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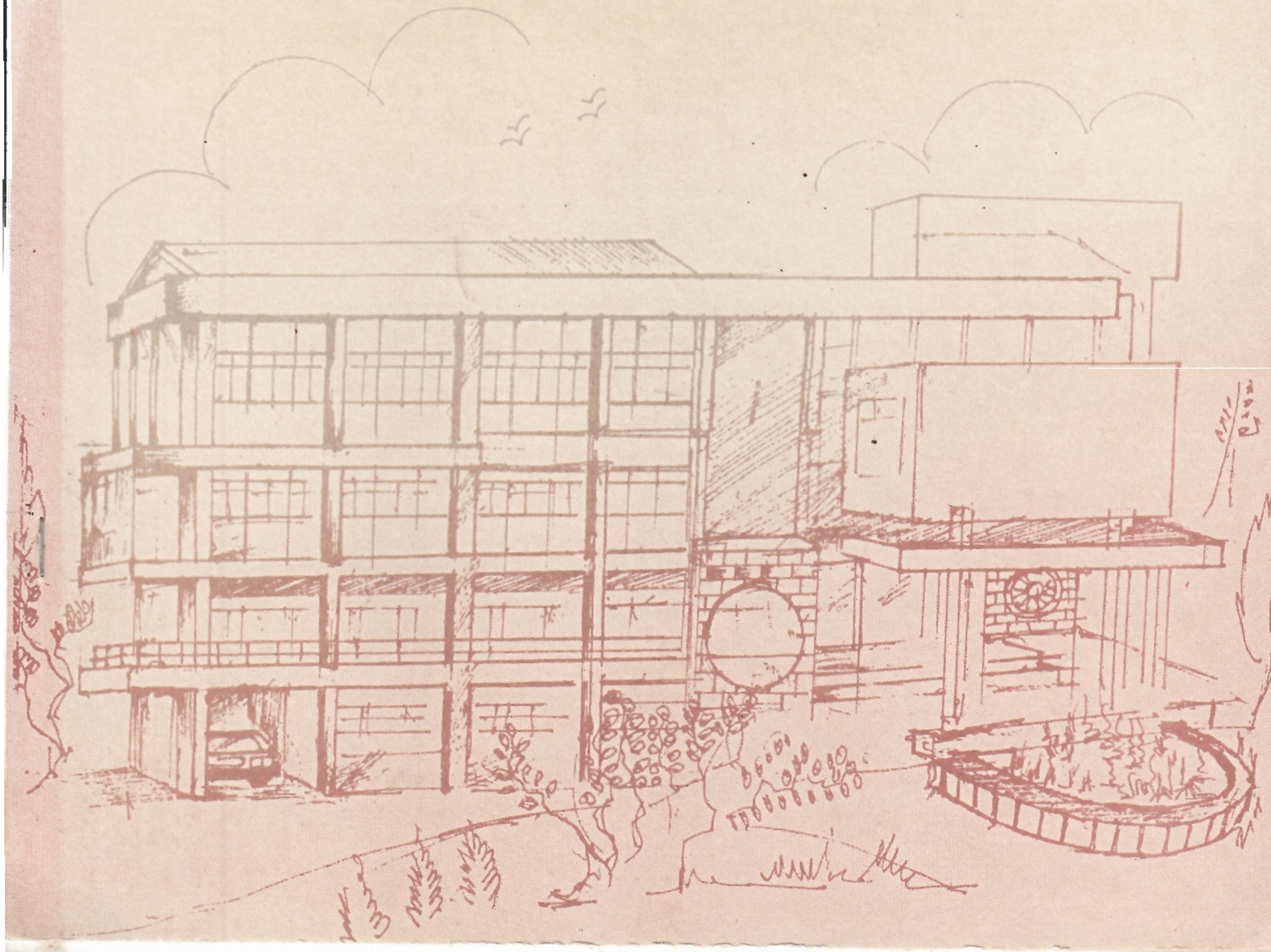
Understanding Risk in IT Outsourcing: A Conceptual Fuzzy Framework



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Understanding Risk in IT Outsourcing: A Conceptual Fuzzy Framework

