Chapter 7: Software Development
Chapter 7: Software Development

7. Software Development in the Companies in the Study

7.1 Introduction

The primary objective of software companies is software development and the inputs for this are people and technology, the process includes learning and development of software and the outcome is software products. There are three significant factors which contribute to the success of 'software development' and they are - time, effort and magnitude of software projects. Time is measured in terms of calendar days, effort in terms of man-days and magnitude in terms of functional points or Kilo Lines of Code (KLOC). For the purpose of the present study, the magnitude was measured in functional points only.

7.2 Software Development Process

The objective of the present section is to define how a full life cycle development project shall be extended. Each development project that is taken up by the Company may go through all the phases of the Software development Life Cycle (SDLC) which is detailed in this section, or may go through only certain phases of SDLC. For instance, a project may encompass only coding and unit testing phases based on the customer’s requirements. The phases that will be followed during the course of the project will have to be detailed in the Software Development Plan (SDP) for the project.
Phase 1 - User's Requirements

In this phase, the information about the user's software requirements shall be gathered and documented in the Quality Management System (QMS) standard format. Discussions shall be held to understand the user's software requirements. A decision has to be taken as whether the acceptance testing is done by the customer or by the Company. The software requirements shall be documented in Company's QMS standard format. The documentation shall use the terms familiar to the customer and encompass the entire functionality of the product as foreseen by the customer. Acceptance Test Plan (ATP) and Acceptance Test Cases (ATC) shall be formulated against the baseline version of User Requirement Document (URD), in case the Acceptance Testing is Company's responsibility.
Phase 2- Software Requirement Specifications (SRS)

In this phase, the User's requirements shall be converted to implementation specific statements. The user-interface shall also be detailed here. The screen dumps of input/output interfaces, menus etc. may be included where necessary. The user's software requirements shall be thoroughly understood to convert to Company specifications. The software requirements specifications shall be documented in Company's QMS standard format. The documentation shall use the implementation specific terms for the ease of understanding for the designers and developers. A traceability matrix shall be established to map the user's requirement may be fulfilled by one or more software requirement specifications. The SRS shall be on par with the base-line URD. System Test Plan (STP) shall be prepared to validate the functionality of the product. Corresponding System test Cases shall be documented with the base-line SRS as the reference.

Phase 3 High Level Design

In this phase, the major modules in the software shall be identified, and High Level Design Documents (HLD) shall be prepared for each of the modules. The interdependencies across the modules shall be documented. The high level design and detailed design phases may be combined into one integrated design phase, if required, based on customer requirements. In this case, the Integrated Design Document (IDD) shall be prepared, and the integration testing phase may be waived. This shall be document in SDP. The major modules shall be identified based on the functionality and design documents shall be prepared for each of the modules.
Phase 4 Detailed Design Document (DDD)

In this phase, each module shall be granulized to simple units, and design specifications shall be prepared for each unit. Unit Test Plan (UTP) and Unit Test Cases (UTC) shall be prepared for each of these Units. The granular units of the product shall be identified and design specifications shall be documented. Unit Test Plan and Unit Test Cases shall be formulated. The Detailed Design Documents are prepared in Company’s QMS standard format. Unit Test Plan and Unit Test Cases are documented against the base-lined input documents.

Phase 5 Coding and Unit Testing

In this phase, coding shall be done following the Programming standards. The coding shall be carried out at each DDD level, code review shall be done and the code shall be unit tested. The programming standards to be used shall be identified. GUI standards, if applicable, shall be indicated. Programmers, Code Reviewers and Unit Testing team shall be aware of the relevant DDDs. Unit Test Plan and Unit Test Cases shall be in place.

Phase 6 - Integration Testing

In this phase, the product shall be tested module-wise and the interdependencies among the modules shall be validated. The ITPs and ITRs that are drafted at the High Level Design phase shall be reviewed and approved before this phase begins. The Integration Testing Reports (ITRs) shall be generated.

