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Identifying Early Warning Signs of Failures in Offshore Software Development Projects – A Delphi survey

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ABSTRACT

The distribution of IT activities around the world as a result of globalization has driven the growth of global IT outsourcing or IT offshoring. Software projects are increasingly sent from high-cost countries to low-cost offshore countries such as India, Russia etc. Because of the inherent complexities and uncertainties of software projects, they continue to experience poor performance problems. This paper discusses the concept of early warning signs (EWS) to improve project success rates, especially in the unique onshore-offshore project environment, which is exposed to higher project risks. This research employs a Delphi survey to identify and rank the most important EWSs of failures in offshore software development (OSD) projects. The survey panelists include 23 experts from the offshore client and vendor companies in Switzerland and India. The survey results are discussed and further steps to study the EWSs in an OSD project context are outlined.

KEYWORDS

Offshoring, Global software development, Project failure, Delphi survey, Early warning sign, Project management

INTRODUCTION

Due to globalization, IT activities are being distributed around the world (Aspray et al., 2006). The share of IT activities sent to offshore countries has seen a significant increase in the last two decades. A study by Forrester in 2007 reported that 65% of the US and European organizations having 1000 or more employees currently develop software in offshore countries compared with 45% two years ago (McCarthy, 2007). The recent global economic recession has further motivated companies in the high-cost countries to send IT activities to low-cost countries such as India, Russia etc. The IT offshoring market will continue to experience a high growth rate in the coming years and this growth will largely come from applications development and maintenance (Optaros, 2007).

Several studies (Standish Group, 1994, 2002; McManus and Wood-Harper, 2007) have reported about failed software projects that cost billions of dollars to organizations every year. In fact, IT projects experience more failures than successes, if the projects are assessed on the originally estimated time, budget and requirements (Standish Group, 1994, 2002; McManus and Wood-Harper, 2007). Failed offshore projects have been reported by Aron and Singh (2005) and Rottman and Lacity (2008). A practitioner-oriented work (Vashistha and Vashistha, 2006) has claimed that 50% of the offshore projects fail as they do not reduce costs as originally intended. Further, recent surveys (Carter, 2006; Hatch, 2005) among executives have revealed that offshore outsourced projects resulted in lower cost savings and lower quality of software development than expected. Little research has been carried out about failures in IT outsourcing projects (Sparrow, 2003) and software development projects (Ewusi-Mensah, 2003). Our research will contribute to fill this gap in the failure research, especially in IT offshoring. The distinct characteristics of offshore projects that make them more difficult to manage and the growing relevance of IT offshoring call for more research to successfully manage offshore outsourced projects.
The concept of project failure is vague and few people agree on its exact definition (Pinto and Mantel, 1990). IT projects can be judged from the implementation and operations perspective and from the project development perspective. Since we are focussing on the software development processes in offshore projects, we have followed the project development perspective. We define offshore software development project failure as the cancellation of the offshore software development project before the information system becomes operational. The failure to deliver information system can happen at any development phase before the system becomes operational. Cancellations of offshore software development (OSD) projects, which have client and vendor team members that work at offshore and onshore sites, can result from several project internal and external factors. Our project failure definition corresponds to ‘total abandonment’ (Ewusi-Mensah and Przasnyski, 1991) and ‘impaired’ projects (Standish Group, 1994) from the major works in the failure research.

Software development requires intensive coordination and control throughout the development stages because of its complex nature that makes it vulnerable to failure (Brooks, 1986; Hoch et al., 2000). Ewusi-Mensah’s (2003) comprehensive work about software development failures found that failures are ‘multifaceted and multidimensional’ (p. 9) and any single contributing factor can cause the project to fail, which can be of technical, cultural, organizational, political, managerial, sociological, and economic natures. Software development projects remain difficult to manage ‘even in conditions of co-location and proximity’ (Sahay et al., 2003, p.245). With high information intensity, low customer need, and low physical presence, software development projects appear to be ideal for global dispersion (Apte and Mason, 1995). However, OSD projects are more prone to failure than the in-house and domestically outsourced projects (Nakatsu and Iacovou, 2009). This susceptibility to failure results from higher offshore-specific risks, such as, cultural differences, linguistic differences, geographical distances, communication difficulties, and knowledge transfer complexities (Sahay et al., 2003; Heeks et al., 2001; Dibbern et al., 2008).

