

Accuracy of Client Specifications and Timely Completion of Software Development Projects

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Abstract—Software development projects are often delayed ranging from a few days to many months due to numerous reasons. Inaccuracies in client specifications and modification requests during subsequent phases of the development life cycle are a major cause for such delays. This paper tries to document the nature and degree of impact of inaccurate Software Requirement Specifications on the final outcome of Software Development Projects which are not well documented and studied in Indian context. We identified the factors that cause inaccuracies in Software Requirement Specifications (SRS) from literature. We validated them for the Indian context through discussions with experts in the field and have assessed how the inaccuracies impact the final outcome. We propose some key aspects that vendors need to prioritize in order to overcome the sources of error during the requirement elicitation process. We have attempted quantification of select causes of delay and their impact on the delay. A major finding of the paper is the distinction between the client's inability to express their requirements correctly and the vendor's capability to correctly understand the client requirements and their relative importance in causing delays.

1. INTRODUCTION

Software Requirement Specifications (SRS) is the most creative and challenging process that provides the foundation for any software development project. All further steps in the software development are based on it. Inaccuracies in SRSs are known to cause project failures for many reasons. Some of the reasons for inaccuracies may be because of developers eliciting the incorrect requirements, or failing to validate the requirements correctly. There is also lack of certainty about future environmental changes and thus it can also contribute towards SRS mismatch with the actual requirement. Incorrect requirements lead to projects getting delayed beyond plan and may also result in a poor quality system. When the requirements are not precise, the project team has to face problems beyond expectations in control and planning of the project. Hence it is necessary and possible to reduce, if not completely eliminate, incorrect requirements coming from the clientele. According to a survey carried out by Standish Group (1995), the normal development projects undertaking expenses overran as high as 189% of the first gauge, and just 17% of the work finished on-time, on-plan and with all highlights and capacities as was first indicated. Large overruns of effort

estimates can lead to customers becoming dissatisfied, leading to lower quality of the software and frustrated software developers.

Eliciting the exact, accurate client requirement is a big challenge in software development life cycle. It is a known cause of delays and failures in software development projects, especially in the Indian context. Requirement rework and delays lead to loss of man hours and increased expenditure for both clients and software vendors. But, the nature and the degree of impact of inaccurate SRS on the final outcome of SDPs are not well documented and studied.

Our contributions from this research are:

- To find the effects of inaccurate client specifications for Indian IT vendors. (Section 4.1)
- To find a relationship between inaccurate client specifications and their impact on Software Development Life Cycle, (SDLC) in the Indian scenario. (Section 4.2)
- The distinct factors that causes inaccuracies in SRS were identified from literature. The impact of select factors on final outcome would be studied quantitatively with their relative importance including ranking. (Section 4.3)
- To study the typical duration of delays/extensions caused and complexity of changes in specification requested by clients. (Section 4.4)
- Analyze the abilities of clients and vendors to correctly specify and elicit requirements respectively with each other. (Section 4.5)
- To determine the priority of types of errors that vendors should focus upon during requirement elicitation process. (Section 4.6)

2. THE PROBLEM

Delays in software development projects is a very natural but undesirable phenomenon as far as the clients and vendors are concerned. It is often unavoidable due to causes which are

beyond the control of either parties, but a saving of even a small amount of time is invaluable for both parties. Our association with different software development projects showed the effects of defunct requirement specifications on the course of the project which included but not limited to delays / extensions, cost overruns, resource wastage, compromise on software quality, dissatisfied clients requiring frequent rework, loss of reputation for vendor and their trust with clients, increased work load on software developers, lost productivity etc.

The problem stems from the fact that no single person in the client side has a holistic and comprehensive knowledge of their requirements. The requirements get diluted or misreported as it passes from person to person. In many cases it is not possible or feasible as requirements evolve over time and it would be asking for too much from clients to have a clear idea of the requirements at the beginning. Similar is the situation at the software vendor side, wherein Business Analysts elicit the requirements from clients and pass on the requirements in a language as understood to developers. If the vendors are relatively inexperienced, the elicitation process will further be of inferior quality. The levels of understanding among the developers also varies, with the hierarchy. There will be very few ones having a holistic view of the exact requirements. It may not be essential always, yet it can cause issues in integration, module compatibility and dependence etc. at a later stage which can lead to further delays in the project.

One common factor among all was delays due to issues related to inaccurate specifications. They often lead to but not limited to delays or extensions, cost overrun, resource wastage, compromise on software quality, loss of reputation and trust etc. It is an undesirable situation for both clients and vendors, yet they seem to overlook the importance of eliciting an accurate requirement specification in the first place. Through discussions and exchange of ideas with peers and others in IT industry then, we realized that the problem is not limited to few established vendors alone; most of them as well as startups were equally facing the problem.

The typical delays or extensions ranged from few days to some months. It induces additional cost on the vendors which is passed on to the clients ultimately. With most of the clients lacking the ability to foresee the exact requirements at the beginning, the number of revisions become alarmingly large for most projects. One of the witnessed reasons was that requirement gathering does not happen at the primary user level; the ultimate end users do not get to express the requirements and expectations to vendor's representatives. Hierarchical organizational systems lead to requirements being collated at a macro level, without keeping in mind the primary or end users' actual needs. Even during development stage, the necessary communication doesn't happen between developers and end users, which would have otherwise

brought down the level of rework required at later stages of development.

