may therefore be classified as exploratory and focused on theory building (the model introduced in this paper may be classified as one of these)

Described characteristics of ABSS suggest that particular strengths of the introduced approach are obvious in the context of heterogeneous environments with interacting agents. Whether it is a useful advantage with respect to sourcing research is going to be discussed in the following section.

3.1 Implications for Outsourcing Research

For the defence plea of ABM in this context the point can be put in two ways. Either there is a need for a single representative actor or actors are homogeneous. In other words the question that needs to be answered is whether replicating TCT foundations in the context of heterogeneous actors will add any value to the theory? The answer on this question is not as straightforward as it might seem to be at first sight.

For example, the mathematical treatment of diverse problems in economics has longstanding and well established foundations. One should recall equation based modelling as an example of the aforementioned mathematical treatment. However this kind of problem treatment requires the environment to be considered as homogeneous, which means that the method is really only suitable for the class of problems where entities can be represented as such. If we recall the issue of social embeddedness of TCT mentioned above, one should seriously consider expansion of TCT examination in the heterogeneous contexts thus enriching purely econometric framework with what it managed to disregard so far.

Central to all modelling research is the issue of power of expression and descriptiveness of models (typified by qualitative approaches such as ethnography) on the one hand, and clarity of expression and precision of formal methods (typified by quantitative approaches such as mathematical modelling) on the other. As explained by Moss (Moss 1999), due to very different backgrounds and training, researchers normally approach the problem from just one point of view, and there will not be much traffic between those aligned on opposite sides. Moss argues that agent-based modelling occupies a middle ground, and is a very powerful approach because it

combines the rigor of formal logic with the descriptiveness of the agent paradigm for representing social actors and their interactions. Through this approach it will be possible to ‘shift out the trade-off’ (Moss 2000) between relevance and rigour in models of social processes.

Therefore the model described in the next section presents a first step towards formalization of some TCT aspects. Terms which were ambitiously used with no exact definitions in the guidance to outsourcing ought to prove their validity on the test bench of a modelling toolkit.

4 Model

This paper presents a conceptual model which can be placed at the *pre-inference* step in the framework proposed by Edmonds (Edmonds 2001). The model has several objectives: evolution of precise statements about measureability of asset specificity and examination of the assumption that agent-based methodology is a helpful toolkit for critical observation of TCT. The next section describes the model objectives in detail.

4.1 Objectives of the Model

In many papers asset specificity is used only as a guidance without quantifying it. Scholars are talking about “commodization” of the IT/S outsourcing and suggest that asset specificity is the way out but admit at the same time that there is a measurement issue present. This model will attempt to assign to asset specificity a tangible value and act according to TCT dogmas.

- Ideally the model should give clues on the impossibility of existence of objective measurement for asset specificity.
- Through the different metrics of the asset specificity during the make-or-buy decision in the same firm should be shown
- that depending on the kind of metric chosen for measurement of asset specificity one gets different outcomes for the same firm/project
- that the value when an asset can be assigned a tag of being specific is of a very subjective nature

4.2 Description of the Model

For the credible observation of concepts operationalized by TCT one needs to set up a model in the environment which incorporates assumptions made by and necessary for TCT.

Williamson, in his introductory work to transaction cost theory (Williamson 1975), encompassed bounded rationality⁴ as limited access to information which is translated in jargon as information impactedness.

This section introduces some aspects of an agent-based model to outsourcing with TCT as a decision basis. As mentioned briefly above a model should serve as a step towards a critical review of the concept of asset specificity which is instrumentalized by TCT.

4.2.1 Simplifications / Assumptions

In his framework Williamson categorises the most efficient governance mechanisms as either classical contract, neo-classical contract or relational contract. In the case of outsourcing it is sensible to translate the aforementioned governance mechanisms in total outsourcing (outsourcing of all services to the supplier), selective outsourcing (keeping the most specific assets in-house while outsourcing others), and keeping services in-house.

4.2.2 Agents

The protagonists of the model scenario are

Supplier

- provides services to the customer.
- is aimed to run the minimal service level required and withstand technological innovation over the contact's runtime as long as only possible.

