

EXPERTISE BASED SOFTWARE PROJECT OUTSOURCING: THE INFLUENCE OF PROJECT RISK ON ONSITE COSTS

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The general trend in software today is in favour of migration of work to low cost centres (such as India) as compared to migration of labour towards higher wage centres (such as the US and Europe). This has resulted in a rapid increase in outsourced software projects from clients in the US and Europe to firms located in India. However, at the unit level of a specific project, we could witness some short term migration of labour from the Indian firms towards the client sites in the US and Europe (for onsite work). Such onsite costs could offset a significant part of the savings gained from outsourcing the project to the low cost centre, defeating the chief purpose of outsourcing. Thus it is in the interest of both the client and the supplier firm to contain the extent of onsite costs while planning the outsourced project.

However, many times the decision to send engineers onsite is taken during the execution of the project, when new information surfaces that indicates that the project may miss committed performance or timelines. This means that the onsite costs cannot be precisely quantified at the start of the project. Such unplanned onsite cost escalation could constitute a significant risk factor that impacts the outsourcing decision making process.

This risk becomes more relevant when supplier firms move to higher value (more complex, expertise driven) work, which may require more onsite work to facilitate tighter co-ordination.

We discuss the impact of this on the contracting process between a client and a supplier firm and the associated benefits of relationships through repeated projects over a longer time horizon.

Keywords:

Global software outsourcing, onsite work, expertise, project risk, contracting.

1. INTRODUCTION

Global offshoring of software projects to Asian destinations continues to show strong and sustained growth (Frost and Sullivan 2004, Nasscom-McKinsey 2002, Baily and Farrell 2004). This is mainly driven by the low cost of developing software in countries like India (Arora et al 2001). The substantial surplus generated through wage difference between high and low cost centres provides a natural impetus for clients in high cost locations to outsource work to firms in low cost locations. The focus has thus shifted away from migration of talented labour from low to high wage centres ("brain drain") to the migration of work from high to low cost centres.

However, when we examine a unit project that is outsourced from a client to a supplier firm, we find that it embeds some temporary migration of labour to the client site (for "onsite work"). The extent of onsite work varies from project to project, and even by stage within a project. Since such onsite work provides no cost advantage to the client, it is in the interest of both client and firm to manage these onsite costs carefully so that the surplus from outsourcing is not eroded.

Evidence from the Indian software industry corroborates that onsite work content of firms is significant: The percentage of onsite revenues for the three top Indian IT companies TCS, Infosys and Wipro (obtained from company reports) are 60%, 54% and 58%. The corresponding percentages of onsite engineers are 40%, 33% and 32% respectively.

Quite clearly, it should be easier to offshore well-defined tasks. On the other hand, since there is considerable ambiguity during the requirement-gathering phase, there could be a higher onsite component during the start of a project. Onsite postings also allow client companies to reduce the risk of working with unknown supplier firms (Venkatesh and Krishna, 2005b). They may thus prefer the first few projects, or the first part of a project to be performed onsite. Since the content of all such onsite work is known before commencement of the project, it can be factored into the outsourcing decision making process (Venkatesh and Krishna 2005a).

Sometimes, new information surfaces during project execution which indicates that the project may miss its goals. This may trigger onsite transfer of engineers to ensure closer co-ordination of the remaining part of the project. This causes an unanticipated erosion of outsourcing gains, and thus needs to be considered as a significant risk factor in the outsourcing decision process. We focus our attention in this paper on the analysis and management of this risk.

The importance of this analysis has to be placed within the context of the new trend towards outsourcing of higher value projects (Nasscom-McKinsey 2002), since these projects are of higher complexity requiring specialised expertise. Before outsourcing such expertise based projects, the client has to make an assessment of the expertise that the supplier firm will deploy on the client's project. Often this is difficult to do. A novice firm may present a level of expertise that it does not truly possess, and which the client is unable to correctly assess. An expert firm on the other hand may present its correct level of expertise, but may not apply its expertise in full to the client's project (Venkatesh and Krishna, 2005b). The client's requirements could also change during the course of the project, and the expertise of the firm may no longer be relevant.

