

A Case Study of Industry- Institute Collaboration Project: Improving Software Engineering Learning Process

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Abstract

The present paper discusses a case study of industry-institute collaboration project for fulfilling curriculum on project-based learning of university students. The case study is conducted with objective to expose students with latest technologies; identify the practices to bridge the gap between institute and industry and implement industry interaction project. The project was developed in closed feedback loop to improve the quality. The involvement of students was from analysis phase to testing phase of the project. The benefits of the project-based learning were, students got adequate knowledge of latest technologies used in software industry; experienced the importance of team-work; industry interaction of faculty has been increased. Although, the project delivered is not as per the expectation of project leader but many lessons are learned by conducting case study. Paper further highlights the hurdles faced during project development phases and suggest the remedies to avoid the hurdles. Thus, the presented case study is part of project-based learning and essentially improves software engineering learning process.

Keyword: Distributed Learning, Industry Collaboration, Major Project, Project-based Learning, Software Engineering

Introduction

Success of teaching software development does not depend only on teaching software engineering or some

programming language, but also depends on exposure to real time development. It has been observed that every year number of computer graduates produced is less than the requirement of industry still only 30% graduates are getting qualified jobs (www.manpowergroup.us). Manpower survey studies stated that most of graduates remained unemployed due to not fulfilling industry requirements (www.sciencebusiness.net). One step towards generating graduate as per industry need is to increase the project-based learning by conducting industry-institute interaction.

Industry institute interaction can be in the form of expert talks, joint software development or visit to industry etc. (Neill *et al.*, 2012). Software development with combination of students, faculties and industry personnel is a great learning for student to understand industry environment, project management and emerging technologies. Industry-institute collaboration also plays a vital role in learning various phases of software engineering and generates the interest of students in the subject. It is also seen that several multinational companies do not entertain fresh passed out graduates, other than the campus recruited as they require hands-on training and cultural shift from university environment to corporate environment. Therefore, we at Acropolis Institute of Technology and Research, (AITR) Indore, India, developed a mobile-cum-tablet application in association with a software development multinational company.

Faculty of computer application at AITR is running full time Master of Computer Applications (MCA) course

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since 2006. MCA course of AITR is approved by All India Council for Technical Education (AICTE), the statutory body of the Govt. of India and affiliated to Rajiv Gandhi Technical University (RGTU), Bhopal, Madhya Pradesh (M.P.) India. Three years MCA course scheme has mandatory 4.5 months of organizational training (project-based learning) as a major project (Subject Code: MCA601), February to May, in the final semester. We selected this duration for our case study to develop an android tablet application with virtual communication with one member as a project leader from the Hyderabad based MNC organization.

The case study was conducted in Feb-May 2013 with an academic objective of providing hands on experience to students and to expose them to real time project. This was an innovative approach that included remote classroom teaching using modern teaching-learning methodologies. Along with exposure to students of real-time development, with following set of objectives:

- A. Exposure to latest technologies to the students.
- B. What practices should be followed to bridge the gap between industry and institute?
- C. To identify major hurdles and their solutions, to avoid these obstacles in future to improve the quality of IIC projects i.e. lesson learned from the entire activity.

The second section discusses the case study set-up and project description whereas the third section highlights complete development stages and practices followed during the case study period. Next section discusses the analysis and result of the study and finally, we conclude with future direction in said area in the last section.

Case Study Setup

This section is divided in two sub-sections viz. Student Selection and Project Overview.

Student Selection

Project leader from software industry took an organized approach to project development by first advertising for the entire project-development by conducting audio-video presentation an interaction between the students and company person was conducted on 10Feb 2013.

Project manager has given over-view of project and prerequisite requirements to the faculty and students. After presentation, a written examination was conducted for selection of right students for the project. Total 54 students appeared in examination. Examination paper consist of logical and fundamentals of C, Java and C++. Only 28 students were shortlisted for project. We, at AITR, started the project along with a faculty coordinator, acting as a main mediator (Mr. Jayant Bihare) and the company personnel in the project manager role. We also appointed a local institute trainer for solving technological issues of the students.

About Project

The project was to develop a social network on Android Apps. This required four modules of parallel development, namely

GUI Design: Social networking site requires very attractive user interface with user friendly and simple approach. It also requires multiple forms designing for homepage, chatting, uploading picture, maintaining status, alerts etc. Therefore, high efforts were required to keep module design simple yet attractive and informative. GUI design of mobile application was developed in CSS, HTML 5 and j Query. Primarily 3 forms and 4 utilities were designed for the required application:

Form 1: Social Networking Membership Registration form.