Customer

- switching the supplier is the last resort due to high costs.
- once a customer has tagged supplier as trustworthy, he is expected to act in a trustworthy manner (it is not entirely clear when a supplier is classified as trustworthy; assumption possible at this stage of the modelling process is that a supplier can be tagged as trustworthy if the last contract with this supplier met the customer's expectations)
- customers are trying to measure supplier performance and to motivate the supplier to improve performance while reducing unit costs over time.

4.2.3 Relationships

Supplier and Customer have a contractual relationship. At the same time they might have a social relationship as well. There is a connection between these two relationships which can be described as follows: "a good contract does not ensure a

⁴ The concept of bounded rationality was originated by the work of Herbert Simon and incorporated into mainstream economic theory. Simon defined bounded rationality as limited information-processing and computational capacities (Moss97).

good (social) relationship, but a bad contract does ensure a bad relationship”(Popo&Lacity 2002).

Customers tend to invest money in relationships with suppliers they have been dealing with for years.

4.2.4 Contracts

Contracts possess following properties:

- contain service level agreements which describe in a meticulous way the service itself, how it is going to be monitored and penalties in case of non-performance.
- the more service level agreements are incorporated into the contract (600 for mega-contracts) the more elaborate and cast iron this contract becomes. This means in the case of an escalation a contract with a more detailed service agreements will offer a better protection.
- one should bear in mind that the more elaborate a contract is the more expensive it is to set-up.
- has to be renegotiated after a certain amount of time due to uncertainty/technological changes/etc.
- after a certain period customers have to carry out benchmarking tests in order to re-evaluate their performance levels for post contractual management

Table 2. Influence of governance mechanism’s chosen to carry out the transaction on the incentive and costs arising.

	Market	Hybrid	Organization
Incentive to efficient resource usage	high	middle	low
Costs due to bureaucratic efforts	low	middle	high
adaptability	autonomous	middle	bilateral

4 Discussion

As mentioned above, a modelling methodology can be split along stages of abstraction, design, inference, execution, analysis and conclusion (Edmonds 2001) with no claim on consequent order of these stages. Thus offering an appropriate alignment for formalization of theoretical knowledge and a deepening of understanding about a target system.

The example of the TCT showed that ABSS can be utilized as an appropriate tool for theory examination. The ever proliferating research on IT/S outsourcing seems to find its state of equilibrium in a sort of standard deviation with the TCT as the mean. Therefore we need a more critical observation of theories borrowed from different disciplines before these can be established. The methodology presented in the paper does not claim to criticize concepts of TCT as such it just aims to point out obscurities where the theory is not clear enough. As the process of formalization is a discipline which needs to be precise ABSS claims to compensate on the lack of precision in the

IT/S research so far. ABSS uses models to devise precise statements about these theoretical points, which are not clear in the theory a priori.

The primary theoretical approach to IT/S outsourcing is economic, followed closely by a strategic perspective (Dibbern 2004). Nonlinear social behaviour needs to be included in the outsourcing research on the more elaborate basis rather than just excluding it from the outset. Nonlinear behaviour is excluded in most econometric observations as the concept of nonlinearity gives problems to the statistician and their forecasts. It needs to be emphasized that this paper does not proclaim the illegitimacy of the concept of asset specificity as such. On the contrary the author is of the opinion that it is a useful concept although it lacks an exact definition and metric which are needed for its proper instrumentalisation.

Critics of TCT propose a resource based view which, they argue is better suited for the analysis of outsourcing decisions. This is going to be the second formalization model that is going to be developed in the course of the described offensive on theoretical foundations in IT/S outsourcing research.

