

From Student to Software Engineer in the Indian IT Industry: A Survey of Training

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Abstract

The benefits of Global Software Development are now well known and India currently has the lion's share in outsourced offshore software development. As a result, the demand for skilled IT professionals is increasing in India. In order to meet the demand, new academic institutes are being established and the existing ones are increasing their intake in IT-related courses. However, according to the latest report of the National Association of Software and Service Companies (NASSCOM) in India, only 25% of the fresh graduates are considered readily employable by the IT industry. To undertake their jobs effectively, most of the companies provide training to fresh recruits before putting them on actual jobs. In order to understand the nature of the training that is conducted, the topics that are covered, and the adequacy of the preparatory education for the first job in the IT industry, two surveys were administered. One was conducted with human resource managers of some of the leading IT companies in India and another was conducted with fresh company recruits. The findings are reported in this paper and recommendations for the curriculum are proposed.

1. Introduction

Many papers have been published that highlight the potential benefits and inherent challenges of IT offshore outsourcing [1,3]. Whatever the perspective, IT offshore outsourcing has become a standard and common practice in the software industry. According to IT industry reports, India currently has the lion's share in outsourced offshore development [10]. Reducing cost is no longer the main reason for the leadership position of India; India has gained experience and is now able to deliver quality products at these reduced costs.

IT offshore outsourcing has impacted the Indian economy and society directly and indirectly, from economic growth, technical and non-technical employment generation, regional development, first-generation entrepreneurship, to changes in social and cultural values. IT education became a center of attention for India with an annual increase in the demand for skilled IT professionals of more than 13% between 1998 and 2008, an increase that is likely to be sustained and even grow until 2016 [8]. A number of new educational institutions emerged, from central and state governments, private initiatives or joint public-private partnerships. The number of the prestigious Indian Institutes of Technology (IIT) increased from seven to twelve under such government initiatives. Eight Indian Institutes of Information Technology (IIIT) were established as public-private partnership institutions to provide graduate and Ph.D. education. Privately owned institutions also flourished, impacting the traditional free education culture in India. In 2008, the University Grant Commission (UGC, <http://www.ugc.ac.in>), an apex body of Government of India for granting funds and maintenance of standards of university education, counted 1645 engineering institutions in India and 400,000 technical graduates. Currently, 88% of the IT students graduate from private institutions and 12% from other institutions. Note that all new technical institutions need to be approved by the All India Council for Technical Education (AICTE,

<http://aicte.ernet.in>) and accredited by the National Board of Accreditation (NBA, <http://www.nba-aicte.ernet.in>).

Despite these initiatives, the Indian IT industry is still struggling with the availability and quality of talent and is projected to experience a shortfall of five hundred thousand employees by 2010 [9]. Companies consider that IT graduates are not readily employable by the industry. Only one student out of four is considered “employable” [2,8]. As part of the reason, the National Association of Software and Service Companies (NASSCOM) report highlights a curriculum that has not evolved significantly in the last two decades, one that is still based on examination rather than practical work and which does not teach soft skills (e.g., communication, negotiation and project management) [8].