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Abstract: Driven by the rapid advances in information and communication technology and liberalization, a new era of outsourcing has dawned. Foundations of the outsourcing model lie in the economic and strategic literature, encompassing transaction cost theory, theories of comparative advantage, resource based view, core competence etc. Research into the decision process of outsourcing provide an analytic hierarchical process view, starting with the decision of the business process to be outsourced, down through the mode of outsourcing, location(s) to outsource, choice of outsourcing partner(s), and finally performance management of the outsourcing engagement. Each decision variable in the hierarchy carries risk to a successful outsourcing partnership. This paper develops a conceptual risk assessment framework for IT outsourcing decisions using a fuzzy approach. The sources of risk in IT outsourcing contracts are identified based on the decision phases of outsourcing. A fuzzy rule base make connections among the sources of risk and maps the input space to an output risk category based on expert business knowledge of the domain. Demonstration of the framework is carried out for offshore software development using two fuzzy variables and four generally known business rules. Simulation of this model showed that the system could infer and quantify risk in a reasonable way. Such a system would support IT outsourcing decision making through improved understanding of the risks involved in partnerships. This will in turn enable effective risk management by appropriate design of contracts.

Key Words: outsourcing, information technology (IT), decision process, risk, contract, fuzzy

1.0 Introduction

Outsourcing of business processes and IT services in particular has become a growing approach to global business practice today. With the path breaking Eastman Kodak IT outsourcing decision in 1989 (Field, 1999; Lee *et al.*, 2003), organizations have largely explored the benefits of doing IT function outside the firm's boundaries. To achieve complex solutions in a rapidly changing world, seeking IT solutions from those who can best

do it largely explains the present global trend in IT outsourcing (Lee *et al.*, 2003). Major forces (Friedman, 2005) that enabled the offshore outsourcing model resulted from the economic liberalization and the advancements in Information and Communication Technologies (ICT). In a world without boundaries, one could choose to get a process done anywhere, enabled by the remote monitoring facilities offered by ICT.

The motivation for IT outsourcing is largely drawn from a sound business case with factors influencing the benefit side including significant cost reduction, effective use of human resources, higher capacity on demand, and better access to advanced technologies (Lee *et al.*, 2003). The major benefits of IT outsourcing could be summarized as:

- Cost Reduction- (30-50%)[1] mainly applies to offshore IT outsourcing owing to labour arbitrage, economies of scale and specialization (Clemons & Hitt, 1997)
- Quality- Owing to Service Provider's (SP) IT capability, achieved through the integration of its human skills, IT infrastructure, reputation etc. (Bharadwaj, 2000)
- Leveraging Time Zones- Work could be continuously performed 24X7, passing it across different time zones of the globe.

Another significant motivation for IT outsourcing is the opportunity to transform an organization through partnerships (Linder, 2004). According to this view based on a few case studies, outsourcing can be more than a tool for cutting costs and improving organizational focus, but also a means of acquiring new capabilities and bringing about fundamental strategic and structural change. Also, IT outsourcing has been increasingly facilitated by the emergence and maturation of process management standards such as Software Engineering Institute's (SEI) Capability Maturity Model (CMM), Capability Maturity Model Integration (CMMI); ISO 9000 etc. Having become a worldwide standard for software development processes, SEI-CMM has provided an objective basis for measuring progress in software engineering and for comparing service providers. This makes

[1] Source: NASSCOM, Indian IT Industry Facts Sheet, http://www.creativebpo.com/IndianITES-BPOFactsheet.pdf

software development process more transparent to clients and helps them explore service providers in offshore destinations like India and China (Davenport, 2005).

However, the promising side of the IT outsourcing opportunity comes at a cost. IT outsourcing partnerships carry innate risk elements as evidenced by reported failures of such engagements in the recent past (Prewitt, 2004; Andersen, 2002). The sourcing of a function from outside a firm's boundaries also results in loss of control, flexibility, qualified personnel, and competitive advantage in ICT. Outsourcing contracts carry risk owing to limited understanding about the future and bounded rationality of humans to analyze the past and the present. Therefore it is essential to understand the process involved in IT outsourcing decisions, the risk factors at each phase of the decision process and measurement and management of the same at the time of contracting a partnership. Previous research has focused on identifying the variables involved in the outsourcing decision process at various levels and also the strategic risk dimensions involved in the process (Clemons & Hitt, 1997; Ge *et al.*, 2004; Gottfredson *et al.*, 2005; Lee & Kim, 1999; Palvia, 2004; Graf & Mudami, 2005). This paper develops a fuzzy logic based framework for the assessment of risk at the time of entering into a partnership. The proper assessment of risk would support the client as well as the service provider in designing and negotiating contracts effectively.