Project uncertainty is an important characteristic of a software development project that makes it susceptible to failure (Hoch et al., 2000). Therefore, the early project stages, when uncertainties are higher, are critical for a successful outcome (Ward and Chapman, 2003). Hoch et al.’s (2000, p. 97) upstream-downstream metaphor (figure 1) illustrates how inherent uncertainty follows the project throughout the development stages. In the early project stages, the degree of uncertainty will be higher in terms of the deliverables, schedule, budget and other project parameters. This high uncertainty during the early stages is referred to as upstream phase. They result because of unclear customer requirements, not entirely predictable design, changing requirements and changing technology. The uncertainty gradually reduces as the project progresses towards the later stages or the downstream phase. However, it will not completely disappear even after the information system becomes operational.

![Figure 1: Upstream-downstream framework (Hoch et al. 2000, p. 98)](image-url)

**EARLY WARNING SIGNS**

Software projects continue to fail because of their inherent complexities and there is no silver bullet in sight to overcome the poor performance of software projects (Brooks, 1986). The postmortem examinations of failed IT projects have shown that
before failures happened, there were significant symptoms, indications or warning signs of trouble in the early project stages (Kappelman et al., 2006). An early warning sign (EWS) is defined as ‘an event or indication that predicts, cautions, or alerts one of possible or impending problems ... in the first 20 percent of the project’s initial calendar’ (Kappelman et al., 2006, p. 31). Patients with heart trouble might list problems such as chest pain, numbness in the left arm as classical symptoms prior to a heart attack (Ward, 2003). However, these symptoms may be too late to treat or they may be late warning signs. For effective prevention of heart trouble, early symptoms such as high blood pressure or high cholesterol levels should be checked (Ward, 2003). As in the above medical analogy, the early symptoms or warning signs that are known from the previous IT project experiences can be leveraged for better project outcomes.

Failures are dynamic and multifaceted and thus their ‘opportunities for occurrence are both ever-present and cumulative’ (Cule et al., 2000, p. 72). The project troubles before the failure are hardly ever detected early enough in the IT industry (Havelka and Rajkumar, 2006). Identifying and managing those troubles provide an effective solution to save project efforts and resources. In order to put the troubled projects back on track, an early warning control mechanism seems to be necessary, especially in the early project stages. Keil and Montalegre (2001, p. 65) have recommended the following:

> At the earliest possible stage, managers need to ask themselves whether any “red flags” ... are serious enough to warrant project termination or significant redirection. By institutionalizing such an early warning system, organizations can save considerable sums of money simply by identifying failed projects while they are still in the stages of development.

EWSs provide an anticipatory framework (Nikander and Eloranta, 2001) to manage uncertainties in the critical early project stages (see figure 1), especially in the offshore project environment where the risks are higher. The effort and intensity that go into the early planning stages will reduce the number of changes that are required after the development stages. This is because corrective actions in the early project stages are cheaper than the costly recovery measures in the later stages (Ewusi-Mensah, 2003; Flowers, 1996) since the rework and retesting of the system will increase the project efforts, costs and time.

Three major empirical works have studied the concept of EWSs (Kappelman et al., 2006; Havelka and Rajkumar, 2006; Nikander and Eloranta, 2001). Two of them (Kappelman et al., 2006; Havelka and Rajkumar, 2006) concentrated on IT projects, whereas one study (Nikander and Eloranta, 2001) was based on industrial construction projects. As opposed to the works that studied EWSs during the whole project life cycle (Havelka and Rajkumar, 2006; Nikander and Eloranta, 2001), Kappelman et al.’s (2006) work, which is central to this research work, focussed on the first 20 percent of the project lifecycle. The early project stages are critical as the management of the EWSs in these stages would still allow the projects to be completed within the original estimates, provided corrective actions are taken.

The concept of EWS that could help to avoid project failures in the offshore environment is highly relevant because of the higher risks involved in OSD projects than in domestic projects. While the research stream of classical project risk management concentrates on threats that could become reality at any future stage, the EWS framework would concentrate on the risks that could be managed in the critical early project stages and ensure that the foundation for the project is set right. We study the EWSs of failures specific to OSD projects in this exploratory work and attempt to answer the following research question:

> What are the most important EWSs of failures specific to offshore software development projects?

**RESEARCH METHODOLOGY**

A Delphi survey was chosen as the research method to answer our research question as it is the most appropriate method considering the ranking nature of the research question as well as the exploratory nature of the study. This survey method allows us to find the EWSs of failures specific to OSD projects and further generate the most important ones. As no single expert can possibly generate all the relevant EWSs related to OSD projects, the panels of experts is in a better position to produce a comprehensive list of EWSs (Kasi et al., 2008). We chose two expert panels for clients and vendors as these stakeholders are equally important for the outcome of offshore projects. Two expert panels of clients and vendors can leverage their years of experience in OSD projects and provide their input to elicit the EWSs specific to OSD projects.