To respond to these issues pro-actively, companies began to invest in in-house training and, at a larger scale, promoted relations between industry, academia and government. Some of the initiatives target the complete Indian educational system – from elementary schools to higher education. For example, Wipro’s “Applying Thought in School” program is an approach that allies philosophy, strategy and action to change the overall educational system holistically. Approximately 3% of the revenue of the overall Indian IT industry was invested in training in 2008-2009. The top five software companies Infosys, Wipro, TCS, HCL Technologies and Satyam invested \$430 million dollars in 2008 to train more than one hundred thousands engineers with a focus on the training of entry-level hires [8]. Such companies are engaged in collaboration with academia on curriculum development and course design, donating material, organizing events, conducting faculty training and sabbaticals, supplying experienced IT professionals as visiting faculty members, and providing on- and off-campus training and mentorship for students to leverage technical and soft skills. The Infosys “Campus Connect” program (<https://campusconnect.infosys.com/>) focuses on bridging the gap between the skills learned in engineering colleges and the needs of the industry. Wipro created its own training institute to train five thousand employees simultaneously. Its Mission10X program (<http://www.mission10x.com>) aims to train ten thousand faculty members by 2010, using active learning and e-learning components, providing them with certificates from Cambridge University, UK. Satyam launched a four-month program called Satyam “Entry-Level Engineering Development” (SEED) for entry-level engineers [6]. Satyam identified sixteen roles for entry-level software engineers, including developers, support and maintenance analysts, and quality-related roles, and identified the knowledge and skills necessary for these roles as the basis to develop training content [7]. Companies are also investing in skills upgrading by continuous training and scholarship to react to a quickly evolving field and support the career ambitions of their workforce. Attention is equally given to the improvement of the working environment to increase productivity and morale, and to decrease turnover. The most common practices include the presence of daycare, a cafeteria and gym inside the company walls, transportation, vacations, healthcare and internal competitions to win company stock options. The training landscape is also composed of IT training colleges such that the National Institute of Information Technology (NIIT, <http://www.niit.com>) offers short courses for corporate professionals and students following undergraduate/graduate studies in parallel. Microsoft and HCL shared the effort to create one hundred Centers of Excellence for training and certification in Microsoft technology for fifty thousand students [8].

The study reported in this paper focused on understanding the specificities of the gap between the types of graduates that universities are forming and the needs of the IT industry in India. It did this by looking at the perspectives of “freshers”, fresh recruits of the IT industry with between zero and three years of working experience, and human resource managers via preliminary interviews and surveys. The objective of the study was also to understand how IT companies are training their freshers and what technical, behavioral and IT offshore outsourcing training they provide. Behavioral training refers

to the acquisition of soft skills, while IT offshore outsourcing training refers to training that reduces the difficulties of dealing with distance, time and culture.

The paper is organized as follows. Section 2 outlines the research questions. Section 3 describes the methodology we used to explore the research questions. Section 4 presents the findings of the two surveys, for human resource managers and freshers respectively. Section 5 provides recommendations for academia and the IT industry and concludes the paper.

2. Research Questions

The research questions we investigated in this study were:

- What are the specificities of the gap between the types of graduates that Indian universities are forming and the needs of the IT industry in India?
- What is the nature and blend of the technical, behavioral and IT offshore outsourcing training that freshers undertake in IT companies in India when hired?
- What recommendations can be made to address the gap between the skills acquired during formal education and the needs of the IT industry in India?

3. Methodology

3.1. Preliminary Interviews

The methodology to carry out this study included visiting companies and interviewing human resources professionals and managers of IT companies in India to gather information about the challenges and prospects of hiring freshers and to discuss the companies' specific training practices. We visited twelve companies across India, in Bangalore, Delhi, Gurgaon, NOIDA, Pune, Hyderabad and Mumbai. The perspective of the freshers was also gathered during interviews by either meeting them at companies' headquarters or by conducting telephone interviews. They were questioned on the training they received as new hires, their integration in the company and their working environment. Based on this preliminary work, more detailed survey instruments were developed to explore the research questions presented in Section 2.

3.2. Survey Instruments

Two surveys were developed and administered in questionpro (<http://questionpro.com>) in February 2009 – one survey targeting human resources professionals and managers and one survey targeting freshers of IT companies in India. The dual nature of the surveys permitted us to compare the perspectives of the two groups at the center of the training scenario.

Human Resources Professionals / Managers' Survey. This survey was sent to 80 different companies and was completed by 32 companies. They send representatives to numerous recruitment events in Indian universities and colleges. The contact information of these companies was obtained through the alumni network of an Indian university. The survey comprised five sections. Section A collected background information such as the ownership status, number of employees and level of involvement with IT offshore outsourcing of the responding companies. Section B gathered data about the trends in recruitment (e.g., the evolution of the recruitment in terms of the number of submitted applications, gender, schools these companies are hiring from, and degrees held by freshers) and turnover (e.g., reason to join and leave the company, and average time in the company). Section C asked respondents to characterize the nature of the training of their freshers (e.g., rationale, type, model and duration) and to describe the topics

covered in technical, behavioral and IT offshore outsourcing-related training (if any), the respective emphasis of these topics and the duration of each training phase. Section D asked respondents to comment on how academia could better prepare its fresh graduates for the IT industry. The last section of the survey was for open comments.