The remaining part of the paper is organized as follows- Section 2 surveys literature to uncover the decision process and underlying theory of outsourcing, Section 3 extracts sources of risk in outsourcing, Section 4 describes and demonstrates a fuzzy risk assessment framework for IT outsourcing and Section 5 concludes the work.

2.0 The Outsourcing Decision Process

The decision process involved in outsourcing is multi-phased and could be depicted by an Analytic Hierarchy Process (AHP), starting with the decision on the process to be outsourced. In this section this decision process involved in business process outsourcing in general is analyzed with the underlying theory. Subsequently, the decision process for IT outsourcing is derived and based on the decision variables in the process risk elements are identified.

2.1 Foundations

The fundamental concepts for analyzing IT outsourcing decisions could be traced back to theories of economics and strategy. The major theories that could be cited here are comparative advantage theory (Suranovic, 1997), Coase's (Coase, 1937) Transaction Cost Economics (TCE), Barney's (Barney, 1991) resource based view and Prahlad's (Prahalad & Hamel, 1990) core competence of corporations. The comparative advantage theory helps resolve the 'make or buy' decisions for organizations. The implication of this theory in outsourcing context would be that with a country 'A' where there is cost advantage in IT services because of labour arbitrage, it would give comparative advantage to a country 'B' to outsource the work to country 'A'. Conversely, for country B, doing IT function in-house leads to a comparative disadvantage.

The TCE gives a basis for economizing on transaction cost, costs involved in arranging to get the work done rather than the cost of doing the work itself. This theory gives a clear insight for the existence of firms and markets as separate entities. In the context of outsourcing this theory helps make economic sense as to whether the market (service provider) or the firm (client) provides the best governance structure for business processes (IT function). The theory further extended by Williamson (1985) brings out three dimensions of a transaction that affect the type of governance structure chosen for transaction: asset specificity-as to which party has invested in assets pertaining to the transactions, uncertainty-arising out of bounded rationality and opportunism of the parties and frequency of transactions. As asset specificity and uncertainty increase, the risk of opportunism increases and therefore decision makers are likely to choose firm based governance structure (insourcing).

Whereas the above theories give a fundamental approach to make business sense for outsourcing, understanding resource based view and core competence help discern the business processes that could be outsourced and those that should be retained within an organization. The resource based view further extended to information technology by Bharadwaj (2000) contends that a unique harmonization of internal IT resources of an organization such as human IT skills, IT infrastructure, and other intangibles like IT reputation, brand image etc. could give a unique capability to an organization. In such a

context, where business performance is closely linked to IT capability, outsourcing IT function might preclude the opportunity to an organization to innovate ahead of its rivals. Similarly core competence of an organization is something fundamental to a firm's existence and therefore the lack of which require an organization to acquire it within the firm; sourcing it from outside the firm's boundaries leads to strategic vulnerability (Ge *et al.*, 2004) risking the future of the organization. Clemons & Hitt (1997) further extend this approach to understanding whether a function qualifies to be outsourced or not. According to this view, with the inherent difficulty in identifying core competence, a more realistic approach could be to take a risk based view of the decision. Therefore a firm should identify an activity as one not to be outsourced if the expected size of the economic loss that can result from an outsourcing contract exceeds the expected economic gains.

2.2 The Analytic Hierarchy of Outsourcing Decisions Process

The phases involved in outsourcing decision processes follow a hierarchical structure comprising of decisions on business process, shore, service provider, location and performance management (Graf & Mudami, 2005; Ge *et al.*, 2004; Pandey & Bansal, 2003). The structure of the decision process is given in Fig. 1.