References

1. ACKERMAN, D., "Product Champion Important Principles of an Outsourcing Benchmarking Clause", Gartner publications, author: Carolyn LeVasseur, URL: http://www.gartner.com/4_decision_tools/measurement/measure_it_articles/2003_101303/ackerman_02.jsp [16-01-2007].
2. ANG, S. and STRAUB, D. (2002). "Production and Transaction Economies and IS Outsourcing: A study of the U.S. Banking Industry", MIS Quarterly, Vol. 22, No. 4 (December, 1998), pp. 535-552.
3. AUBERT, B. A.; CROTEAU, A. "Information Technology Outsourcing from a Business Strategy Perspective", Cahier du GReSI # 05-01, February 2005.
4. AUBERT, B., ROUSE, A. C. and CORBITT, B. J. "Perspectives on IT Outsourcing Success: Covariance Structure Modelling of a Survey of Outsourcing in Australia", ECIS, May 2001, URL: <http://is2.lse.ac.uk/asp/aspecis/20010097.pdf>
5. AUBERT, A.B., WEBER, R. "Transaction Cost Theory, the Resource-Based View, and Information Technology Sourcing Decisions: A Re-Examination of Lacity et Al.'s Findings", GreSI publications, May 2001.
6. BCG's European IT Benchmarking in Banking Study, "IT Costs in Banks: Revisit Your Beliefs!", 2003.
7. DIBBERN, J., GOLES T., HIRSCHHEIM R., JAYATILAKA B., "Information systems outsourcing: a survey and analysis of the literature", ACM SIGMIS Database, Volume 35 , Issue 4 (Fall 2004), Pages: 6 - 102, 2004, ISSN:0095-0033, ACM Press
8. EDMONDS, B. "The Use of Models - making MABS more informative", in Moss, S. and Davidson, P. (eds.) Multi Agent Based Simulation 2000, Lecture Notes in Artificial Intelligence, 1979:15-32, 2001.
9. GILBERT, N., TROITSCH, K.G., "Simulation for the social scientist", Buckingham, Open University Press 1999.
10. KLEIN, H. K., "On the Theoretical Foundations of Current Outsourcing Research," in Information Systems Outsourcing: Enduring Themes, Emergent Patterns, R. A. Hirschheim, A. Heinzl and J. Dibbern (Ed.), Berlin, Heidelberg, New York: Springer, pp. 24-44, 2002.
11. KNIGHT, F.H., "Risk, Uncertainty, and Profit" with an introduction by George J. Stigler. Phoenix Books. C., 1971 [1921]

12. LACITY, M.C.; WILLCOCKS, L.P., "Interpreting information technology sourcing decisions from a transaction cost perspective: findings and critique", *Accounting, Management and Information Technologies*, Volume 5, Number 3, pp. 203-244(42), Elsevier Science, July 1995.
13. MOSS, S., "Boundedly versus Procedurally Rational Expectations," Discussion Papers 97-30, Manchester Metropolitan University, Centre for Policy Modelling, 1997.
14. MOSS, S., "Applications Centred Multi Agent Systems Design (With Special Reference to Markets and Rational Agency)", International Conference on Multi Agent Systems (ICMAS-2000), Boston MA, IEEE Computer Society, 2000.
15. MOSS, S., "Relevance, Realism and Rigour: A Third Way for Social and Economic Research", Manchester, Centre for Policy Modelling, MMU, 1999.
16. POPPO L., LACITY M.C., "The normative value of transaction cost economics: What managers have learned about TCE principles in the IT context", 2002. Hirschheim R., Heinzl A., Dibbern J., eds. "Information Systems Outsourcing: Enduring Themes, Emergent Patterns and Future Directions", Springer, Dordrecht, Netherlands, 253-276.
17. WALDROP, M. M., "Complexity : the emerging science at the edge of order and chaos", London, Viking, 1993.
18. TAYLOR, R.I., PhD thesis "Agent-Based Modelling: Incorporating Qualitative and Quantitative Methods: A Case Study Investigating The Impact Of E-Commerce Upon The Value Chain", Centre For Policy Modelling, Manchester Metropolitan University Business School, available online as CPM report at <http://cfpm.org/cpmrep137.html>
19. WILLIAMSON O.E., "Comparative economic organization: The analysis of discrete structural alternatives", *Administrative Science Quarterly*, 36: 269-296.
20. WILLIAMSON, O.E., "Markets and hierarchies, analysis and antitrust implications: A study in the economics of internal organization", New York: Macmillan, 1975.