The net result is that the client discounts the expertise presented by the firm. This works to the disadvantage of more expert firms in the industry (the adverse selection problem). Expert firms could correct for this by using fixed price bids as a signalling mechanism, where the cost escalation is entirely borne by the firm. But when there is uncertainty in the project specifications, fixed price bids could be too risky for the supplier firm.

Since the impact of incorrect expertise assessment will show up during the course of execution, the client and firm could mutually decide to increase the onsite presence midway through the project, implying that such projects should be multi-staged. Several authors have suggested multi-staging as a strategy to reduce the risk in contracting due to potential renegotiation (Richmond and Seidmann, 1993; Whang 1992) and to take advantage of the learning from one stage to another (Wu, Ding and Hitt, 2004). We suggest yet another reason for multi-staging – the need to effectively manage the risks arising from incorrect expertise assessment.

The paper is organised as follows: We first present a simple model (section 2) to explain the optimal onsite-offshore mix (section 3) that balances two opposing factors – reduce employment cost by increasing the offshore component, but reduce project overheads by keeping some tasks onsite. The overheads are lower when the project is managed by expert firms (section 4). We discuss how the optimal mix is impacted by contractual arrangements between the clients and the firms when they negotiate the sharing of the outsourcing surplus between themselves (section 5).

We then examine how the risk of cost escalation impacts the contract negotiation process (section 6). This leads us to study the evolution of relationships in repeated project engagements between a client and a firm (Section 7).

2. THE MODEL

We consider a high cost location client (centre H) that is interested in offshoring to a low cost location firm (centre L). The work arrangement between the centres is organised through projects, and we will be interested only in projects assigned to centre L (offshored project). To reduce risk, the firm could locate part of the project team at H (the on-site component), with the remaining being in centre L (the offshore component). Clearly, for the project to be considered an offshored project, the offshore component has to be higher than the onsite component.

Throughout this paper, the unit of analysis will be a *unit of effort* (for example a person-month, or a person-year for large projects). The average cost incurred by the firm if the unit of effort is carried out on-site is W_H , while for offshore it is W_L , where we assume $W_L < W_H$.

The client and firm mutually decide to assign to each incoming project a proportion of onsite effort component 'm' based on a number of factors. Since we are mainly concerned with offshored projects, the value of 'm' will range from 0 to ½.

The employment cost (EC) is given by the following wage equation:

$$EC(m) = W_L * (1 - m) + W_H * m$$

The maximum *offshoring gain*, i.e. the profit gain per unit through offshoring is thus $EC(1) - EC(0) = W_H - W_L$, and we can write the employment cost in terms of this as:

$$EC(m) = W_H - (W_H - W_L) * (1 - m), \text{ in terms of the offshore component } (1 - m).$$

Offshoring increases the risk of misunderstandings, leading to rework (Sharma and Krishna 2003). When offshoring to a different firm the possibility of risk further increases due to moral hazard (work at a distance cannot be monitored) and due to adverse selection (actual performance of the vendor firm differs from the original). Such project risks need to be managed carefully and this introduces management overheads in the form of reviews conducted face-to-face or through conference calls, or in terms of introducing redundancy or backup plans.

The overheads introduced by project risk should increase with the extent to which the outcome depends on the outsourced component. We model overheads due to such dependency through $OH(m) = a * (1 - m)^2$, which will be zero when the project is completely done onsite and increases quadratically with the extent of offshoring (see Venkatesh and Krishna 2005a for an explanation). The factor 'a' depends on the complexity of the project.

The total project cost is thus given by:

$$TC(m) = EC(m) + OH(m) = W_H - (W_H - W_L) * (1 - m) + a * (1 - m)^2.$$

Note that when $m=1$ (completely onsite project), $TC(m) = W_H$ which is how it should be.

But when $m=0$ (completely offshored project), $TC(m) = W_L + a$ (the entire overhead appears).

If $m=0$ and $a=W_H - W_L$, then $TC(m) = W_H$ and the entire gain due to offshoring is lost.

Consider $m=1/2$ (offshored, with $1/2$ the team onsite), then $TC(m) = W_H - 1/2 * (W_H - W_L) + 1/4 * a$.

