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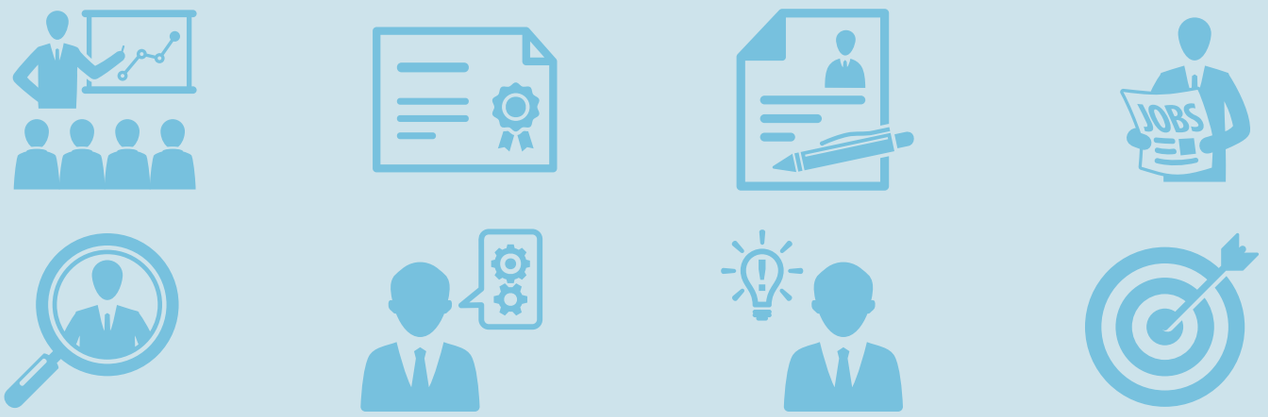
AI-powered Talent Evaluation

# NATIONAL EMPLOYABILITY REPORT

## ENGINEERS

**Annual Report 2019**


ENGINEERS



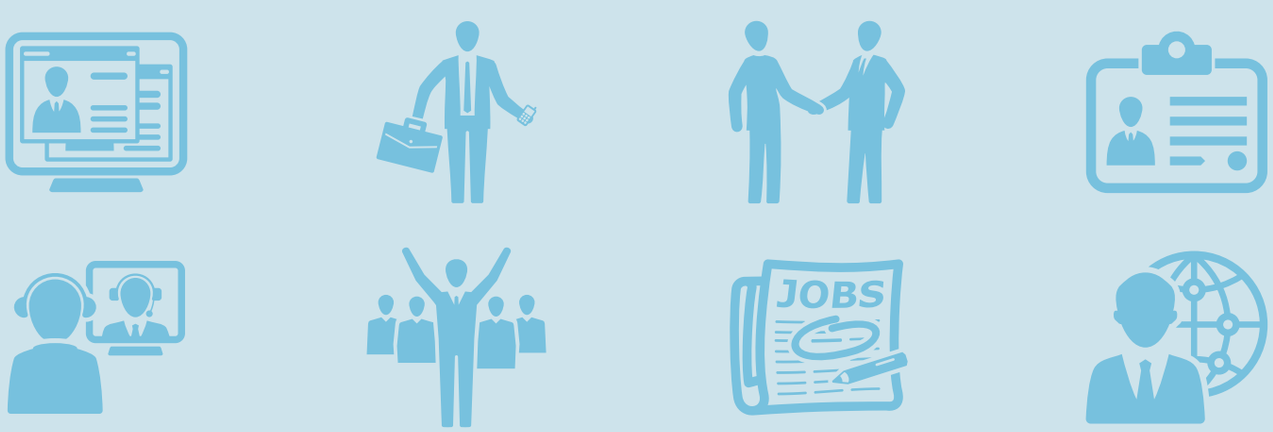

Aspiring Minds is India's leading employability solutions company, headquartered in Gurgaon with operations in the US, China, India, Middle East, Philippines and Sub-Saharan Africa. The company offers scientific assessments with an innovative large-scale sourcing model analogous to a GRE-for-job concept. The state-of-the-art assessment tools developed by Aspiring Minds have been used across industry verticals to help recruit the right people, develop profile-wise employability benchmarks and assess workforce health.