The ranking-type Delphi survey (Schmidt, 1997) was employed to elicit the offshore-specific EWSs of software project development failures and to rank the most relevant ones. This method also allows us to provide statistical analysis of the consensus among the panelists and make comparisons between the two expert panels. The data regarding the EWSs were solicited by senior executives and project managers (experts) with years of experience in the offshore software development environment. We contacted 68 experts by e-mail from the client and vendor sides primarily from the companies in Switzerland and India, which are involved in OSD projects. Out of 32 positive responses, we looked for experts with a minimum experience of 2 years in OSD projects. We had 23 panelists that fulfilled the minimum experience for this study.
Table 1 shows the average career experiences of the panelists. The 12 panel experts from the client side and 11 panel experts from the vendor side had average OSD project experiences of 7.2 and 8.5 years respectively. The client and vendor panelists experienced on average 2.3 and 1.1 OSD project failures in their careers respectively.

<table>
<thead>
<tr>
<th>Panelist Experiences</th>
<th>Clients</th>
<th>Vendors</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT-related (years)</td>
<td>16.2</td>
<td>13.4</td>
</tr>
<tr>
<td>Project management (years)</td>
<td>10.1</td>
<td>8.5</td>
</tr>
<tr>
<td>OSD projects (years)</td>
<td>7.2</td>
<td>8.5</td>
</tr>
<tr>
<td>No of OSD project failures</td>
<td>2.3</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Table 1: Client and vendor panelists

The Delphi survey was conducted in three phases (figure 2). In the first phase of the survey, we asked the panel experts to list all possible EWSs of failures in OSD projects based on their career experience. We also provided the top 12 EWSs identified by Kappelman et al. (2006), which allowed the consideration of a major work (not specifically in the offshore development environment) about EWSs in their inputs. The 23 panelists identified 44 EWSs in the first phase. In the second phase, the panelists were asked to validate the EWSs identified in the first phase and choose their top 20 ones to narrow down the list of EWSs. This phase resulted in 21 EWSs, which was a manageable number for ratings in the third phase.

The client and vendor panel experts were asked to rate 21 EWSs of project failures according to their importance in the third phase. The survey strived to achieve a consensus among the ratings of clients and vendors, which was measured using Kendall’s coefficient W (Schmidt, 1997). The experts were asked to compare the average ratings of each EWS with their own inputs and revise their ratings, if required. This phase allowed us to provide the rankings of EWSs based on their average ratings and further compare the responses of clients and vendors. This allowed us to analyze the importance of the EWSs from the client and vendor perspectives in the onshore-offshore project environment.

FINDINGS

The survey generated the ratings of the most important EWSs from the project teams’ perspectives. 18 (10 clients and 8 vendors) out of 23 panelists participated until the end of the Delphi survey. After the second round of the third survey phase, the client and vendor panelists had Kendall coefficients W of 0.196 and 0.401 respectively, which indicated weak agreements among panelists (Schmidt, 1997).
The panelists were asked to rate 21 EWSs in the third phase according to their importance. The ratings were made on a scale of 1-10 (10 = very important, 1 = unimportant). The EWSs of failures identified by clients and vendors in the second phase revealed similar patterns between them, which facilitated the categorization of EWSs. We found four categories of EWSs by subsuming particulars into more general categories (Miles and Huberman, 1984). The four categories of EWSs are the following: communication-related, people-related, formal process related and formal output related. The most important EWSs identified by clients and vendors as well as their categories are given in Table 2.