Freshers' Survey. This survey questionnaire was sent to 82 freshers who graduated from different Indian universities. Approximately 10% of the recipients were alumni of the University of Delhi. The remaining recipients were contacts made at conferences, seminars and through visits to IT companies. The questionnaire was answered by 46 freshers. The survey comprised five sections. Section A collected the background information of the freshers, such as their educational background (e.g., degree, graduation date and school) and their software engineering education (e.g., software engineering courses, projects and topics emphasized). Section B gathered data about their company (e.g., ownership status and level of involvement in IT offshore outsourcing) and their working experience (e.g., job history, and choice and time at the company). Section C asked respondents to characterize the nature of the training they went through when hired (e.g., type, model and duration) and to describe the topics covered in technical, behavioral and IT offshore outsourcing-related training (if any), the emphasis of these topics and the duration of each training phase. Section D asked respondents to comment on how well academia prepared them for the IT industry. The last section of the survey was for open comments.

4. Findings

4.1. Human Resources Professionals / Managers' Survey

Participants and Companies. The respondents were human resources managers and directors, training managers and vice presidents with detailed knowledge of their companies. The companies were foreign multinational companies (46.88%), Indian companies (25%), Indian multinational companies (25%) and foreign companies (3.12%). For the purpose of this paper, companies were classified into three categories: small (< 1000 employees), medium (<10000 employees) and large (\geq 10000 employees). Out of all responses, 46.88% were from small companies, 15.62% from medium companies and 37.5% from large companies. Out of the total number of projects reported, 64.42% were offshore projects developed in India, 22.31% were also offshored projects but developed outside India, whereas local projects accounted only for 13.27%.

Trends in Recruitment. 86.95% of the respondents reported that the number of applications from freshers had increased significantly in the last three years. As a result, the number of interviews had also grown. In this context, 35% of the respondents mentioned that the number of new graduates hired over the last three years had stayed the same in their company, 15% stated that this number had reduced a little, 25% stated that it had increased dramatically and the other 25% reported that it had increased only a little, the increases being present mainly in the medium to large sized companies. The recruitment comprised more men (62.71%) than women. Freshers were mainly recruited from the universities and colleges recognized by UGC (75.86%) rather than from the technical and training institutes from the private sector. Freshers are typically assigned the title of software engineer (51.72%), system engineer (10.34%) or associate engineer (10.34%). The survey results showed that a B.Tech in Computer Engineering and IT (at the bachelor level) is the typical degree held by new hires, followed by the Master of Computer Applications (M.C.A.). Graduates with a M.Sc. (Master of Science in Computer Science) or a M.Tech in Computer

Engineering and IT are then equally hired by the companies. The survey data showed that freshers joining large companies are likely to stay longer in these companies than freshers joining medium and small companies. The reasons given by newly hired graduates to remain in their companies were the learning opportunities (65%), the interest of the job (15%) and the reputation of the company (15%). They leave for better salaries (40%), to rejoin their home states (20%), to work for more reputed companies or to pursue higher studies.

Training. The respondents reported that their companies are conducting training, the rationale being to polish the students' theoretical skills and to provide them with a practical baseline while also learning about company-specific practices and culture. Only 20% of the respondents ranked the lack of necessary skills as the primary reason for training. Training was conducted in a variety of ways, interactive learning with instructors and instructor-led lectures being the most common. Job shadowing, online courses, and graded individual and teamwork were also reported as being approaches that were used. The surveyed companies mentioned continuous mentoring and mandatory formal upfront training as the two main models they use to train their employees. The average training time is 12 weeks, and is conducted by either internal faculty or a mixture of internal and external faculty.