Aspiring Minds' intelligent adaptive assessments span across Language, Cognitive skills, Domain knowledge and Personality. A strong in-house research and development team with alumni from IITs and MIT form the development backbone of the patent pending assessment tools.

AMCAT® - Aspiring Minds' flagship product is India's Largest Employability Test. Conducted across the country throughout the year, AMCAT has been taken by over 2,000,000 candidates in 4000+ campuses, spread across 25 states. Tens of thousands of candidates secure their dream jobs every year through AMCAT.

Powered by a highly dedicated management team, drawn from the IITs and IIMs and pan-India operational presence with over 500 full-time employees, Aspiring Minds has helped leading brands across verticals to improve their recruitment process efficiency and the quality of talent they hire. Aspiring Minds' products and solutions have been adopted by more than 3500 clients in sectors as diverse as BFSI, IT, ITeS, Hospitality, Retail, etc.

Aspiring Minds works with 100+ fortune 500 companies. The client list includes Amazon, Concentrix, TSA, Cognizant, Genpact, Tata Motors, Deloitte, DuPont, Airtel, Verizon, Wipro, Tata Steel, Vodafone, Sitel, Reliance, Transcom, ZTE, Baidu, Ernst & Young, NTT Data, Interglobe, Godrej, EXL, Philips, Hyundai, Honeywell, XL Catlin, Hinduja Global Solutions, Bosch, IQVIA and many more.



# AUTHORS


**Varun Aggarwal**
Co-founder & CTO,
Aspiring Minds

**Siddharth Nithyanand**
Assistant Vice President,
Aspiring Minds

**Malvika Sharma**
Research Analyst,
Aspiring Minds

Along with contributions from various teams at Aspiring Minds


**National Employability Reports**

National Employability Report- Engineers, Annual Report-2016
National Employability Report- Engineers, Annual Report-2014
National Employability Report- Hotel Management Graduates, 2014
National Employability Report- Graduates, Annual Report- 2013
National Employability Report- MBA Graduates, 2012
National Employability Report- Engineers, Annual Report-2012
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All the previous editions of Aspiring Minds National Employability Report can be accessed at https://www.aspiringminds.com/research-reports

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# INTRODUCTION

We are pleased to present the fifth edition of the National Employability Report for Engineers. The National Employability Report has become India's most authoritative audit of engineering education, providing a comprehensive data-based understanding of the higher education and employment ecosystem. This report conforms to the highest standards of scientific research methods and analysis. Our studies have been cited in more than 250 technical papers, featured in international publications such as The Economist[1] , and quoted in a wide array of economics publications[2] and policy reports. Government agencies such as NITI Aayog[3] quote our data and we have recently found our way into pop culture with the new Bollywood film *Why Cheat India*[4] .

The 2019 edition presents the state of employability skills of the latest graduating class of engineers in India. In addition to cumulative data, we provide a variety of group comparisons: by institutional tier, institution city, candidate residence, gender, etc. The report is based on data gathered from the AMCAT test, which is now recognized throughout North America, Asia, the Middle East and Africa. Our analyses have been instrumental in diagnosing employability gaps among various candidate groups and in tailoring interventions to address those gaps. In consideration of current needs, the 2019 report incorporates three major new additions.

The first of these explores the gaps in engineering education that account for the ongoing trend of low employability of graduates. The lack of improvement since 2010 (the year of our first report) in employability at the macro level has been disconcerting to say the least. The current report presents first-of-its-kind data on these gaps. This data provides insight on how to design interventions at the college, university and national level to effect change. Our recommendations have informed previous public policy initiatives such as the AICTE. To further assist sensible policymaking, we have distilled all recommendations from the present narrative into a separate section "Recommendations" for easy reference by all interested stakeholders.

The second new addition provides a glimpse into how the skills of Indian engineers compare with the skills of engineers in the US and China. The world is rapidly becoming a level market for talent. Indian IT companies have increased their recruitment and hiring in the US, while Chinese and Filipino companies such as Baidu, Alibaba and Tencent have begun to challenge India's dominance in the call center industry. As there is no predictable end to these trends at present, we expect this new analysis to produce many informative and fascinating comparisons over time.

The final new addition considers the preparedness level of Indian engineers for next-generation technology. With the advent of artificial intelligence, the job market is taking new shapes and forms.