Form2: Social Networking Login page.

Form3: Social Networking Homepage- the main page.
Utility1: Left Navigation on the main page; links Like books, members etc.

Utility2: Icons for nodes on the main page at bottom area; for writing and saving comments by members of the application. Also used for text chat and

Utility3: Social Networking Logo.

Client Side Development: Programming at the local machine, i.e. Android app. and development is being achieved by J Query, Android, Node .Js and Backbone .js using Phone Gap. All these technologies were pretty new for the students and major part, thus this module was tough as per student perspective.

Server Side Development: Since the social networking was an online project, server-side programming played a very crucial role in the successful execution of the entire project. Technology for server side programming was PHP and MySQL. HTML was also used for saving data, which was one of the utilities in the main page of the application.

Testing: QUnit.js was planned to use for testing the entire application. This module unfortunately could not flow with the initial stage itself as it was an entire new realm for the students, who never had any exposure to real-life testing of heavy software. Thus, skill set of our students is low and rigorous training is required to get acquainted with technologies required for project development.

Study Stages

Since the team is distributed i.e. development team at institute and team leader is working from industry located at Hyderabad, we decided to follow traditional development approach and scrum management practices to get the better quality. In our project, all team members are inexperienced except mentor and project leader. Therefore, we decided to follow hierarchical team structure as shown in Fig.1. Some of the scrum management practices such as team velocity, daily stand-up meetings, face-to-face communication etc. are followed for tracking and monitoring the project progress. We have categorized project study phases in following subsections:

Training Phase

The project needed latest technologies for its development like- Phone gap using Android, CSS, HTML 5, JavaScript, jQuery, various testing tools and designing tools. Since the level of command needed in these tools was quite high and therefore to understand the technology, we organized 22 training sessions (minimum 1.5 hours each) from the company personnel via Skype- audio-video Skype calls, Start meeting and Web Accessions. Appropriate assignments were given to the students to develop themselves based on their conference-call teachings by the company personnel. The mini-projects that the students prepared as their assignments, based on the Skype conference classroom sessions, were evaluated by the company personnel himself. Industry provided training on technology required for the project as shown

in Table 1. Assignment inform of mini project increased the confidence level of both students and industry people. Evaluation process further eliminated six students from project due to their poor performance. Therefore, development team consists of 22 students along with one faculty coordinator and a project leader from MNC.

Figure 1: Team Hierarchy

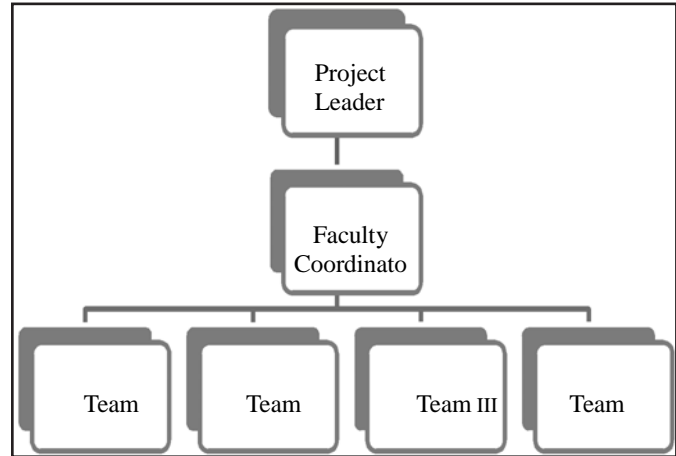


Table 1: Training Schedule

S. No	Technologies	Duration(days)
1	Java Script and J Query with trouble shooting session	15
2	Phone Gap Training	7
3	Android Introduction	3
4	CSSHTML5	2
5	Q unit Testing Mango DB	1
6	Assignment on Mobile app	5

Table 2: Team and Modules

Team	Team size	Module
I	4	GUI design
II	6	Programming at Client M/C
III	6	Server side programming-giving connectors
IV	4	Testing
	2 in rotation	coordinating all modules and management

Development Phase

After technical sessions, development modules were assigned to each team and a team of two students was

monitoring the project progress and also assisting the other teams as shown in Table 2. Multiple designs were made for the main page and mostly all were rejected! As the best designs of the GUI student team was the poorest for the project lead of the MNC! After several of such to and fro designs finally one, which happened to be overall one-piece in look and feel, as per the expectations of the project lead was selected. Similarly server side-programming went tough for the students, though they tried their best. The overall purpose of this module was to provide connectors from the web for our Social Networking application to work successfully by constant flow of data.