Phase 8 - Acceptance Testing

The final product shall be validated against the user requirements, acceptance criteria and acceptance data.
7.3 Technology Used

Software companies in the study used different combinations of tools & technologies for developing software. Broadly these tools & technologies can be classified as follows — Microsoft, Sun, Oracle, Rational, IBM and others. For example the broad group Microsoft indicates that the operating system is windows based, the application development tool is visual studio, web server is IIS, database is MS SQL Server and tools & technologies packages under the brand name of Microsoft. Similarly other broad technology groups indicate the usage of tools & packages under that brand name. Most commonly these tools & packages are used in combination. Primarily these groupings are representation of broad usage of tools & packages under three priorities. In the first priority 16 (50%) companies were using Microsoft platform followed by nine (28.13%) companies using Sun platform, five (15.63%) companies were using Oracle platform and two (6.25%) companies were using other technologies at the time of the study. In the second priority 13 (40.63%) companies were using Oracle platform, 11 (34.37%) companies were using Sun platform, four (12.5%) were using Microsoft platform, three (9.37%) companies were using other technologies and one (3.13%) company was using Rational platform. In the third priority 11 (34.37%) companies were using Oracle platform followed by 10 (31.25%) companies using Sun platform, eight (25%) companies were using Microsoft platform, two (6.25%) companies were using other technologies and one (3.13%) company was using IBM platform. (see Chart 7.1)
7.4 Nature of Technology Development

Technology development may be classified on the basis of two criteria — (a) the content of technology and (b) quantity of change. The second relates to gradualist quantitative or a radical qualitative. Gradual - qualitative development takes place in a phased manner over time, whereas radical — quantitative indicates a qualitative shift from one kind of technology to another. If the technology development area is at systems level it is called "fundamental development" and if the nature of technology that has been developed is used for general business applications it is called "application development". If the technologies are developed over a period of time in phased manner with some additions and improvements in every phase of development it is called "incremental development" and if the same is done at a time it is called "radical development". Based upon the above two classifications the nature of technology that has been developed can be divided into four groups as shown in the following table.
Table 7.1: Technology Development Areas

<table>
<thead>
<tr>
<th></th>
<th>Application</th>
<th>Fundamental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental</td>
<td>Application Incremental</td>
<td>Fundamental Incremental</td>
</tr>
<tr>
<td>Radical</td>
<td>Application Radical</td>
<td>Fundamental Radical</td>
</tr>
</tbody>
</table>

The majority of 27 companies (84.37%) were involved in developing software in the area of application - incremental as the top priority activity, four (12.5%) in the fundamental - incremental area and one (3.13%) in the application - radical area. In the second priority there were 23 (71.88%) companies in the application - incremental area, eight (25%) in the application — radical area and one (3.13%) in the fundamental — incremental group. In the third priority there were 12 (37.5%) companies in the application — incremental area followed by 11 (34.37%) in the application - radical area, eight (25%) in the fundamental - incremental area and one (3.13%) in the fundamental — radical area. (see Chart No 7.2)

Chart No 7.2: Nature of Technology Development
7.5 Software Development Areas of the Companies in the Study

Every software company has core competencies in terms of specific software development area and takes up projects only in those areas. These core competencies go along with the brand name of the company and the customers evaluate the software companies based upon the factors like - number of similar projects executed and number of people with similar project experience. Software Areas are the technical segments in which the companies are offering technical services like: Enterprise-wide Solutions, Enterprise Resource Planning (ERP), Internet & Web base Solutions, E-commerce & E-business Solutions and Packaged Software Products. (This technical segmentation is followed by default by industry association like Nasscom & STPI) as industrial standard. (Nasscom, 2002)

The companies were asked to prioritise their technical service areas according to the above technical segments. Forty-seven percent of the companies have mentioned enterprise wide solutions as their first priority followed by 21.9% offering internet & web solutions, whereas the same internet & web solutions is expressed as second and third priorities by 34.4% and 37.5% of the companies respectively. Enterprise wide solutions were reported as second and third priorities by 25% and 12.5% of the companies respectively. Similarly, packaged software products was as first priority for 12.5% of the companies and as second and third priority for 18.8% and 12.5% of the companies. E-commerce and E-business solutions were the first priority in the case of 9.37% of the companies. (see Chart 7.3)
Chart 7.3: Software Development Areas of the Companies

7.6  Encouraging Areas in Software Development

Encouraging are those which contribute to the strength of software development process. When asked about the encouraging areas in technology development 22 (68.75%) companies mentioned global opportunities as the prime reason followed by five (15.63%) as partners requirement, four (12.5%) as employees technical expertise and one (3.13%) as technology itself as their first priority. In the second priority 14 (43.75%) companies mentioned partners requirement, nine (28.13%) as technology itself, three (9.37%) each as employees technical expertise, faster learning curve and global opportunities as the encouraging areas in the technology development. In the third priority 14 (43.75%) companies mentioned technology itself as the prime area followed by nine (28.13%) as employees technical expertise, eight (25%) as faster learning curve and one (3.13%) as global opportunities. (see Chart No 7.4)
7.7 Constraints in Software Development