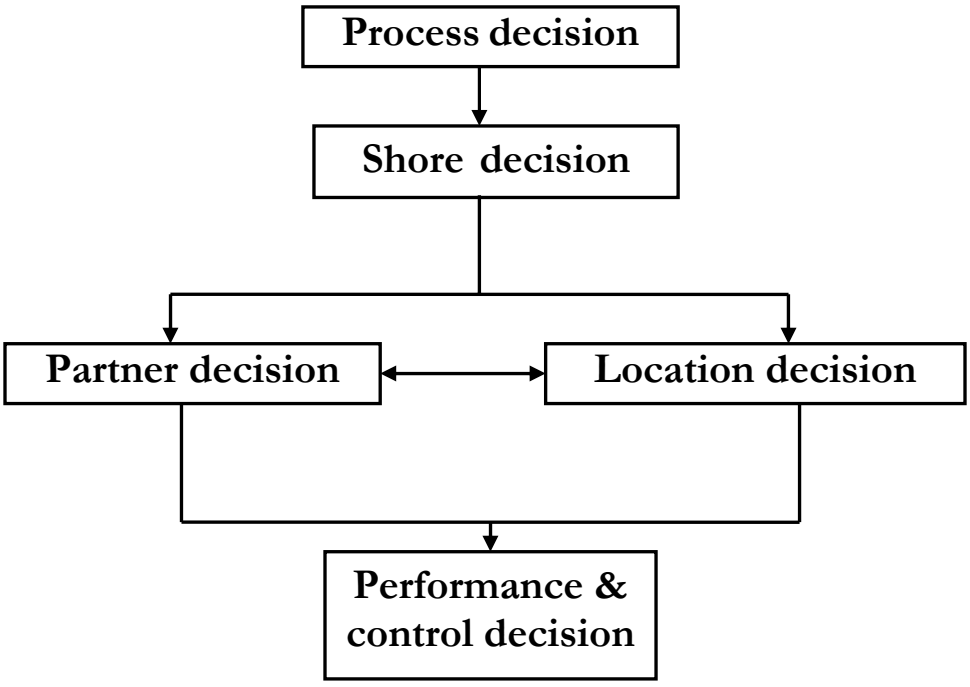


Fig. 1: The Hierarchical Structure of Outsourcing Decision Process

Process decision involves identifying business processes that could be better performed outside a firm's boundary. Theoretical basis for this phase of the decision process could be found in the works of Prahalad & Hamel (1990), Clemons & Hitt (1997), Ge *et al.* (2004) and Gottfredson *et al.* (2005). The next important decision in the hierarchy is the selection of sourcing mechanism, the various options being domestic insourcing, domestic outsourcing, offshore insourcing and offshore outsourcing (Ge *et al.*, 2004). The option of domestic insourcing carries lowest risk but least returns and offshore outsourcing carries highest risk but high returns, in line with the finance theory on risk-return relationship.

The next phases of the process, partner and location are mutually dependent options. The selection of the right partner first could influence the choice of the location based on partner preferences or constraints and vice versa (Graf & Mudami, 2005; Palvia, 2004; Ge *et al.*, 2004). Having decided on all the previous phases, deciding on an appropriate contract to monitor and control outsourcing partnership is the final phase of the process (Clemons & Hitt, 1997; Sabherwal, 1999; Ge *et al.*, 2004).

2.3 Risks in Outsourcing Decision Process

Each decision in the hierarchy carries risk and there is a compounded risk from the previous phases when an organization enters into an outsourcing partnership contract with another by virtue of the decisions already taken. The major categories of the strategic risk involved in the process have been identified as risks due to shirking, poaching, opportunistic renegotiation (Clemons & Hitt, 1997; Aron *et al.*, 2005).

- Shirking

  Shirking involves deliberate underperformance by the service provider yet claiming the same full payment for the task as if the task has been performed according to contractual norms. Shirking fundamentally involves the classical principal agent problem, where the agent chooses activities that reward oneself the most, as against the line of action which is desired by the principal. Shirking may result from the personal ambitions of service provider's employees, perceived lack of profit from the engagement, etc. wherein the service provider may employ lower quality resources for providing service. Possibility of shirking exists because behavior of both the parties cannot be fully observed and

contracts are signed under bounded rationality and as such cannot cover all possible outcomes and behaviors.

- Poaching

Poaching involves the illegitimate effort to make extra revenue by misusing the client's data. It may involve breach of trust that could damage the client's business. As absolute transparency is impossible to achieve, service providers could sell client's proprietary data to competitors, use client's customers to pitch its own services, steal software source code to build its own software product etc. This is a serious challenge to outsourcing especially in the context of offshore outsourcing where legal framework for data security and IPR are not well defined in the country where client's business process is outsourced.

- Opportunistic Renegotiation

This risk evolves when the power of one party involved in the partnership increases due to a condition unforeseen in the contract. A client may re-negotiate for lesser money when supply of service providers becomes abundant. A service provider may learn client's process more than the client knows about it thereby the client becoming too much dependent on a service provider, in which case the service provider may exploit it and demand more money for the same work.