Project Management

Project manager divided the project in small stories and their efforts and time estimated based on various attributes such as complexity, size, team-compatibility as per generalized agile estimation method (Thomas, 2000). Scrum management practices such as daily stand-up meeting with project manager to get new assignment, resolve the problems incurred in tasks and technical solutions. Teams followed the instructions as per the industry project manager and delivered the modules in continuous feedback loop to improve the quality and access progress. Although, team worked hard to meet the deadline but they could not submit the complete project by their exam dates. Table 3 shows the scheduled project timeline v/s actual time taken to develop the project. However, it was a learning to all the team and staff members and students. It has been observed that activities were delayed due to unavoidable activities such as institute's cultural program (tech-fest), college-level seminars of various types, dependency on one industry trainer and unexpected holidays. At the end, the project could not reach to implementation level and was counted as a failure one.

Table 3: Schedule vs. Actual Time of Case Study Project

Task	Schedule	Actual
Training	14Feb-22March	14Feb-7April
Design	10March-20March	7 April-25April
Coding-Testing	31March-20May	26April-22May
Documentation	20May-24May	22May-25May

Analysis and Result

Students along with faculty learned a good lesson by project-based learning method in terms of industry institute project. Developing commercial software involving students was a big challenge as such software development has time and quality constraints. Students were developing the project for partial fulfillment of their MCAVI semester degree with an objective of getting good grades in exams. In such a situation, mediator faced real challenge of coordinating among the students and project leader from MNC. We had following observations:

In the entire exercise, qualification, communication skills, learning ability of team members are treated were same in all teams still we have observed that Team II and Team III had completed higher numbers of tasks as compared to Team I and Team IV.

We also observed team coordination during the case study. Team coordination is assessed on the basis of frequency of communication, work delegation and its completion. It has been noticed from Table 4 that Team II and Team III had better coordination. In case of defects or any technical issue, they immediately contacted the faculty and local trainer. Minor problems and issues were resolved at same time thereby increasing team efficiency whereas

Table 4: Team Velocity, Coordination and Skill Set

Team	Number of Task Allotted	Number of task Completed	Velocity	Team members co-ordination	Team Skill set
I	45	25	0.55	Satisfactory –50%	Average
II	45	35	0.77	Good – 75%	Good
III	45	36	0.8	Good – 75%	Good
IV	45	10	0.22	Poor25%	Poor
		2inrotation, coordinating all modules and management			

unresolved problems were immediately communicated to project leader telephonically or using video conferencing. Thus, Team II and Team III had less defect delays as compared to other teams thereby increasing the team velocity. Here, the team velocity is defined as in equation (I).

Team velocity = number of task completed / number of task assigned - (I)

In our study, we found that higher communication reduces the development time. The mode of communication face-to-face is effective to resolve the problems in shorter time as compared to email and documents. Team II and III could perform better due to their higher communication.

Nevertheless, this entire exercise would be helpful for future collaboration for projects between industry and institute. We have conducted project-based learning with some objectives mentioned in Introduction section. These are: Explore latest technologies to students.

Students explored the new technologies such as Phone Gap, J Query, Backbone, CSS etc. which are highly required by industry. Training on these new technologies certainly increased the employability of students. Students trained on these technologies are immediately absorbed by small and middle scale enterprises.

Students learned software engineering concepts in a practical way and understood the importance of software development model, estimation, project management practices etc. Participants learned project management techniques of agile software development which are highly recommended for rapid software development as well as achieving the higher customer satisfaction. Working in closed feedback loops in the form of standup meetings increased the self-discipline, team coordination and ownership of project by students to certain extent.

Thus, we have achieved our first objectives inform of increased employ ability of students in small and medium scale organizations and giving there al time environment to our students.

What practices should be followed to bridge the gap between industry and institute?

Institute had first experience of working with such collaboration and identified the gaps in technology. These gap are mainly; cultural shift in environment, lack of

exposure to new technology, lack of hands on practice over project etc. The identification of such gaps leads to initiative of new courses parallel to degree course and bridges the gap between institute and industry. Therefore, institute had taken initiative and started technical skill development cell for the same gap by providing knowledge on technology required by industry. Also, institute-industry collaboration project provided the vision to faculty members to make their students employable.

Our second objective still required along way to achieve as inception of technical skill development cell generated interest among the students about international certifications and to learn the emerging technologies.

However, developed project was not up to the industry standards and industry closed the project but we at institute learned various lessons from these efforts.

To identify major Hurdles and their solutions.

