

## Project Management in Software companies –An Empirical Study in Bangalore City

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### Abstract

In recent years, the software industry has been struggling with building quality software unsuccessfully. This is witnessed by failures in major software projects. Software projects fail not because of complexity but unconscious response to software project management approach which has led to major drawback of software industry in achieving tremendous success in their services. There is need to bridge the gap between increasing diffusion of software projects in the industry and the challenge of optimizing the allocation and integration of inputs necessary to meet defined project objectives. This study evaluates how software projects are managed in the Bangalore software industry. Eight software companies in Bangalore city were selected for the study based on their software project management experiences. Project Managers were interviewed and professionals were observed. Projects documentations were also examined. The research measured four independent variables: project planning, project estimation, project scheduling and project management methodologies. Nine independent variables were measured in the research: scope, developmental stages, requirement management, cost, effort, project duration, team members, tools, and models. Results from the study shows that 80% of the software projects were 20% ahead of deadline, 6.67% were 10% ahead of time and 13.33% met deadline but they were not of good quality. Lack of presentation of requirements in an understandable form, project scope expansion, problem of training and managing team members; and adopting the right methodologies as stated by the Project Managers are the major drawbacks in achieving project goals.

### 1. Introduction

Software is becoming an integral part of every product. Nothing seems to be concrete nowadays without the incorporation of software because they hold the key to the future and almost everything is becoming a key part of it, for instance consumer products, medical devices and so on.

The application of software to engineering is software engineering. That is, the application of systematic, disciplined, quantifiable approach to the development, operation, the maintenance of the software and the study of the approaches. The phases involved in software development are software requirement, software design, implementation, testing and maintenance.

Software project is a part of software engineering modules because the technology of developing software ties to the techniques of software project. It encompasses the knowledge, techniques and tools necessary to ensure the development of software products. It plans for software development using effective estimation of size and effort and to execute plan with

attention to productivity and quality.

The primary challenge of managing the software project is how to achieve all the project goals and objectives with some preconceived constraints. The constraints are critical to the developers and customers. The constraints are scope, scheduling and cost. These three constraints are often competing: an increase scope typically means increased time and increased cost and a tight time constraint could mean reduced scope and increased cost and a tight budget could mean increased time and reduced scope. The accuracy of the above constraints will aid in generating request for proposals, contract negotiations, scheduling, monitoring and control.

There is no doubt that software industry has made progress but there is need to bridge the gap of the challenge of how software development project can be well managed, planned and organized to enhance productivity given deliverables, timeframes and budgets. This study was carried out with a view to understudy the nature of software project management in some selected software companies in Bangalore. The rest of this paper is organized as follows: Section 2 contains the review of some related works. In section 3, the methodology approach used for this study is stated. Results obtained from the study are given in section 4 while section 5 gives the discussion of the results. Conclusions from the findings are presented in section 6.

## **Review of Literature**

A project is a temporary endeavor having a defined beginning and end, undertaken to meet particular goals and objectives usually to bring beneficial change or value. Project Management is the discipline of planning, organizing and managing resources to bring about the successful completion of specific project goals and objectives. Another school of thought believes that project management is a leadership role which plans, budget, coordinates, monitor and control the operational contribution of property professionals.

Software Project Management is a sub discipline of project management. Project management is as old as written history and has been practiced since early civilization. Projects were generally managed by creative engineers and architects such as Christopher Wren (1632-1732), Thomas Telford (1757-1834) until 1950s when organizations began to apply project management tools and techniques to complex projects.

As a discipline, Project Management was developed from several fields of application such as construction, engineering etc. Two forefathers of Project Management are Henry Gantt called the father of planning and control techniques that are famous for his use of Gantt chart as a project management tool and Henri Fayol, a father of management function which forms the foundation of the body of knowledge associated with project and program management.

The 1950s marked the beginning of modern project management era. Prior to the 1950s, projects were managed on an ad hoc basis using mostly Gantt Charts and informal techniques and tools. Early metrics on project management are Gantt chart and Program Evaluation and Reviewing Techniques chart developed in the 1950s and 1960s. Two mathematical project-scheduling models were also developed as at that time and they are the Critical Path Method (CPM) and Program Evaluation and Reviewing techniques (PERT). These mathematical techniques quickly spread into many private enterprises.