Also a client may over a period of time become too weak in a process, say IT applications because it has lost its internal resources and exposure for a long time, which may in turn make the organization more vulnerable. Apart from the above a number of operational risks exist when a job is carried out in a country distant from the client, owing to differences in geography, work culture, legal framework, ICT infrastructure etc.

3.0 Risks in IT Outsourcing

The primary objective of this work is to understand the risk involved in IT outsourcing engagements at the time of contracting. Therefore the sources of risk need to be identified and risk from each source need to be assessed. The basis for understanding the risk in this way are:

- The decision process for IT outsourcing which could be derived from the analytic hierarchical process already identified in Section 2.2.

- Previous work on contracts in offshore software development (Gopal *et al.*, 2003)
- Previous work on effect of partnership quality in IS outsourcing success (Lee & Kim, 1999)

Sources of risk associated with the decision process could be extracted from the decision variables involved in the process. In addition, previous investigations into the success of outsourcing engagements in terms of partnership and contract act as further sources for identifying risk.

3.1 Sources of Risk based on Decision Process

The potential service lines[2] for IT outsourcing are Infrastructure Management Services (IMS), Application Development (AD) and Application Management (AM) in addition to other less prevalent lines of service in outsourcing such as consulting, R&D etc. The decision process in the case of IT outsourcing would begin with the choice of the IT service lines for outsourcing, whether all or part of the services to be outsourced, whether internal IT human resources to be retained (co-sourcing) or not etc. The second phase of decision would be the sourcing mechanism as in the case of business process outsourcing discussed in Section 2.2. Partnership consideration involve the number of partners -handing over entire services to one partner involves high risk; involving too many partners pose challenge in control and co-ordination, and the choice of partners. Major dimensions of the location decision (Graf & Mudami, 2005) are infrastructure (quality, cost and geographic distance), country risk (economic, political), government policy (tax rate, investment incentives) and human capital (work force size and availability, outsourcing experience, technical and language skills, compensation levels, cultural distance) with firm specific and situation specific moderating factors.

3.2 Sources of Risk based on Partnership and Contract

Outsourcing engagement is based on a mutually agreeable contract that will set the performance parameters as well as control and co-ordination mechanism for the partnership(s). The determinants of partnership quality (Lee & Kim, 1999) which influences the success of outsourcing engagement have been classified into three dimensions: dynamic, static and contextual. Dynamic factors like participation, joint action, communication quality,

[2] Source: CRIS INFAC SOFTWARE, January 2004.

etc. come into picture once the partnership starts off and therefore cannot be assessed prior to signing a contract. However static factors of age of relationship, mutual dependency, and contextual factors of culture similarity and top management support could be assessed to understand risk.

Further, based on the service line chosen for outsourcing, choice of contract is a determinant to success of the outsourcing engagement (Gopal *et al.*, 2003). The previous work identifies the determinants pertaining to application development outsourcing as size of the project, requirements uncertainty, project type, human resources (training), client MIS experience, client experience with outsourcing, project importance, client reputation, future business, client size, competition (client), competition (vendor), no. of prior projects and contract type (fixed price or time and materials).

Table 1: Risk sources in IT outsourcing

Risk Sources-Client Side	Risk Sources- SP Side
▪ Sourcing mechanism ▪ Geographic location (country) ▪ Number of SP partners ▪ *Mutual dependency* ▪ *Top management support* ▪ *Culture similarity* ▪ Partnership age ▪ Project size ▪ SP's experience in the service line ▪ SP's experience in offshore projects ▪ SP's trained manpower ▪ SP's attrition rate ▪ *Criticality of the service* ▪ *Requirements uncertainty* ▪ *Cost uncertainty in contract* ▪ Clients in-house IT resources ▪ Client size ▪ Competition (vendor) ▪ Competition (client)	▪ Project size ▪ SP's experience in the service line ▪ SP's experience in offshore projects ▪ SP's attrition rate ▪ SP's trained manpower ▪ *Mutual dependency* ▪ *Criticality of the service* ▪ *Requirements uncertainty* ▪ *Culture similarity* ▪ Partnership age ▪ Client's size ▪ Number of SP partners ▪ Competition (vendor) ▪ Competition (client) ▪ *Cost uncertainty in contract*

Based on the discussions so far in this section, the risk factors-variables that contribute to the risk of the outsourcing engagement for a client and service provider (SP), have been listed in Table 1 by combining the variables that point to a risk in the "to be" engagement. The client side and SP side sources have been identified based on what could adversely affect each of them in case of a failure. In this context attrition is a major concern for service providers today. SP's attrition rate is therefore another factor of concern as continuity of project is often hampered by high rates of attrition.

