CHAPTER 5

Derivation of Integrated Model for performance improvement

5.1 Overview

5.2 Empirical Case Study

5.3 Inferences and results

5.4 Summary
5.1 Overview

Main aim of any software company is to look into every aspect for effective project management. Developing software systems is difficult process as software development projects are affected by a series of problems, such as poor project management, cost and schedule overruns and it is mainly due to under - motivated and incapable developers (Linberg KR, 1999). In order to improve their performance, organizations must focus on two interrelated components - people, process (Bate R., 1994). With the realization to focus on human component, a need to find a good methodology for analyzing the same became one of the top concerns. Recently, there is a growing interest in data mining area which can discovery knowledge, that is correct and of high benefit for management. This chapter introduces a model for high capability performance. This approach is based on the results obtained from data mining methods. It is an experimental and empirically driven model. The companies on following this model will be able to build a project team capability to achieve the desired software quality within the time and cost constraints. It is an integration of personnel capability and post training. The capability and training are co-supportive and work in conjunction to ensure project success.

Software Engineering has undergone a massive change in outlook due to challenges faced by practitioners. Quality deliverables within cost and time frame cannot be met despite focus on software development process. Companies are realizing that one of the major factors related to failure in software development is human aspects. Human aspect needs a deeper investigation. Right people for right job are identified as one crucial aspect for software success. Many practitioners have realized and stated that there is a need to focus on human aspect of software Engineering (Agarwal et al. 2006). It was thus important to look into technical aspects of human components involved in the project for identifying the right criteria for recruitment and selection. Also, it is necessary to see how to develop and retain the right talent pool. Data mining techniques have proved to be a very good technique for knowledge discovery. To validate the generated tree and rules, experiments were conducted using training data and later real test data collected from few companies working on similar projects. The model is used for predicting the
performance of project personnel in a new project thereafter. This will set things right considerably at the very start of the project.

The objective of this study was to propose an effective methodology to find skill factors which are needed in software industry through data mining techniques. It is important to find the right candidate who will show excellent performance and enhances the software process to build a successful system. This in turn increases the turnover rates of the company and provides a competitive edge over other similar companies existing in the industrial market.

Staff capability coupled with project training of the team members will prove to have multiple benefits. It brings cohesion between team members and also communication between members who are new to each other. This approach of integrating staff capability with developing the right talent will show highly positive impact on software development process (Belout, et al., 2004). This approach of identifying the right project personnel will take care of most of the human aspect of software engineering. This integrated model of capability and developing the capable people as mentioned in Fig 5.1 is derived through data mining methods that will ensure project success.

Figure 5.1: Capability Development Integrated Model (CDIM)
As indicated in Figure 5.1, the Capability Development Integrated Model (CDIM) takes into account the capable factors of project personnel and integrates it with company culture for development of those capable project personnel (Sangita et al. 2015c). The integration of the above two components will ensure project success in terms of quality and following the time and cost constraints.

5.2 Empirical Case Study

Several companies were visited for study on impact of human aspect on software development. Finally, five companies were taken for case study which covered human aspects differently. Based on the patterns revealed by data mining techniques, it was important to now see the impact of findings on the company growth. Companies are named as A, B, C, D and E to keep the confidentiality of the data.

- **Company A** - Company A is a CMMI level 5 company. It has seven levels of written tests and interview for recruiting project personnel. All tests and interview judge the skills of the person. These tests enable one to judge the intelligence of a person, though the academic scores may be low. They take people without economic, social and gender discrimination. The company has a very elaborate food court. It has an indoor games centre and gym too. It also provides a place to relax such as resting chambers for employee to work with complete relaxation. The pay provided to their employees is highest among all companies taken for this study. Employees are given other benefits like flexible timings and work from home to work without stress. Employees have rated the company as best place to work in terms of salary, culture, relations with senior management and facilities. Discussions are held between project members from time to time. The company is 15 year old and has more than 37000 employees. All projects are successful. Their products like search engines, mailing service, maps are very popular. It has overruled all products of company D which was in the market very popular before company A came into existence. Company A became very popular instantly due to ease of use of their products by people using World Wide Web. (Sangita et al. 2016).

- **Company B** - Company is at CMMI level 4 companies. This company takes project personnel only from government colleges of India or latent talent of company A and
similar companies. It has few experienced people and maximum fresher. It is 8 year old company. It had 600 employees in 2014 and it has recruited 400 employees more in 2015. The company gives most important to college tier. The company has a paid food court. It gives flexible timings to employees and stress free environment. The company has good pay scale. Employees have rated the company as satisfactory place to work in terms of pay, culture and growth opportunities. The website has become the best portal leaving behind other similar sites. The portal is user friendly and has become very popular from 2014. The company has brought innovations in its website time and again. It keeps adding much better features and their portal is very user friendly. The management said that employees from government colleges performed best due to the skills they had.

- **Company C** - It is a CMMI level 5 companies. It takes candidates from private as well as government colleges based on academic scores. They then give intensive training to the candidates before putting them on projects. Work environment is average. Pay is satisfactory. Employees are happy since they find job security due to good management policies. Though, the company is not seeing much growth in turnover, it is still able to sustain in the market. The management feels that they need to incorporate the research model for uplifting the growth of the company.

- **Company D** - It is a CMMI level 5 companies. The company is not recruiting young talent. It has experienced people from various government and private organization. The company has come out with several innovative products. However, Company A also works in the same domain and comes up with better versions. This company, namely company D is thus not making much profit. Many of their products are closed. It appears that though company has best of processes and environment, due to its human resource policies and other management policies, it is not able to sustain in the global market. Also the management was not ready for any change or innovations in their policies.