Software project management is a sector that arguably witnessed the highest rate of project failure in the world. Dorsey pointed out that large information system projects have been reported to be subject to failure rates between 50-80% and Bupa stated that according to a recent report by the Standish Group, only one in three IT projects were delivered on time, within budget and according to Specification. IT projects, particularly those of a software nature, have different strengths and weaknesses as compared to traditional engineering projects. For instance, some strengths associated with software projects include flexibility, ease of creating backups, scalability, replication and reusability of components while some weaknesses include invisibility, complexity, difficulty to add people to delayed projects and the need for regular upgrades.

However, hard skills remain the traditional main focus of most IT project management methodologies. Hard skills, often described as a science, comprise processes, tools and techniques applied to projects. In managing software projects, tools and techniques related to hard skills are given much attention in an attempt to drive projects towards success. Unfortunately, we find that many software projects do not live up to expectations. Hard skills are the technical skills required within the confines of a domain. They encompass the dimensions such as processes, tools and techniques.

Extensive research has been conducted in project management with greater emphasis on hard skills. These skills, although of crucial importance, are to be considered along with the broader soft skills according to Belzer. Most project management methodologies show a greater coverage of hard skills. It is observed that research efforts are expended towards automating the process of management of projects with regards to hard skills.

Soft skills, often described as an art, have been identified as critical for project success. Soft skills are the non-technical skills that are often not given due consideration while managing projects. Soft skills, often described as an art, is concerned with managing and working with people, ensuring customer satisfaction with the intention of retaining them and creating a conducive environment for the project team to deliver high quality products within budget and on time and exceeding stakeholders expectations They are often concerned with managing and working with people. These skills are typically acquired through experience and the various dimensions are communication skills, team building, organization effectiveness, leadership and so on. Companies, like Mastek, Polaris and Sun Microsystems, being conscious of the importance of soft skills, have incorporated such skills into their training agenda.

Every year, the CHAOS chronicle reports on the failure rate of IT projects in the USA. Although there was an observed decline in the percentage of failed projects in the USA since 1994 as summarized by Sonnekus and Labuschagne, the same trend may not have been observed in other countries, especially those with a developing economy. Developed countries like the UK and USA are facing an advantageous situation with the use of well adapted methodologies, tools and techniques through rigorous research and development initiatives both from academia as well as from professional bodies like the Project Management Institute (PMI) and Office of Government Commerce (OGC). According to a survey carried out by Sonnekus and Labuschagne, the failure rate of IT projects in South Africa was found to be 22%, which can be observed to be comparable to that of the CHAOS chronicle released in 2000.

Following a survey carried out in 2003 in Mauritius, at least 50% of software projects that suffered due to deadline problem, budget overruns and quality problems were found to be 50%, 30% and 10% respectively. Table 1 gives the percentage of USA failed projects from 1994 to 2002.

**Table 1: USA Project Success Rate (Source: Sukhoo, et al., [20])**

Year	Percentage of failed projects
CHAOS-1994	31%
CHAOS-1996	40%
CHAOS-1998	28%
CHAOS-2000	23%
CHAOS-2002	15%

In contrast, traditional engineering projects generally achieve much higher success rates. This is due to exploitation of inherent strengths and prudent management of weaknesses associated with engineering projects that are different from those of software projects. The strengths and, in particular the weaknesses associated with engineering projects have been addressed better due to the fact that these projects were managed for many decades and are also better understood. Management of software projects in particular has been carried out for far less than what is the case with traditional projects. In addition to hard skills required, it has been observed that a good mix with soft skills is required for IT organizations. When popular project management methodologies like the Project Management Body of Knowledge (PMBOK) and Projects in Controlled Environment (PRINCE2) are analyzed closely, one finds that not much emphasis is laid on soft skills.

Furthermore, a survey of soft skills required in IT organizations was carried out at the University of Arkansas and the results obtained showed highly desired skills to be problem solving process, listening skills, teamwork, adaptability to new technology and new languages, transferring knowledge to application, time management, visualization and conceptualization skills and verbal communication. Desired skills included the ability to multi-task, dealing with business culture, inter-team communication, interpersonal skills, constructive criticism, organization skills, stress management and general writing skills. According to the survey, less desired skills comprise leadership, technical writing, dealing with diversification (different cultures) and presentation skills.