4.0 A Fuzzy Framework for Risk Assessment in IT Outsourcing

Risk assessment is an area of measurement marked by imprecision. Therefore scientific and engineering domains have widely used fuzzy based approach to risk assessment in the past (Tah *et al*., 1993; Mahant, 2004). Fuzzy logic acts on imprecise data and vague concepts (Kosko, 1993) – 'high', 'low', 'good', 'bad' etc. and could appropriately quantify such linguistically expressed variables. Unlike a classical set (crisp set) which defines membership of elements bivalent as either member or non-member, a fuzzy set uses a membership function to define the *degree of membership* in 0 to 1 range (fuzzification). Therefore a fuzzy set could be used to quantify linguistic user perceptions about behaviour, appearance etc.

In addition to the need of handling imprecise data, a risk assessment in outsourcing also requires human expertise for experience based scenario building. This involves making intuitive connections among the input and output variables thus building an if-then rule base for inference. Also a final quantified output is required from the risk assessment process to provide a mechanism for objectively measuring and comparing different risks before signing a contract.

A fuzzy inference system or simply a fuzzy system provides a convenient way to map an input space to an output space. A fuzzy IF-THEN rule base forms the heart of a fuzzy system. As shown in Fig. 2, fuzzy rules embed in the inference engine the expert human reasoning and connection making required to map input variables to output variables. This makes fuzzy inference system more robust as compared to a simple statistical model. The final output for a specific input state is obtained by manipulating

the output from the inference engine by an appropriate defuzzification algorithm such as the centroid method.

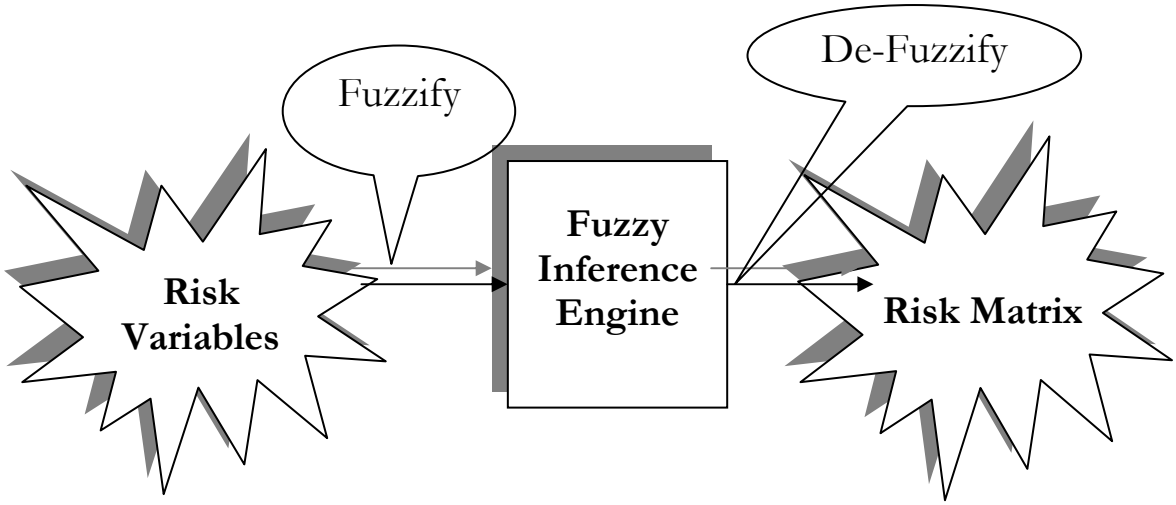


Fig. 2: A Fuzzy Inference System for Risk Assessment

In our context, the variables printed in *italics* in Table-1 are imprecise in nature. For example, perceived mutual dependency is a variable that is a determinant of the risk of the outsourcing engagement. Study in this area (Lee & Kim, 1999) shows that mutual dependency between partners increases when size of the exchange and importance of exchange are *high*, when partners consider each other the *best* alternative and when there are few alternatives or potential sources of exchange. By this understanding the perception is linguistically expressed as high, low, best, better etc., which are inherently imprecise expressions. A partner may use the term high dependency with regard to two distinct partners, but the degree he attributes to the high could be different. Therefore a fuzzy set could realistically quantify the 'high' with a membership value [0, 1]. Fuzzy membership in this way provides infinite number of points between zero and one to express one's perception of the value of the variable state.