<table>
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<tr>
<th>Early Warning Signs</th>
<th>Categories</th>
<th>Average Client and Vendor Ratings</th>
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<tbody>
<tr>
<td>1. Project scope changes constantly</td>
<td>Formal process</td>
<td>7.61</td>
</tr>
<tr>
<td>2. Unclear and ambiguous business specifications</td>
<td>Formal process</td>
<td>7.61</td>
</tr>
<tr>
<td>3. Lack of transparency and openness to discuss about problems/delays</td>
<td>Communication</td>
<td>7.56</td>
</tr>
<tr>
<td>4. Communication difficulties between onsite and offshore team members</td>
<td>Communication</td>
<td>7.56</td>
</tr>
<tr>
<td>5. Lack of documented requirements</td>
<td>Formal output</td>
<td>7.39</td>
</tr>
<tr>
<td>6. No quality assurance procedures in place</td>
<td>Formal process</td>
<td>7.28</td>
</tr>
<tr>
<td>7. Misunderstanding of requirements by the offshore team</td>
<td>Communication</td>
<td>7.22</td>
</tr>
<tr>
<td>8. Stakeholder involvement and participation are missing</td>
<td>People</td>
<td>7.11</td>
</tr>
<tr>
<td>9. Serious quality issues in deliverable items</td>
<td>Formal output</td>
<td>7.11</td>
</tr>
<tr>
<td>10. Consecutive failures to meet deadlines</td>
<td>Formal process</td>
<td>7.00</td>
</tr>
<tr>
<td>11. Project manager cannot effectively lead the offshore team and communicate with clients</td>
<td>Communication</td>
<td>6.94</td>
</tr>
<tr>
<td>12. Onsite coordinator cannot communicate effectively with offshore team members</td>
<td>Communication</td>
<td>6.83</td>
</tr>
<tr>
<td>13. Unclear roles and responsibilities</td>
<td>Formal process</td>
<td>6.72</td>
</tr>
<tr>
<td>14. Ineffective schedule planning and/or management</td>
<td>Formal process</td>
<td>6.72</td>
</tr>
<tr>
<td>15. Lack of communication between clients and vendors</td>
<td>Communication</td>
<td>6.56</td>
</tr>
<tr>
<td>16. Project team members do not have required business knowledge</td>
<td>People</td>
<td>6.50</td>
</tr>
<tr>
<td>17. No questions asked by vendor team members</td>
<td>Communication</td>
<td>6.39</td>
</tr>
<tr>
<td>18. No change control process in the project</td>
<td>Formal process</td>
<td>6.06</td>
</tr>
<tr>
<td>19. Issues not resolved in a reasonable time</td>
<td>Formal process</td>
<td>6.06</td>
</tr>
<tr>
<td>20. Lack of top management support and commitment to the project</td>
<td>People</td>
<td>6.00</td>
</tr>
<tr>
<td>21. Project team members do not have required technical skills</td>
<td>People</td>
<td>6.00</td>
</tr>
</tbody>
</table>

Table 2: Ratings of EWSs of failures and their categories

**Communication-related EWSs**

Cultural differences as well as geographical distances between the onshore and offshore team members could cause a lot of communication problems in OSD projects. Further, communication in English, which is mostly not the native language of the
team members analyzed in the survey, affects the communication and thus the knowledge transfer in projects. The different cultural orientations (Hofstede, 1984) of project team members indicated the need for different coordination and control strategies in offshore projects (Krishna et al., 2004; Narayanaswamy and Henry, 2005; Gefen and Carmel, 2008). The approaches and attitudes of team members from different countries, who lack ‘cultural intelligence’ (Beck et al., 2008) could lead to misunderstandings, especially when the opportunities for informal communication are less in OSD projects. The intangible and informal project management measures become particularly important in the OSD project context as not every team member may meet all the dispersed team members during the offshore project lifecycle. Especially, the informal project management measures such as informal ‘corridor talks’ and spontaneous conversations that have an effect on trust building and mutual understanding among team members in the early project stages are missing in the globally distributed software development scenario.

EWSs related to communication problems result from a lack of transparency and openness to discuss problems/delays as well as the communication difficulties among team members, which mostly result from different cultural orientations. Indian vendor team members may not ask questions openly because of the importance of Indian team hierarchies. This can also cause misunderstandings among project team members. The lack of effective communication possibilities is also an EWS of OSD project failure. The communication limits of onsite coordinators and project managers, which result from the physical distances, could also affect the project outcome.

**People-related EWSs**

Skill sets and commitment of project team members are crucial for successful project outcome (Kappelman et al., 2006). As weak project team members affect the progress of projects, the performance of key project team members provides important EWSs of project failures.

People-related EWSs include project team members’ lack of business domain knowledge and technical skills. The lack of top management support and the missing participation of the stakeholders could be further signs that projects are heading for failure.

**Formal process related EWSs**

Formal project management processes will be indispensible to avoid OSD project failures because of the cultural differences and geographical distances between the client and vendor team members. These distances affect the communication, control, coordination, social bonding and trust building in OSD projects (Carmel and Abbott, 2006). Several studies (Narayanaswamy and Henry, 2005; Beck et al., 2008) have shown the relevance of differentiated formal and informal control mechanisms on the outcome of OSD projects. Formal project management measures are formally documented and pre-specified, whereas informal ones are less pre-specified and unwritten (Kirsch, 2004). Both these control measures in the team and individual levels could influence the outcome of projects (Beck et al., 2008). Formal project management measures include the explicit project management processes, roles, responsibilities, documentation etc. and informal project management measures include the implicit and unwritten group norms, values and expectations (Kirsch, 2004).