However, Moreira claims that success in the management of software projects does not rely entirely on hard skills. A combination of hard skills and soft skills may effectively and efficiently steer projects towards success. This is confirmed by the fact that the best jobs are often offered to seasoned professionals who have a good combination of technical

knowledge, general business skills and communication skills. Given that software projects have inherent complexity and invisibility features (Hughes and Cotterell, 2002) that may hamper progress during development stages, it becomes necessary to articulate hard skills together with soft skills.

### **3. Research Methodology**

#### **3.1 Random sampling**

According to Soriyan and Heek, there are more than 100 active firms, in the city of bangalore. Eight software Companies in Bangalore were picked at random to represent a sample of the software industry in Bangalore based on their experience in the industry. They are all private companies which are multinationals having joint venture with foreign companies. Six of the firms claimed that they have been in the business of software development for more than ten years while the rest two were about five years old in the business.

The software firms specializes in the integration of information technology into business processes through the design and installation of mission critical information systems in key sector of Indian economy like financial, information technology and other business sectors.

Some of the services provided by the Organizations are Installation, Software development, Training, IT consulting, Bureau Services, Accounting System Automation, Maintenance and Support and so on.

#### **3.2 Data Collection**

##### **3.2.1 Interview technique**

Interview technique was adopted as a reliable data collection tool for eliciting some useful and detailed information from the staffers of the companies especially the Software Project Managers. The interview questions were structured to enable the researcher gathers as much relevant information as possible from the Project Managers and Group Project Coordinators of some of the software companies visited in Bangalore. The structured interview schedules were strictly followed except for some questions that arose at intervals. The replies to these questions were carefully noted. Some general views but relevant about software industry featured in the discussion.

##### **3.2.2 Fact-finding and observation**

This inductive process of careful observation was done by working with the software organizations. Various teams employed in the organization were worked with because what one see for oneself is the best source of information. The appointments with the software companies visited vary depending on their schedules. The reasons for this choice of method are to evaluate the efficiency of current software project management in software companies and for verification.

#### **3.3 Variable used for evaluation**

Table 2 shows the variables used for evaluation. The key software project areas were chosen to be able to draw observation and have a picture of the large software industry.

**Table 2 Variables used for evaluation**

<b>Variables</b>	
<b>Key Project Areas</b>	
<b>Independent</b>	<b>Dependent</b>
Project Planning/Initiation	Scope, Development Stages Requirement Management
Project Estimation	Cost Effort, Project Duration
Project Scheduling	Team Members Tools, Software
Project Management Approaches / Methodologies	Models

### **3.4 Research Hypotheses**

The following hypotheses were tested within the span of the research study of software project management among the software companies:

- Ho1: There are no significant differences in the average time taken to complete a project among the software companies.

- Ho2: There are no significant differences in the software developmental stages practiced by software companies.
- Ho3: There are no significant differences in the project estimation techniques employed by the organizations.
- Ho4: There are no significant differences in the average number of people in a project team in the organizations.
- Ho5: There are no significant differences in the scheduling tools employed by the organizations.
- Ho6: There are no significant differences in the project methodologies practiced by software companies.

### 3.5 Statistical analysis

The data collected from each of the eight software companies were tabulated based on the key project areas and the variables. The data were analyzed for interpretation using simple percentages and Analysis of Variance (one-way ANOVA). The research hypotheses were tested at 0.05 level of significance to be able to draw conclusion on the research work.

## 4. Results

### 4.1 Software Planning/Initiation

Software Projects are rarely tackled as a single monolithic job. They are broken down using stages. Usually in Software Engineering, the stages are Requirement Analysis, System Design, Implementation, Testing and Delivery. Most of the organizations rely and practice in-house stages rather than Software Engineering standard. Some Software companies do not really have the understanding of these stages; some skip some of the stages while some have in-house stages to enhance effective Project Management.

**Table 3 Challenges encountered at each Development Stages**

Development Stages	Challenges Encountered
Survey	Scope
Requirement Analysis	Identifying the Requirement Clients changing the Requirement
System Design	Flexibility of tools

Implementation	Lack of Training
Testing	Ability to detect errors Lack of resources Training problem
Delivery	Heterogeneous problem: ability to use older software versions on new Operating System
Maintenance	Maintenance failure with change in Requirements

## 4.2 Project Estimation

The estimation of project in term of cost, effort and project duration to provide the environment the developers can work varies among the software companies. It was ascertained that many of the firms based their estimation on both scope and size, that is, software project costs were estimated based on product module, the work involved and the development days required to deliver the work.