Technical Training. Most of the respondents listed the following topics in their company's training: software processes, programming languages, databases, testing and quality assurance, the use of specific tools, operating systems, and design and requirements. Programming languages was the topic with the most emphasis, followed by software processes, databases, testing and quality assurance, operating systems and requirements. Companies focus on Core Java, database programming, J2EE and Web programming (e.g., ASP, JavaScript, PHP). Languages such as Python and Ruby are not covered because they are not widely used. Eclipse is the IDE training covered by the highest number of companies, followed by JBuilder and Visual Studio. The companies offering this type of training are mainly medium and large companies. The average technical training time is 8 weeks, but some companies extend it to 16 weeks. In the preliminary interviews, human resources professionals and managers expressed their concerns about the lack of coverage of tools that are very commonly used in the industry in the curriculum of educational institutions (e.g., Eclipse and version control systems) and topics of software engineering (e.g., requirements, design, testing, quality assurance and configuration management). This transfers to what companies are offering and emphasizing in their training.

Behavioral Training. 78.95% of the respondents mentioned that their companies provide behavioral training to freshers. Teamwork is the most emphasized topic followed by oral communication, behavior with clients, behavior in business settings, written communication and leadership. The companies offering this type of training are mainly small and large companies. The average behavioral training time is 6-7 days.

IT Offshore Outsourcing Training. Only 21.05% of the respondent's companies provide training related to IT offshore outsourcing, which is surprising considering the place of India in this market and the amount of literature showing that culture is one of the important difficulties to overcome [11]. Where conducted, this training concentrates mainly on culture, socialization tools and the use of collaborative tools (e.g., wikis). The companies offering this type of training are small and large companies. The average IT offshore outsourcing training time is 1-2 days.

Comments from Human Resources Professionals and Managers. Human resources professionals and managers do not want colleges and universities to become training

centers, but they would like to see more practical work, business orientation, emerging technologies and soft skills emphasized in the curriculum. For one of the respondents: “It is not a question of adding and deleting [topics]. Academia should continue giving a holistic education to the students. Don’t convert universities and colleges into training centers. One great skill that academy should impact is – learn to learn.” They want freshers to understand the concepts and to be able to apply them in different scenarios, have more practical experience, and sounder skills in programming and data structures.

4.2. Freshers’ Survey

Participants. The respondents had a B.Sc. degree in Computer Science (44.26%) or a general B.Sc. degree (26.23%). They obtained a M.C.A. (70.49%) or a M.Sc. in Computer Science (19.67%) from a UGC recognized university or college or from one of the IITs between 2006 and 2008. They had their first computing courses when at college (49.15%), in higher secondary school (11th-12th grade) (27.12%) or in secondary school (6th-10th grade) (18.64%), and decided to pursue a career in the computing field during their higher secondary studies.

Trends in Recruitment. 90.38% of the freshers revealed that it was their first job. 34.62% of the freshers worked for foreign multinational companies, 26.92% for Indian multinational companies, 25% for Indian companies and 11.54% for foreign companies. They worked for offshore customers (71.17%) or local Indian customers (26.65%). Their title in the company was largely software engineer (53.85%) or developer (11.54%). They mostly chose the company they were working in for the learning opportunities and its reputation.

Software Engineering Education. Only 80.33% of the freshers reported that they had undertaken a course in software engineering during their education, of which 92.68% had undertaken a software development project. Their software engineering courses covered the standard topics with an emphasis on software process, testing and design, followed by implementation and requirements, and then quality assurance, with teamwork and communication being least emphasized. This seems to show that software engineering is mostly taught from a theoretical point of view.

Training. 90.20% of the respondents had undergone training provided by their companies. All the freshers of the Indian and foreign multinational companies went through training, while those freshers working on offshore projects were more likely to receive training than the others. Internal personnel, rather than external personnel, conducted the training. Interactive learning with instructors and instructor-led lectures were the most common types of training. The models of training included continuous mentoring (32.43%), mandatory continuous training (25.68%) and mandatory formal upfront training (22.97%).

Technical Training. 71.43% of the freshers had undergone technical training. The training covered programming languages, use of specific tools, Web programming, databases, design, software process, configuration management, network and data communications, requirements, testing and quality assurance, project management, operating system, information security, version control and distributed programming, with emphasis in that order. Freshers were trained in Core Java and Web programming more than other programming languages, Java technology being more emphasized than .Net and Eclipse being the most widely taught IDE. Technical training lasted 10 weeks on average, with a variation from 4 to 24 weeks.