Troubles related to formal project management typically result from process issues such as unfrozen project scopes, ineffective schedule planning and management, and lack of change control processes. Further, unclear roles and responsibilities, consecutive failures to meet deadlines, issues not resolved in reasonable time, and lack of quality assurance procedures in place result in critical issues could lead to OSD project failures.

**Formal output related EWSs**

The issues related to the results of the formal project management processes (Applegate et al., 2003) provide indications about the direction in which projects are heading. The failure to deliver outputs or results by project members in the desired quality will lead to further troubles in projects.

The typical formal output related EWSs show up as serious quality issues in deliverable items. This can result from a lack of documented requirements as well as unclear and ambiguous business specifications.

**DISCUSSION**

The Delphi survey has generated the list of most important EWSs of failures in OSD projects. 6 out of 21 (29%) EWSs of failures were found to be specific to OSD projects. These offshore-specific EWSs were all communication-related ones (#3,
We refer to these EWSs that are unique to offshore projects as *offshore-specific EWSs* since they require special attention in OSD projects. These troubles result because of the unique characteristics of onshore/offshore project environment and they need to be managed accordingly.

The predominantly larger number of EWSs (16 out of 21 – 71%) appear as non-offshore specific ones. These indispensable *non-offshore specific EWSs* require at least as much attention for offshore projects as in domestic projects. These results suggest that the non-offshore specific EWSs of failures still remain highly relevant and can endanger OSD projects as in domestically outsourced software development projects.

The high proportion of EWSs in the formal project management related categories (10 out of 21 - 48%) show the relevance of formal control mechanisms to offset the disadvantages in terms of cultural differences and geographical distances. It suggests the necessity of formal and structured processes to avoid project failures in OSD projects.

Most EWSs identified by panelists also appear as the causes of failures, which is consistent with the earlier studies (Nikander and Eloranta, 2001; Havelka and Rajkumar, 2006). This is because the causes of problems will manifest as warning signs as the project progresses. Only 3 EWSs (#10, 17 and 19 in table 2) were found to be the pure indicators or events prior to failure, which can be termed as *shallow EWSs*. These EWSs are relevant during the project execution and could be noticed as the project progresses. The rest of the EWSs (18 out of 21) were found to be the indicators or events prior to failure as well as causes of OSD project failures, which can be termed as *deep EWSs*. Since these EWSs are also known as causes of failures, they can be anticipated from the project start.

The weaker agreements among the panel groups of clients and vendors resulted because of the following reasons. On average, client panelists (W 0.196) had 7.2 years of OSD project experience compared with vendor panelists (W 0.401) who had 8.5 years experience. 3 out of 12 client panel members had also worked as vendor team members, which could have affected the agreement among client panel members. Further, the lowest average rating for EWSs on a scale 1-10 was 6. Although the higher ratings for EWSs indicate higher relevance, they translated into lower Kendall coefficients. Further, a few participants did not seem to have rated seriously in the third phase as they were frustrated with the many rounds of the survey.

**CONCLUSIONS**

We have attempted to identify the most important early warning signs (EWS) of failures specific to offshore software development (OSD) project. We have gained practical insights about OSD projects through this exploratory research in IT offshoring and contributed to the IT failure research stream, which remains under-researched. The Delphi survey found the relevance of both offshore-specific and offshore-indispensable EWSs in OSD projects that could help to avoid failures. The remarkable number of offshore-specific EWSs found for OSD projects (29%) indicates that the offshore projects are fundamentally not too different from domestic outsourced projects; however, they should be managed with special attention. These EWSs were found to be affecting the offshore projects as a result of offshore-project characteristics. However, the higher proportion of formal project management related EWSs underline the need for more structure and better planning to avoid OSD project failures. Further, the non-offshore specific EWSs that are relevant for domestic projects gain more importance in the unique onshore/offshore project context. This is because these EWSs compensate the informal interaction possibilities among team members.

The EWSs of failures provide an anticipatory framework that could improve project performance and thus save a significant amount of resources and efforts in the unique OSD project context. The appearance of most EWSs (18 out of 21) as the causes of OSD project failures suggests the presence of risk factors that need to be managed right from the project start.

This survey was based on the broad career experience of offshore experts without specifically analyzing any cases. The level of organizational and project management maturity of the companies involved in outsourcing affect the offshore projects and thus the perceptions of EWSs resulting from the survey. The degree of uncertainty will be higher for companies that have low project management maturity and, consequently, the concept of EWSs could further help to improve project success in such companies. In order to further understand the weak agreements among survey panelists, around 20 case-specific qualitative interviews will be conducted to collect richer data. This research step is required to more deeply study the dynamics that lead from the EWSs to the failure situation.
REFERENCES