If now $a=W_H - W_L$, then $TC(m) = W_H - 1/4 * (W_H - W_L)$, i.e. even with 'a' at $W_H - W_L$, we can get some offshoring gain by placing part of the team onsite.

3. OPTIMAL ONSITE-OFFSHORE MIX

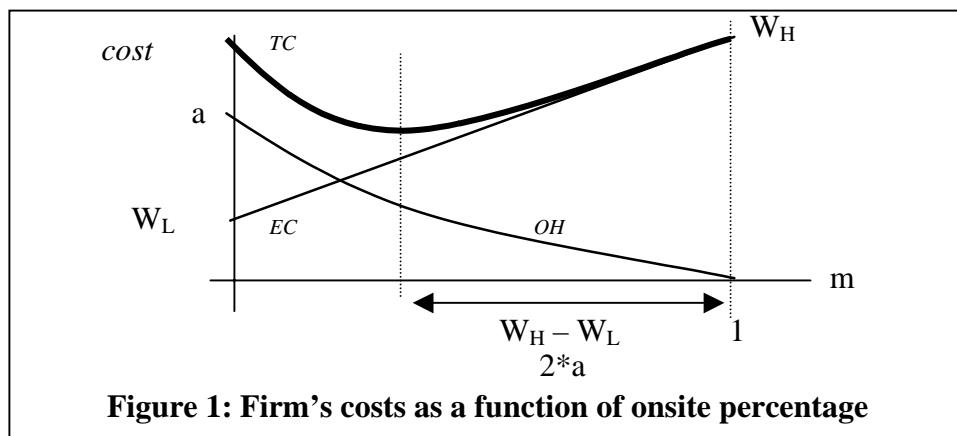
To find the minimum value of total project cost, we differentiate $TC(m)$ with respect to m . The minimum value occurs when the first derivative is zero, i.e. at:

$$m_{opt} = 1 - \frac{(W_H - W_L)}{(2*a)}, \text{ when } a \geq \frac{(W_H - W_L)}{2}$$

$$= 0, \text{ otherwise}$$

Figure 1 demonstrates the variation of employment, overheads and total cost to the firm with varying onsite percentages m . Note that the optimal onsite percentage increases with 'a', and decreases with increasing onsite-offshore wage difference ($W_H - W_L$).

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The optimal project cost is given by:

$$\begin{aligned} \text{TC}(m_{\text{opt}}) &= W_H - (W_H - W_L)^2 / (4*a), & \text{when } a \geq (W_H - W_L)/2 \\ &= W_L + a & \text{otherwise} \end{aligned}$$

Note that surplus from offshoring is $W_H - W_L$ when 'a' is 0, but drops to $(W_H - W_L)/2$, when 'a' rises to $(W_H - W_L)/2$, and further drops to $(W_H - W_L)/4$ when 'a' rises to $(W_H - W_L)$.

When $a < (W_H - W_L)/2$, the TC curve is monotonically increasing, and is minimum at $m=0$.

When $a \geq (W_H - W_L)$, $m_{\text{opt}} = 1/2$, i.e. the project is no longer an offshored project.

We thus only consider values of 'a' ranging from $(W_H - W_L)/2$ (the minimum at which an onsite component is required) to $W_H - W_L$ (at which the project ceases to be considered an offshore project). The graph below shows how m_{opt} changes with a.

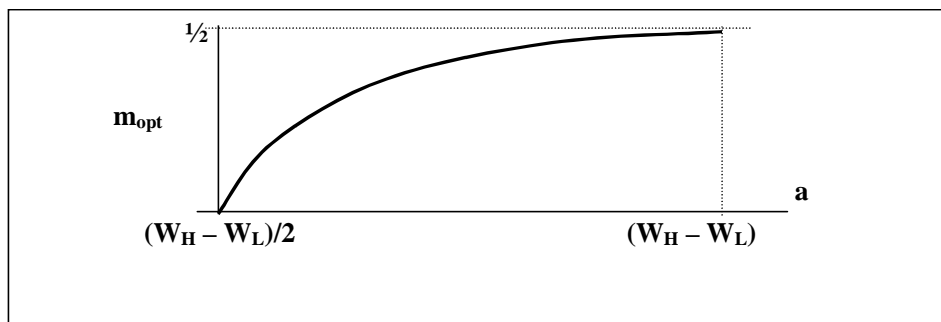


Figure 2: Optimal onsite component as a function of max overhead

4. OVERHEADS AND EXPERTISE

The overhead factor 'a' depends on the project complexity, which in turn is not an absolute measure but is dependant on the track record of the firm in carrying out projects of similar nature. A novice firm that has never done projects of similar nature before should see the project being more complex than an expert firm who has executed several such projects in the past.