Behavioral Training. 50% of the freshers went through behavioral training that equally covered teamwork and oral communication, followed by written communication,

behavior in business settings and behavior with clients. The emphasis was on behavior with clients, teamwork and leadership. The duration was 5 days on average.

IT Offshore Outsourcing Training. Only 9.76% of the freshers received IT offshore outsourcing training. That type of training covered mainly culture and socialization, with an emphasis on socialization. The duration was 2 days on average.

Comments from Freshers. 50% of the students expressed satisfaction with the curriculum they followed during their studies, 28% reported that the curriculum was inadequate preparation for industry and the remaining reported that it was inadequate only to some extent. Freshers regret that educational institutions stress many subjects without giving in-depth knowledge on any particular one and the focus on programming. Freshers realize the importance of software engineering in their daily work, as indicated by the following statement: “I think the emphasis should be put more into design principles. The emphasis on basic knowledge is good but the emphasis on languages should be changed. More emphasis should be put into the architectural design of software. [Exams] should test the ability to design rather than testing the ability to gulp down stuff without understanding what the problems are.” A unique but relevant comment about the lack of attention to maintenance was reported: “My work is to provide support to applications. I think this is what the curriculum lacked for. Developing an application and supporting it are two different things. In our curriculum we are given emphasis on development. Although we provide documentation for projects’ assignments, more emphasis should be given to maintenance.” Lots of technologies commonly used in industry were not introduced during their studies and they reported the need for some of the most common tools to be introduced. One participant mentioned that “The concepts learned in the university help in forming the base. On that base we can learn different new technologies in the company”. Another participant reported that “There are so many technologies in the industry. No course can include them all. We need to learn them on the field only”. Yet another one made a comment that students “should be encouraged to do real-project projects in collaboration with the industry”. A few others felt that projects should be introduced and “software engineering processes should be followed, as well the use of configuration management and version control”. One fresher also suggested that: “In the last semester, industry experts should be invited to coach and guide the students about their professional life.” Concerning soft skills, freshers commented that “Soft skills are also rarely emphasized” and “a continuous focus on written and verbal communication is a must.” They added that “This lack of focus is unfortunate as they help students to differentiate themselves in the market.” and “The [educational] system is lacking extra curricular activities like debates and other activities which play an important role to improve confidence in a student and also to think interactively.”

5. Recommendations and Conclusions

The findings presented in this paper were drawn from the responses of two surveys of 32 human resource professionals and managers and 46 freshers from the Indian IT industry. Even if statistically limited, we believe that the findings are general in nature with actions required from academia and industry. There is a gap between the types of graduates that Indian universities are forming and the current needs of the IT industry in India. Collaboration between the industry and academia including faculty training and curriculum development is crucial to bridge this gap. Students must be exposed to tools that are standard in the software industry (e.g., Eclipse and version control systems). They need to acquire

more practical experience and work on real-life projects that will permit them to acquire technical, soft and IT offshore outsourcing skills. Companies are investing massively in the training of freshers to address some of the issues. However, this training does not equally addresses technical, behavioral and IT offshore outsourcing training at present. Technical training is emphasized, followed by behavioral training and then by IT offshore outsourcing training, which is surprising considering the place of India in the outsourced offshore software development. If the first designation of freshers in the IT industry is “software engineer”, software engineering topics (e.g., process, requirements, design, development, testing and quality assurance) should be emphasized in the curriculum rather than programming. The authors of this paper have collaborated for five years and proposed changes in the way software engineering is taught by incorporating real-life experience of offshore outsourcing for students. They implemented different models of collaboration where teams of students globally distributed in the US, India, Thailand, Cambodia and Senegal worked together on the development of software systems for clients [4,5]. The settings permitted students to develop technical skills, leverage their soft skills and be exposed to engineering, communication, project management and socialization tools to support the distributed development of software systems.

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7. References

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