Constraints are those which hamper the process of software development. When asked about the constraints of software development 25 (78.13%) companies ranked employee turnover as the first constraint, followed by five (15.63%) who ranked constraints in coping with fast moving technology and two (6.25%) ranked lack of finance as their first constraint. In the second rank 16 (50%) companies mentioned fast moving technology, six (18.75%) as employee turnover, five (15.63%) as no opportunities, four (12.5%) as lack of finance and one (3.13%) as lack of human resources as the problem areas in technology development. In the third rank 15 (46.88%) companies mentioned lack of human resources, seven (21.88%) as lack of finance, six (18.75%) as no opportunities, two (6.25%) as fast moving technology and one (3.13%) each as employee turnover and other reasons. (see Chart No 7.5)
7.8 Software Development Projects - Size

The size of the software project is generally measured in terms of the number of functional points or number of kilo lines of code. For the purpose of the present study the number of functional points is taken as the measure of size of software project. The big companies had an average of 855.4 estimated functional points and 855.4 actual functional points delivered without any gap between the estimated and the actual functional points. However in case of medium size companies the average functional points estimated were 114.73 and they had actually delivered 137 functional points, thus over shooting the estimated functional points by 18.56% as compared to the actual functional points delivered. The small size companies tend to show a huge difference. The difference between the average estimated functional points (81.63) and the average actual functional points delivered (103.94) were 44.66%.
7.9 Technology Development - Effort

Similarly the average estimated effort for the big companies was 636 man-days and the actual average effort was 636.8 with a negligible difference of 0.34 per cent. However, the same for the medium size companies was 84.01 average estimated man-days and 93.82 average actual delivered man-days with a difference of 12.57 per cent. The small companies have a huge difference of 34.71 per cent between the average estimated man-days (27.5) and the average actual delivered man-days (33.34) at the time of study.

7.10 Technology Development — Time

The time or schedule difference between the average estimated time (13.7 months) and the average actual delivered time (13.75 months) for the big companies was 0.53 per cent. For the medium companies the average estimated time was 8.9 months and the average actual delivered time was 10.31 months with a difference of 11.1 per cent. For the small companies the difference between the average estimated time (8.45 months) and the average actual delivered time (10.35 months) was 31.55 percent.

7.11 Summary of Findings

The primary objective of the software companies is software development and the inputs for this are people and technology, the process includes learning and development of software and the outcome is the software product. There are three significant factors which decide the success of software development and they are time, effort and magnitude. Time
is measured in terms of calendar days, effort in terms of man-days and magnitude in terms of functional points.

Fifty per cent of the companies in the sample were working in the Microsoft based technologies (that is - the operating system is windows based, the application development tool is visual studio, web server is IIS, database is MS SQL Server) and one-third were using Java as the technology platform. Eighty-five per cent of the companies were involved in "application — incremental" method of software development. Forty-seven percent of the companies have mentioned enterprise wide solutions as their first priority followed by 21.9% offering internet & web solutions.

The big companies had an average of 855.4 estimated functional points and 855.4 actual functional points delivered without any gap between the estimated and the actual functional points. However in case of medium size companies the average functional points estimated were 114.73 and they had actually delivered 137 functional points, thus overshooting the estimated functional points by 18.56% as compared to the actual functional points delivered. The small size companies tend to show a huge difference. The difference between the average estimated functional points (81.63) and the average actual functional points delivered (103.94) were 44.66%.

Similarly the average estimated effort for the big companies was 636 man-days and the actual average effort was 636.8 with a negligible difference of 0.34 per cent. However, the same for the medium size companies was 84.01 average estimated man-days and 93.82 average actual delivered man-days with a difference of 12.57 per cent. The small companies
have a huge difference of 34.71 per cent between the average estimated man-days (27.5) and the average actual delivered man-days (33.34) at the time of study.

The schedule difference between the average estimated time (13.7 months) and the average actual delivered time (13.75 months) for the big companies was 0.53 per cent. For the medium companies the average estimated time was 8.9 months and the average actual delivered time was 10.31 months with a difference of 11.1 per cent. For the small companies the difference between the average estimated time (8.45 months) and the average actual delivered time (10.35 months) was 31.55 percent.