Let 'e' denote the expertise of a firm (for the project being outsourced), and \hat{e} be the average expertise of all the firms in the industry.

The relation between the overhead factor 'a' and the firm's expertise 'e' can be expressed by:

$$a(e) = c * \hat{e} / e$$

where 'c' is the complexity of the project as seen by a firm with average expertise.

Thus, when the client works with firms whose expertise $e > 2*c*\hat{e}/(W_H - W_L)$, it makes sense to totally offshore the project ($m=0$), and when the firm has expertise $e < c*\hat{e}/(W_H - W_L)$, offshore projects do not make sense.

Thus we consider only the range of expertise e such that $c*\hat{e}/(W_H - W_L) < e < 2*c*\hat{e}/(W_H - W_L)$.

Consider now the situation where the client wishes to outsource a single project and selects a firm based on competitive bidding on the basis of expertise and price.

The client's problem is that it is not easy to precisely assess the firm's expertise before outsourcing a project. It is in the interest of a novice firm to masquerade as an expert firm in order to win the outsourcing contract or to win higher prices. Even for firms with established expertise, the firm would reserve such experts for deployment over a wide range of projects, and the client cannot be sure that the expertise demonstrated by the firm during award of the contract is

going to be deployed on this specific project (Venkatesh and Krishna, 2005b). Finally, the client's requirement can change during the course of the project. When this happens, the firm's specific expertise may become less relevant for the project.

The impact of all these situations is the same – the level of expertise available during the execution of the project turns out to be very different from what is assumed at the start of the project. This obviously leads to significant time, effort and cost overruns. From the model above, we see that if the firm presents an expertise e_h to the client, but actually delivers a level of expertise e_l , then the adverse impact due to this is given by $a(e_l) - a(e_h) = c * \hat{e} * (1/e_l - 1/e_h)$.

The issue here is this – if the firm had been honest about its expertise at the start, then the client and firm could together have planned a more optimal onsite component to deal with the lower expertise level. But since the client cannot distinguish an honest firm from a dishonest one, there is no incentive for a firm to be honest – which is the standard adverse selection situation.

The impact of adverse selection can be determined as follows: If the expertise level was correctly determined at e_l , the onsite component $m(e_l) = 1 - (W_H - W_L)/(2*a(e_l))$, and the corresponding project cost $TC_1 = W_H - (W_H - W_L)^2/(4*a(e_l))$. On the other hand, since the expertise level was planned at e_h , the onsite component is planned at $m(e_h) = 1 - (W_H - W_L)/(2*a(e_h))$, while the project overhead is still determined by the expertise level e_l and thus the total project cost TC_2 is:

$$W_H - (W_H - W_L)*(1 - m(e_h)) + a(e_l)*(1 - m(e_h))^2 = W_H - (W_H - W_L)^2 * e_h/(4*c*\hat{e}) * (2 - e_h/e_l)$$

The cost is unnecessarily higher by $AS(e_h) = TC_2 - TC_1 = (W_H - W_L)^2/(4*c*\hat{e}) * (e_h - e_l)^2/e_l$.

The net result is that clients discount the expertise level of the firms when they plan the projects.

5. INFLUENCE OF OVERHEADS ON CONTRACTING BETWEEN CLIENT AND FIRM

Consider now a client H (with internal wages W_H) outsourcing to a firm L with wages W_L . We assume that the wages W_H and W_L are common knowledge since both client and firm have access to wage statistics that are generally available for both locations. If the project is fully outsourced (and the project overhead $a=0$), then the surplus from outsourcing is the wage difference $(W_H - W_L)$. Both client and firm attempt to negotiate a contract that determines how they will share this surplus. If their negotiation power is roughly equal, then the surplus is shared equally – which means that the client pays the firm $W_L + (W_H - W_L)/2$ per unit of effort.