4. 1 Demonstration of the Model for Offshore Software Development

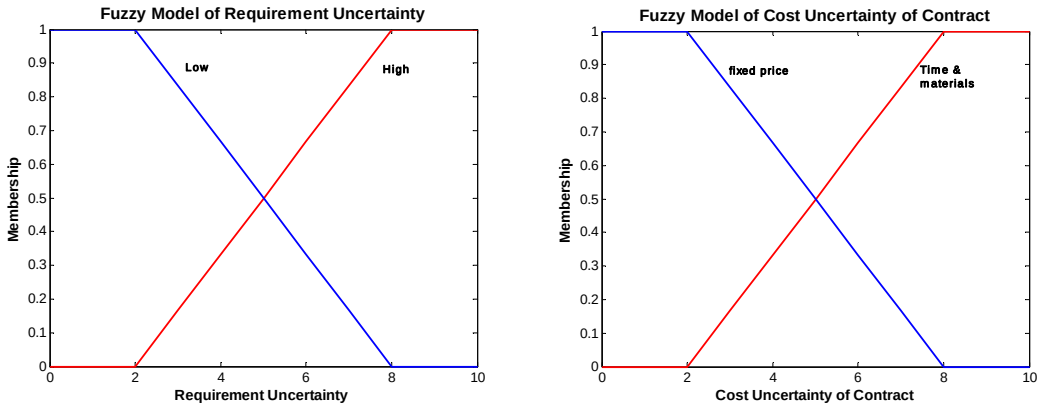
Application development outsourcing is a growing area of offshore IT services. In general US clients outsource software development to offshore destination like India and China for obvious benefits discussed earlier. Two major types of contracts between a client and a service provider in this area are the fixed price contract and the time and materials contract.

A fixed price contract creates a *high* risk for the service provider when requirement uncertainty is *high*. Similarly a time and materials contract presents the client a *high* risk if *high* requirement uncertainty exists. Thus type of contract to be chosen is closely linked to the requirement uncertainty of the project (Gopal *et al.*, 2003).

The demonstration of the model is to assess the risk of Shirking for a client based on a simplified model considering only two variables: requirements uncertainty and cost uncertainty of contract. This is to give an understanding about how this framework could be applied to different contexts of IT outsourcing risk measurement. The membership functions for requirements uncertainty high and low has been plotted in Fig. 3 (a). Mostly, linear region of a triangular membership function is initially assumed for simulation of the system. Using characteristic functions, these memberships could be represented for requirement uncertainty (x) as:

$$R_{low}(x)=\begin{cases}1 \; if \;\; x<2 \\ \dfrac{8-x}{6} \; if \;\; 2<x<8 \\ 0 \; if \;\; x>8\end{cases} \qquad (1)$$

$$R_{high}(x)=\begin{cases}1 \; if \;\; x>8 \\ \dfrac{x-2}{6} \; if \;\; 8>x>2 \\ 0 \; if \;\; x<2\end{cases} \qquad (2)$$



(a) (b)

Fig. 3: Membership functions for: (a) Requirements uncertainty (b) Cost uncertainty of contract

Cost uncertainty of contract is defined to capture the varying degrees of uncertainty about the cost of a project for a service provider depending on the design of contract as fixed price or time and materials or a combination of both as depicted in Fig. 3(b). The characteristic functions for this variable would be similar to Eqn (1) and (2). The uncertainty about the return from a project for a service provider is a perceived risk for the client as likelihood of the service provider underperforming (Shirking) in such a case is high. It may be noted here that it is not just one variable, but the combination of both the variables that decides the risk in the contract. Based on common business knowledge in this area, the rules that decide risk in this context could be codified as given below:

1. If (Cost_uncertainty_of_contract is Fixed_price) and (Requirements_uncertainty is High) then (Shirking is High)
2. If (Cost_uncertainty_of_contract is Fixed_price) and (Requirements_uncertainty is Low) then (Shirking is Low)
3. If (Cost_uncertainty_of_contract is Time_and_materials) and (Requirements_uncertainty is Low) then (Shirking is medium)
4. If (Cost_uncertainty_of_contract is Time_and_materials) and (Requirements_uncertainty is High) then (Shirking is High)