To avoid such obstacles in future, thereby to improve the quality of IIC projects the lesson learned from the entire activity were as follows-

Hurdle 1: Hierarchical team: As the team is in experienced, we have followed hierarchical team approach in which team dependency was on one project leader from MNC, therefore in his absence the entire project schedule got disturbed. As per agile development practices, each team member is involved in all activities and absence of any team member does not hamper the project progress. But since we followed hierarchy team structure in our project development, where in mostly the project leader was aware of the entire project modules, this hurdle was being faced.

Dependency on single person must be avoided, moreover when compared with industry personnel, students are not self-starters. Thus, just one person being leader and knower of the entire project hampers the project speed and quality. On the contrary a self-organized team structure can also be not followed in industry-institute project, due to the fact that students are not professionals thus cannot be self-organized.

Solution: A hybrid of hierarchy and self-organized approach, with a team of at least 3 members from industry is required to handle the project.

Hurdle 2: Lack of Self-commitment: Industry project allotted to the final year students who were mostly involved in campus recruitment process thereby delaying the project. This reflects the lack of self-commitment on part of students.

Solution: IIC project must be allotted to the students who are either going for higher studies or already placed to avoid the delays in project. Students must be motivated by providing stipend and job assurance on the basis of their performance during the project.

Hurdle 3: Distributed Team: The absence of a local full-time dedicated experienced team member also increased the entire complexity. Agile development process proposes 8 hours daily working for five days in a week for experienced team members. However, in IIC project, ratio of experienced team members versus fresher is low. Therefore, faculty should be competent enough and always be available to resolve issues and play role of domain and technical expert on development site. But this could not be met as the faculty coordinator has other teaching assignments etc.

Solution: Two fully dedicated local faculty members are required for project management and monitoring the project progress otherwise the project gets severely dampened.

Hurdle 4: Team Competency: Training on higher technology consumed most the time of project cycle.

Solution: IIC projects require higher proficiency on technology that was not covered in university syllabus.

Therefore, the students must be technically ready before project development cycle. Training should be completed in the semester prior to such IIC project development one, so that students are ready for such live project.

Hurdle 5: Insufficient Network Support: Dedicated Internet and full-time working computer lab is required for IIC project otherwise a major challenge is being faced; which happened in our case. Also, the lab-computer's configuration must be supportive to the heavy software that are used by MNC in their software development process. This caused a major hurdle in our IIC project especially while selecting for a back-end tool, due to insufficient compatibility with the RAM configuration we had to change the technology.

Solution: Industry must provide hardware and software configuration required for the project to avoid hurdles and delay. A dedicated lab for project must be provided to students.

Hurdle 6: No Formal Agreement: The MNC itself was exploring IIC project for the first time, therefore everything was hazy. It was mutual understanding of company personnel and AITR. It was an experiment conducted without any formal agreement. The working days for students were less compared to their efficiency over the IIC project. There was weak evaluation of expected working day plan in the beginning and unfortunately it became late or actually impossible to change in the interim period. Therefore a miss-match of time factor needs to be carefully dealt within such IIC project approach. Common official holidays of the Institute etc. made the work irregular. Therefore a big gap later turned out from actual planned progress.

Solution: Formal agreement of estimation of time along with expectations will resolve the issue. Although, there must flexibility to accommodate changes and change the requirements. At the same time, mutual understanding on working days in institute and industry in advance would be helpful in reducing project lifecycle.

Although, the biggest flaw in this entire approach was the big gap between the functioning level of university students and MNC professionals. However, our IIC project could not be completed as per the expectation of project leader but students and faculty of FCA department learned a lot about project management, new technologies, team commitment etc. University students failed to meet industry expectations due to technological gap and major time of project development lifecycle was spent on training.

Conclusion and Future Scope

Though a big start but a sad ending! Such a big opportunity is next to impossible for any institute other than IITs or NIITs in India. The IIC project did not succeed in delivering a quality project, but efforts were surely proven success. It served as an effective way of teaching software engineering processes to students by project-based learning. The biggest flaw in this entire approach was the big gap between the functioning level of institute and industry. The learnings that the students gained were

highly appreciated by every single participant, but they could not practically handle it.

The highest level of education at University level was even less than the beginning level working at corporate, especially with the mobile-cum-tab social networking software development which was planned for. Nevertheless, it is beginning of a new story and taught us a new lesson for developing our students as per industry needs so that they can immediately work in industry environment. AITR inaugurated technical skill development cell for its students to copeup with technology required by industry thereby commit to bridge the gap between institute and industry by conducting various workshop and interaction to start collaboration project with successful ending.

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