As the overhead of the project increases, the surplus available falls. If the client and firm can agree on the assessment of project complexity and risk, and hence the extent of onsite work, then the surplus shared between them also falls. For instance, for $a = (W_H - W_L)/2$, if the surplus is equally shared, then the client pays the firm $W_L + (W_H - W_L)/4$ per unit of effort.

But in fact, the negotiation is usually much more difficult with complex projects because the client and firm will have differing perceptions of the firm's expertise in managing project risks, and thus arrive at different values of the overhead 'a'. The supplier firm has better visibility over their own expertise level e_h , while the client estimates a lower value e_l which reflects the discounting of expertise we discussed in the last section.

The client's assessment of the optimal onsite component is $1 - (W_H - W_L)*e_l/(2*c*\hat{e})$ that is higher than the firm's assessment of the onsite component $1 - (W_H - W_L)*e_h/(2*c*\hat{e})$.

There is thus a different assessment of the overall surplus available. The client's assessment is lower than the firm's assessment by the factor $(W_H - W_L)^2/(4*c*\hat{e}) * (e_h - e_l)$.

The only solution to this adverse selection situation is for the firm to signal its expertise using some signalling mechanism. One way that firms typically do this is by offering a fixed price bid for the project (Venkatesh and Krishna, 2005b), where it becomes the supplier firm's responsibility to take care of the onsite cost component.

However, when the project specifications are not clear, the expert firm is exposed to considerable cost escalation risk. Then the expert supplier firm may not be willing to make a fixed price bid, and has no signalling mechanism available to separate it from the novice firm.

6. REVELATION OF THE EXPERTISE DURING THE PROJECT EXECUTION

As we have seen in Section 4, as the project progresses, the expertise of the firm could be found to be less than what was assumed at the start. This means that the onsite component is planned at a level less than the optimal level, leading to a loss in the total surplus by an amount given by $AS(e_h) = (W_H - W_L)^2 / (4 * c * \hat{e}) * (e_h - e_1)^2 / e_1$.

This loss can be recovered to some extent if the project is split into two stages 1 and 2, where at the end of stage 1, the firm's expertise level becomes more visible to the client. While the client assesses the expertise of the firm at an initial high level, say e_h for stage 1, it can be reset to a more accurate lower level e_1 for stage 2. When the lower expertise level is detected, the client should trigger a higher onsite component to reduce further schedule variance.

Multi-staging of outsourced projects has been suggested for reducing risk of potential renegotiation (Richmond and Seidmann, 1993; Whang 1992) and to benefit from learning from one stage to another (Wu, Ding and Hitt, 2004). We suggest yet another reason for multi-staging of projects – the need to effectively manage the risks arising from incorrect expertise assessment.

Let the optimal onsite ratios for the two stages be m_1 and m_2 respectively, with $m_2 > m_1$ for a novice firm (because the real expertise is discovered after stage 1), and $m_2 < m_1$ for expert firms (due to the learning from stage 1). If a is the proportion of the project executed in phase 1, and $(1 - a)$ is the proportion executed in phase 2, then the total cost of the project can be written as:

$$TC_3(a) = a * TC_2(m_1) + (1 - a) * TC_2(m_2)$$

Now, a longer stage 1 could expose the client to much higher risk in stage 2, since it has less time to correct for the sub-optimal expertise. On the other hand, a shorter stage 1 provides less time for the client to assess the real expertise of the firm. The client thus needs to determine an optimal value of a that minimises:

$$TC_3(a) = W_H - (W_H - W_L)^2 * (4 * c * \hat{e}) * [a * e_h * (2 - e_h / e_1) + (1 - a) * e(a) * (2 - e(a) / e_1)]$$

where $e(a)$ is the estimate of the expertise at the end of stage 1.

We can use the linear interpolation expression $e(a) = (1 - a) * e_h + a * e_1$ to represent the estimate of expertise at the end of stage 1.