- **Company E** - This is a CMMI level 4 company. The company takes candidates from private and government institutions. It does not give training. However it has meetings of team members working on the same project. It has low pay scale. It has few projects which generally cross the time constraints. The company has low turnover rates. The company is not able to produce any innovative or new products of their own for last 2
years. The employees have rated the company as fair in terms of job satisfaction. Most of the employees of the company are average candidates when compared based on skills across other companies.

The comparative study of various companies validated the research findings. The observations regarding company policies and culture regarding human aspects clearly reflected in the popularity of their product and growth of the company. The empirical study clearly showed that human aspects are one of the important aspects for company growth. The company which neglected it was at the verge of closing.

The major inference which could be drawn based on results obtained in chapter 4 and empirical study done across 5 companies are described further.

5.3 Inferences from results

The results from data mining as depicted in chapter 4 were presented to project team leads and human resource managers. The attributes taken into consideration are analyzed and inferred as follows

All the results obtained from various classifiers were consistent in terms of results obtained and accuracy. Therefore the consolidated inferences from all the results are as follows.

- **Inference 1: Job satisfaction**
  
  Job satisfaction and company culture played a very important role for good performance. Companies which gave good pay and good working environment were able to uplift the performance of their employees who had average skill sets. It was also observed that employees preferred companies which had good food courts and other facilities even if pay was little less. It was also noted than in company D which offered less pay, employees were still having job satisfaction since the company did not have high talent and these candidates were happy with job security and stress free work environment. It was observed that highly skilled individuals showed dissatisfaction with low pay whereas average skilled people showed satisfaction with low pay.

- **Inference 2: Reasoning Skills and Programming skills**
It was seen that employees with good skills performed very well. According to the managers such candidates played key roles in innovations and enhancing the product. Company A selected the candidates through talent matrix defined by experts. Company A involves project members, top management along with human resource department during selection. Therefore, Company A is able to produce innovative and quality software and has the best turnover from when it was initiated.

- Inference 3: Domain skills and experience
  Domain skills and experience were important factors, however it was ranked after other skills like reasoning skills and programming skills by data mining methods. An experienced person will definitely have the domain expertise. These parameters were needed to a certain extent. However, in software industry and especially in web based domain, domain skills came after reasoning and programming. It was surprising for the management to see that employees without much experience to performed well. Company A and B which took capable candidates direct after they completed their degree could get quality work done by them.

- Inference 4: College Tier
  College tier also appeared to be a important attribute as derived from research findings. Also while doing empirical study for validating results it was observed that employees who graduated from government colleges of India exhibited better performance in all the case studies. However, it was seen that candidates with good academic records in private colleges too performed well. Company B which follows the strategy of taking candidates from only government colleges is able to compete better. This was because these candidates are generally with better skills to be admitted in a government college and they undergo best industrial training and other workshops as part of their course work.

- Inference 5: Training
  Companies which gave training could uplift the performance of the employee. However, companies which did not select candidates on skill factors or from government colleges despite giving a lot of training could not come derive good performance as stated by the project manager. Also few of the managers reported that training such of the candidates turns out to be non profitable since they did not exhibit average performance too. Therefore, training appeared to be subjective to college tier and skills.
Therefore the major inferences could be drawn based on research finding and later by validating it on empirical study done on 5 companies.

This research has thus used data mining techniques to find the significant information related to human aspect of software engineering in order to develop qualitative software products from their project personnel. This approach of data mining i.e. classification has revealed the patterns regarding employee selection which was earlier based on assumptions and intuitions. Without job satisfaction the performance of project personnel goes down despite of having skilled competency. Therefore, management of organizations should adopt practices in work place for providing job satisfaction to their employees. Though, pay was an important criterion for job satisfaction but a stress free environment and encouragement by project manager and management policies enhanced job satisfaction. The company should recruit candidates with a specific skill set and provide a good work culture for their development. Further, candidates from government institutions performed well and there was a strong correlation between college tier and skills. Hardly there was any candidate from Government College with poor programming or reasoning skills.

Training candidates with skill sets and job satisfaction was fruitful. Training could uplift the performance in these cases. Training provides domain expertise to skilled candidates. However, data collected from companies which are into development of web based applications did not show much importance to experience and academic scores. The main cause of performance lapse is lack of skills and lack of job satisfaction.

The database and personnel information of the software industry of Bangalore was studied and analyzed as a case study to identify the factors that effect in job performance. Appropriate and computational methods i.e. data mining methods which is also a low cost technique, provided valuable information to the organisation.
5.4 Summary

Traditionally more effort has been devoted to technical and process aspects of software quality and productivity. However, software development is an activity which is so intensive in workforce and so dependent on professionals' performance, it is strange that human factors affecting development has not got due attention. This study therefore aimed at analyzing contributions in this area as well as providing empirical data from specific domain of software industry to get a real picture of the situation in software organizations.

Software companies are realizing the need to shift focus on human aspect since it relies on human mind to produce innovative system for having competitive edge over other companies. The root factor in human aspect is allocation of right project personnel. Different companies follow different strategies for having a good talent pool. Data mining approach has precisely brought out the factors which are needed in project personnel and companies to enhance the quality of software developed. With the help of these algorithms, companies can have a parametric performance analysis. It is utmost important for such companies to understand performance gaps, deploy a framework for root cause analysis for these performance gaps and adopt strategies to fill these needs. This study will assist software companies in future for hiring and developing the right project personnel for better turnover.

Future work of this study can be investigating other domains of software industry apart from web based applications. Also apart from decision trees other data mining techniques such as genetic algorithms, neural networks, clustering can be considered for comparison of techniques. This approach can be extended to other industries too for profitability and productivity analysis.