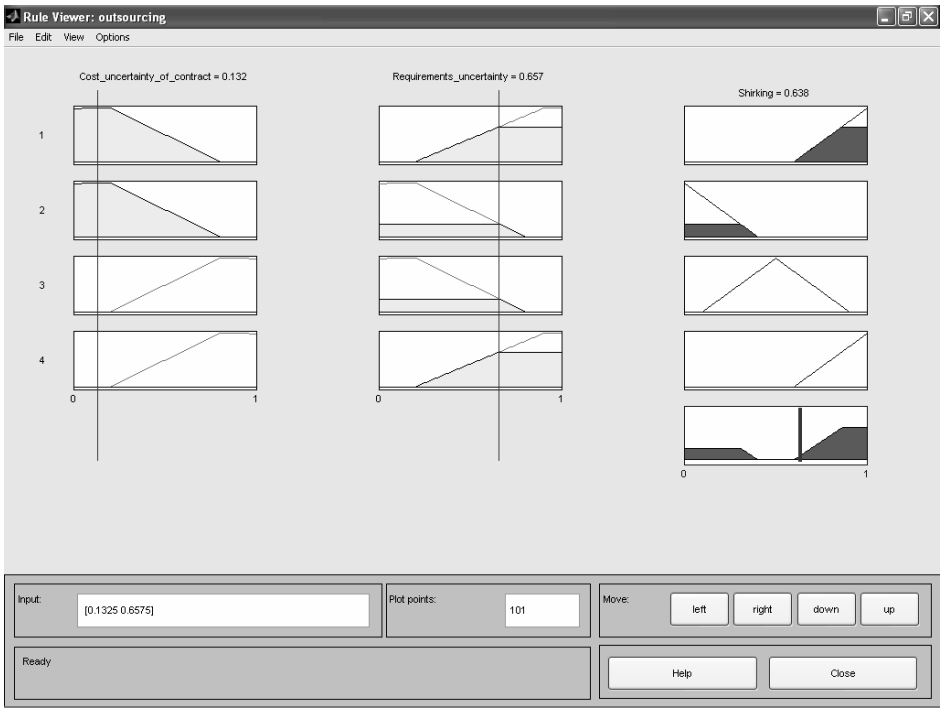


Fig. 4: Matlab™ Simulation of simplified fuzzy risk assessment model for offshore software development

Here *Shirking* from a partnership based contract is perceived as the major dimension of the risk. The simulation of the model for specific user inputs has been shown in Fig. 4. For a Cost_uncertainty_of_contract of 0.132 and Requirement_uncertainty of 0.657, the system generated an on output of Shirking=0.63. Though a contract that is fixed price when requirement uncertainty is medium-high is generally a safe option for a client, the relatively high risk transferred to the service provider increases the risk of shirking. Therefore the system generates a relatively high value of *Shirking* risk (0.63).

5.0 Conclusions

This paper analyzed the decision process that leads to outsourcing partnership contracts based on previous works done in this area. The major objective of the work was to understand the risk involved prior to entering into a formal contract. There are three major contributions from this work:

- Structuring the decision process and decision variables of ITO into an AHP
- Extraction of *sources of risk* based on the AHP & previous works
- Development and demonstration of a fuzzy system framework for risk assessment

Need to objectively compare and weigh risks involved is necessary to appropriately design and negotiate contracts prior to entering into a partnership. Simultaneously risk assessment has to make sense out of imprecise linguistic expressions, make contextual connections among the sources of risks and output quantified risk. This study explored a fuzzy inference system to address the above requirements. The facility to work with human expertise expressed through natural language gives a superior capability to this approach as demonstrated through the case of offshore software development.

Further work in this area envisages the development of a fuzzy expert system for risk assessment of outsourcing contracts. The assessment of risk in different categories such as shirking, poaching, opportunistic re-negotiation etc. in this way involves the discovery of rules that govern the connections among the different variables. The rules will thus map the sources of risk to a category of risk which when defuzzified would provide a quantified risk for a particular scenario. Rule discovery in this case could be done based on:

- In-depth interviews with expert professionals from the industry

- Case studies of past outsourcing contracts on client and SP side

Analysis of the successful and failed contracts with corresponding status of the risk factors identified in Table-1 could be done to establish the if-then rules of contract outsourcing risk.

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