Overestimation and underestimating these variables has affected the projects which has even made customers to cancel projects in the past. The customers had actually question the rationale but some of conflicts are resolved by persuading the customer to increase the budgets, giving out discount to encourage them to commit, and making the customer to see reason with comprehensive breakdown analysis of the cost and why the total cost as it stands.

Underestimation affects both the project deadline. The project either never ended or it took a long time to complete because the commitment and resource deployed are affected thus affecting the quality. Some projects that meet deadline are often of low quality. Besides, no profit will be made on the side of the Organizations.

### Estimation Method

Expert Judgment was highly used as an estimation method across the firms. Majority of the firms derived their estimate based on experience on past and similar projects which results in guessing. Some of them have history record on past projects thereby using them to derive their project estimates. This indicates a poor impression of software companies providing a good estimate. Expert judgment will not always work because two projects can never be the same even though they may look similar. There is always a lesson to learn from each project which may not be applied to similar project in the future.

## 4.3 Project Length/ Duration

The software companies handled various Software Projects and the duration of each project varied from time to time depending on the scope and user requirement elicitation. Majority of the firms complained that users do not know what they want until they see it and thus affecting project duration. Some stated that users know what they want but they

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can't communicate it effectively.

The firms were asked to give an average time for completing their five recent projects. The average duration of these projects was around six months but projects that were similar with past projects had durations around three months. Some took more than six months to about a year or more depending on the complexity of the projects.

### **Average length of project**

One of the major critical successes of a software project is for it to meet deadline. It is a project constraint which requires project to be completed before some given time instant which is usually used in connection with the project objectives.

Results from the study indicate a poor impression to rate project deadlines by the software companies. Majority of the projects did not meet deadline. 80% of the software projects were 20% ahead of deadline, 6.67% were 10% ahead of time and 13.33% met deadline but they had rigorous obstacles they overcome and were of poor quality. The various reasons given that warrant software projects not meeting deadline are delays in customer providing the requirement, lack of relevant personnel, team members not managing their time well, lack of proper understanding of requirement, users going out of defined scope and requirements being changed at interval.

Some of the Projects that met deadline had to undergo some critical exercises for them to succeed and be of good quality by defining a clearly timeline and monitoring it effectively, boosting the morale of developers, managing clients request against what is available, ensuring design is done prior to project development, engaging the customer to understand project imperatives, and defining the scope.

## **4.4 Project Scheduling**

Every project requires people to perform all the tasks involved in the project to be successful. The software companies were mostly medium-sized with a range of 20-100 staffers on the average. Not all the staffers are involved in project execution and those selected to be part of the team are chosen based on some criteria.

Some of the criteria chosen in selection of project teams' members are educational qualification, interest, experience in the industry, work ethics and styles, aptitude and technical. Majority of the software companies has a high percentage of choosing educational qualification as criteria which is an indication that educational qualification is not alone a sufficient threshold for entry into software project management practices. Many of the team members' lack management training and the industries tends to focus more on end user training than project team members training.

Team work/interpersonal relationship has a low range in the criteria chosen which has effect on projects. The degree of communication and ability of team members to communicate effectively can also affect the project.

The team member varies from one firm to another and on the average there are 3-5 people in a team depending on the size and scope of the project. If the project is of large size, more

personnel are always employed and sometimes, clients and project developer hired consultants to represent their interest in the project or to execute some part of the project.

90% of the team members are said to be committed to their assignment and the ratio of man hour to personnel on the average is 8 hours per day and 40 hours per week. There are rarely cases where there will be extra commitment no matter how tight the schedule may be. Conflicts are said to be inevitable among the team members and it affects project deadline and productivity especially if the disharmony is carried into the job and if left unchecked or unresolved on time. Some of the firms handled conflicts by having ground rules in place, discussion, reporting to senior management and negotiating with the team members. In carrying out any project, the time of completion is crucial to both the developer and the clients. The software companies employed many scheduling tools for effective planning.