Then, to minimise $TC_3(a)$, we can minimise the adverse selection cost:

$$\begin{aligned} & a * AS(e_h) + (1 - a) * AS(e(a)) \\ &= (W_H - W_L)^2 / (4 * c * \hat{e} * e_1) * [a * (e_h - e_1)^2 + (1 - a) * (e(a) - e_1)^2] \\ &= (W_H - W_L)^2 / (4 * c * \hat{e}) * (e_h - e_1)^2 / e_1 * [a + (1 - a)^3], \end{aligned}$$

which occurs at $a = 1 - 1/\sqrt{3} = 0.423$.

The adverse selection cost is thus reduced to a factor $[a + (1 - a)^3] = 0.62$ of its original level.

We thus see a **38%** reduction in the adverse selection cost due to two-staging the project.

7. UNDERSTANDING THE ROLE OF RELATIONSHIPS IN OUTSOURCING

We can extend the model to consider more than two stages in the project to represent the scenario of repeated projects between the same client and the firm in a similar domain. As an example, we consider what happens when we use three stages in the project instead of two.

Let the proportion of effort in stage 1 be a , in stage 2 be b and the final stage be $1 - a - b$.

Then adverse selection cost is:

$$\begin{aligned} & a * AS(e_h) + b * AS(e(a)) + (1 - a - b) * AS(e(a + b)) \\ &= (W_H - W_L)^2 / (4 * c * \hat{e}) * (e_h - e_1)^2 / e_1 * [a + b * (1 - a)^2 + (1 - a - b)^3]. \end{aligned}$$

Minimising this cost expression with respect to b gives $b = (1 - a) \cdot (1 - 1/\sqrt{3})$.

Substituting b back into the cost expression and minimising with respect to a gives $a = 0.26$, $b = 0.31$, and the cost is reduced to $[a + b \cdot (1 - a)^2 + (1 - a - b)^3] = 0.51$ of its original level.

We thus see a **49%** reduction in the adverse selection cost due to three staging the project.

With more stages, a number of positive factors contribute to improving the relationship between the client and the firm:

- Both client and firm can arrive at a framework to do a common assessment of the expertise and project risks, and hence also the amount of surplus available
- Learning from the earlier stages can contribute to increasing the amount of expertise in the later stages, which in turn contribute to reducing the project complexity and the onsite component

Both the client and the supplier firm gain from the continuity of the relationship, since the firm can gain in expertise, the client can find value from this expertise and both have a system by which they are continuously assessing the correct level of expertise and precisely determining the optimal onsite component based on this.

CONCLUSIONS

In this paper, we argue that the realistic gain due to offshoring needs to take into account project complexity issues, which require onsite presence. We have presented a simple model that can be used to determine the optimal onsite percentage for a software project based a variable that accounts for project complexity and the supplier firm's expertise level to deal with this complexity. We argue using this model that the difference in project complexity assessment between the client and the supplier firm could significantly hamper their ability to strike a mutually acceptable deal, especially for more complex projects. Expert firms are more significantly affected due to this, and could be driven out of the market. They could counter this by using fixed price bids to signal their expertise level, but this may be too risky when the project specifications are not clear. This adverse selection situation can be somewhat rectified by multi-staging the projects, so that the expertise gap revealed through the earlier stages can be used to make better estimates of the onsite components in the later stages. This brings out yet another reason for supplier firms to build deep relationships with clients, where both gain from the outsourcing of a series of projects in a specific expertise area.

The paper suggests the following implications for managers:

- a. The client and supplier should exchange sufficient information so that there is a common assessment of available expertise; the possibility of misrepresentation especially in case of a new supplier should not be overlooked. If the client and firm cannot agree on the level of expertise available, then it is safer to split the project into a pilot and main phase, where the pilot phase is used to gauge the expertise of the firm.
- b. Based on the expertise assessment, the client and supplier firm should plan for the appropriate level of onsite work that will enable the project to be executed efficiently. There should be continuous monitoring to check if the expertise level is sufficient, and to tap into the client's expertise whenever necessary either by sending supplier firm's engineers to the client site or vice versa.
- c. It is preferable to enter into long term relationship with supplier firms, since the clients have a detailed history of projects executed from which they can correctly deduce the expertise of the firm to undertake new projects. Repeated project relationships also allow the client to benefit from the expertise gains of the supplier firm.

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