Even small revisions become complex in the overall integration process, due to inter module dependencies. The inability of clients to sufficiently express their requirements gets inflated when the vendors also lack in their competence to elicit exact requirements from clients. Employees in IT organizations are not satisfied with their organization's traditional ways of requirement elicitation from clients as they are forced to rework on those parts lacking clarity as well as where requirements emerge at a later stage where significant progress had already been made with the initial specifications.

Traditionally there are thus various causes behind delays in software projects, backed by literature. Based on our experience and interactions with professionals in the field we have selected four of them in particular for the purpose of this research. They are: requirement revision requests from clients, complexity of change required, client's inability to express requirements and vendor's incapability to understand requirements. The purpose was to identify the relative importance of them and to propose the order in which vendors should prioritize these issues in the process of requirement elicitation. It can help vendors improve their efficiency and effectiveness. The various sources of errors can be broadly classified into three classes – people, process and documentation errors. Vendors need to introspect and recognize the effects of each of these independently on their requirement elicitation process and take corrective measures to ensure significant savings of time and resources.

3. THE FINDINGS

The main aim was to find out if inaccurate client specifications lead to delays in software development projects. 93.6% of the respondents believed it to be true in their experience.

3.1 The effects of inaccurate client specifications for Indian IT vendors as obtained from the research include: Delays/extensions in development, Cost overrun, Resource wastage, Loss of trust between client and vendor, Compromise on quality of software, Loss of reputation for Vendor.

3.2 93.6% respondents agree that inaccurate client specifications cause delays/extensions in software development projects. The major consequences of inaccurate client specifications are:

- a) Delays/extensions in development (93.5%)
- b) Cost overrun (80.6%)
- c) Resource wastage (77.4%)
- d) Loss of trust between client and vendor (54.8%)
- e) Compromise on quality of software (48.4%)
- f) Loss of reputation for Vendor (45.2%)

4.3 Ranking of critical sources of error [1] during requirement elicitation:

1. Process errors - errors that occur due to inadequate requirement engineering process, and selecting wrong means of achieving goals and objectives.
2. People errors - resulting from people involved in requirements preparation.
3. Documentation errors - errors that occur due to incorrect organization and specification of requirements, regardless of whether the requirements author understood the requirements correctly or not.

The selected causes for delays/extensions in software development projects include: Requirement revision requests from clients, Complexity of change required by clients, Client's inability to express requirements, Vendor's incapability to understand requirements. The pairwise comparison matrix for performing Analytical Hierarchy Process (AHP) as obtained from the survey is:

		R	C	I	V
Req. Revn Reqsts	R	1	1	0.937	1.257
Cplxty of Change	C	1	1	0.932	1.25
Client's inab	I	1.066	1.072	1	1.341
Vendor's incap	V	0.795	0.8	0.745	1

The ranks of the criteria and corresponding Eigen vectors are:

		E V	Rank
Client's inab	I	0.2765	1
Req. Revn Reqsts	R	0.2589	2
Cplxty of Change	C	0.2582	3
Vendor's incap	V	0.2062	4

Performing regression analysis with Average delay as the dependent variable and Requirement revision requests from clients (X1), Complexity of change required by clients (X2), Client's inability to express requirements (X3) and Vendor's incapability to understand requirements (X4) as independent variables, the regression equation comes up as:

$$\text{Average Delay} = 14.366 + 0.729x_1 + 1.503x_2 + 4.782x_3 - 1.757x_4$$

The regression equation is not statistically very significant with beta value less than 30%, but suggests that client's inability to express their requirements correctly is a major contributor to the delays in software projects. Client's inability to correctly express their requirements is the most critical factor causing delays in software projects. Vendor's incapability has far lesser influence on delays.

The ranking of causes:

- i. Client's inability to express requirements
- ii. Requirement revision requests from clients
- iii. Complexity of change required by clients
- iv. Vendor's incapability to understand requirements.

4.4 Delays are inevitable in software projects; it typically ranges between 10 days to more than 3 months. Mean delay is of 28.63 days.

4.5 Requirement revision requests from clients are inevitable. It ranged between 5 to more than 20 with a mean of 11.95. Requirement revisions are often complex or very complex. (58.1%) Vendor's capability to correctly understand the client requirement in the beginning without modifications subsequently (48.4%) is higher than the client's abilities to correctly express their requirements (19.4%).

4.6 The distinct factors causing inaccuracies in SRS include Process, People and Documentation errors. Process errors (inadequate requirement engineering process, and selecting wrong means of achieving goals and objectives) and People errors are critical sources of error during requirement elicitation and vendors need to tune their engineering process to overcome the same.

4. CONCLUSION & FUTURE WORK

The research focuses on inaccuracies in clients specifications in IT industry and the delays caused in software development projects. Delays are most common in most projects and there is a need to reengineer the whole requirement elicitation process to optimize the process. Clients lack the expertise to effectively communicate their requirements to vendors; the end users are most often alienated from communicating to vendors and this causes a huge gap between the actual and delivered requirements. Delays can be avoided by the vendors by focusing on the critical factors that causes delays. Client's inability to express their requirements correctly is a major concern for the vendors and they need to create processes that overcomes this issue.

The research paper is limited in scope due to want of time and number of IT professionals and their responses via surveys and focused interviews. More number of personnel from different software vendors could be covered for a broader perspective. Clients belonging to different industries who have availed new software installations in their respective organizations can be included in the study as a future extension of the work and incorporate their standpoints as well.

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