#### **4.5 Project Methodologies**

Metrics are used to determine or compare the status of activities planned against the actual activities [19]. The various method used by some of the companies are numbers of line of code developed within delivery time, number of resolved errors, project duration measured against resources and deliverables, hours spent to date against planned hours, system evaluation and Rag report which is a tool commonly used to track project and gives a transparent overview of the project being undergone even though there are significant variance across the firms.

#### **4.6 Testing and evaluation**

ANOVA statistical test performed at 0.05 level of significance on the software companies with respect to their tasks showed that there were no significant differences between the average time taken to complete projects ( $p = 0.39$ ), in their project costs estimation techniques employed ( $p = 0.88$ ) and in the methodologies used (0.14). However, there were significant differences between the average number of people in a project team ( $p = 0.02$ ) and the scheduling tools employed by the software companies ( $p = 0.05$ ).

#### **4.7 Summary of Research Findings**

Further observations and results obtained in the study show that:

- Clients do not know what they want until they see it. They do not usually understand how to present their requirements in understandable manner for development. Majority of the organizations used interview, questionnaire and email as tools to elicit requirements which are not effective enough thereby leading to conflict between user expectations and software development teams.
- It was discovered that customers keep on expanding project scope once they see the initial deployment of prototypes or framework, thus affecting project deadline.

- Lack of adequate technical know-how and training. Effective performance is not all about team members putting in their best or someone failing to do the job correctly but bringing in people with adequate skills into the project. Since the software companies tend to focus more on end user training than project team training, it has led to inability to understand customer process before starting development.
- A large percentage of the firms do not always involve team members in project estimation. They just assign roles and responsibilities and if their estimation is not accurate, schedule will be inaccurate. Many of the team members do not appreciate the value of time and has affected projects not meeting deadlines.
- Expert judgment estimation technique is mostly used by the software companies, that is, they based their estimation on experienced guessing which will not always work because two projects cannot be the same no matter how similar they are. It has even affected some projects because some Project Managers complained that they sometimes forget some activities thus affecting project estimation.

## **5. Discussions**

Based on the findings on software project management among the software companies in Bangalore with comparison to other nations of the world, it is noted that project management in Bangalore city needs a lot of room for improvement. Although the sample size of the software companies visited cannot be assumed to be a representative of the software industry in general but it tries to gain insight into the problem area in the industry.

The findings revealed that majority of the projects was not delivered on time, within budgets and according to specifications, the same trend has been observed in other countries but UK and USA have experienced a decline in the percentage of failed projects.

The findings ranging from understanding of requirement, expansion of project scope, managing staffers, lack of technical know-how are critical challenges for project success. The reasons for this is that the software companies have not adopted the right methodologies, tools ,techniques and managing people as compared to other developed countries who make use of well adapted methodologies through rigorous research. According to the research made in the University of Arkansas, it was discovered that USA and UK too are facing much challenges in soft skills, that is, managing people.

## **6. Conclusion**

The findings such as scope expansion, lack of understanding requirements, and lack of training and so on if not well addresses could add more redundant complexity to the project, thus affecting the quality of software produced. If software project quality disappears then the project will be shoddy software that must be tested and retested. Team members need to be train and retrain because if they lack specific software project management knowledge and background experience, mistakes will be inevitable leading to project not meeting deadlines and project delay will always affect the business. Besides, it could lead to project deliverables not standing up to expected standard. The software companies can use better software project management strategy to overcome these failures through careful planning techniques. They

may also need to accommodate people skills and adopt right methodologies, tools and techniques at different phases of software project management life cycle.

The degree of the efficiency of the project management was based on the findings and the survey data. The recommendations made herein are that seminars and workshops should be held before commencement of project to provide temporary requirements to keep the project within schedule; project stakeholders should spend more time at project requirements and analysis stage and proper documentation of users' requirements should be signed off before project commences; staffers should be trained and retrained. Realistic target should be given when assigning responsibilities; and project should be monitored progressively and reported at interval because the sooner the job is known to be running late, the better.

We intend to continue the in-depth study of software project management in Bangalore with more software companies involved. In addition, Project characteristics that influence the implementation of project management technique are another area of our focus. This will help us to determine the significant and non significant activities in a project, in order to enhance project quality and to save time.

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