1 https://www.economist.com/node/21563411/sources-and-acknowledgments, https://www.economist.com/special-report/2012/09/29/a-billion-brains
2 https://www.amazon.in/Public-Policy-India-Rajesh-Chakrabarti/dp/0199470693/ref=sr_1_3?ie=UTF8&qid=1552044412&sr=8-3&keywords=public+policy+in+india
3 http://niti.gov.in/writereaddata/files/coop/India_ActionAgenda.pdf
4 Our report is cited at the end of the movie 'Why Cheat India', directed by Soumik Sen and released in the month of January

# INTRODUCTION

Earlier we presented a report on “The Future of Skills.” With this current edition, we take up a project to examine “Future Skills” in our engineers: the gaps in education and training, and how we can intervene to close them.

I hope this analysis and its findings will give you a clearer perception of the current state of Indian engineering education and employability and provoke a wider conversation on how to meet the needs of the technology industry and scientific inquiry generally. The Indian higher education ecosystem is in need of systemic change. India has the elephant’s strength, but also the elephant’s inertia. The cooperation of all stakeholders is required if we hope to effect the long-term policy changes necessary to lift us out of the “unemployability trap.”

Varun Aggarwal,
Co-founder & CTO, Aspiring Minds

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# EXECUTIVE SUMMARY

***The past nine years have brought no change in the employability of Indian engineering graduates. India's higher education system is in need of systemic change.***

The broad employability numbers remain surprisingly and painfully stubborn! Macro employability and employability trends show no change over the past nine years. Even today, 80% of engineers are not employable for any job in the knowledge economy. This is quite disheartening. It is safe to conclude that the Indian higher education system has not been helped by the small ad-hoc changes to which it is accustomed, and is rather in need of fundamental change. Micro-interventions may help create isolated pockets of competence, but they do little for higher education or the larger economy as a whole. The government of India needs to prioritize higher education and undertake long-term policy interventions in the next 5-10 years to ameliorate the low rate of engineering employability.

***Engineers score very low in next-generation technological skills (i.e., data engineering, data science, AI and wireless).***

Only 2.5% of Indian engineers[5] possess the skills in artificial intelligence (i.e., machine learning and data science) that industry requires. Only 1.5% - 4.5% of engineers possess the necessary skills in data engineering, while only 2.8% - 5.3% are qualified in wireless technologies. These figures pale compared to the percentage of engineers (5.5%) that are qualified for basic programming. However, the true employability figures for data science are actually much lower: only 50% - 60% of these numbers (or 1.5% total) when we factor in other skills such as cognitive and language that are key for career success. If India hopes to become competitive and achieve parity with international competitors, then all national stakeholders must help our engineers move beyond basic coding skills to meet the demands of 21st century industry.

***US job applicants are further ahead in coding skills than Indians; India and China compete!***

Good coding skills (the ability to write functionally correct code) are possessed by 4.6% of Indian job applicants, 2.1% of Chinese candidates and 18.8% of the US candidates in the IT and software industries. However, if we consider only those candidates who can write correct code with few errors, the gap between China and India narrows (8.6% vs. 9.8%, respectively). Interestingly, while the percentage of Indian engineers who code well is greater than the number of Chinese engineers, a much higher proportion of Indian engineers (37.7%) cannot write a compilable code compared to Chinese engineers (10.35%). This means that India must do more to educate its general population in proper coding skills. By comparison, the US engineers perform four times better than Indian engineers in coding: only 4% of the US candidates cannot write compilable code despite the fact that the base of the engineering population in the US is approximately four times smaller than in India.

5 We only consider engineers here who wish to work in these domains and choose to take assessments in these areas. The whole engineering population is considered for these statistics.

# EXECUTIVE SUMMARY

***Engineering education is mainly theory-based. Only 40% of students perform internships while only 36% undertake projects beyond their required coursework.***

Engineering is an applied discipline. Engineers learn primarily by doing, not only by reading and listening. However, only 40% of engineering students in India perform internships and only 36% undertake projects outside their assigned coursework. As a consequence, the engineering discipline in India is very theoretical. Internships are win-win for industry and academia. Internships provide students with industry exposure to help them gauge which jobs they are best suited for and which skills they must develop to succeed in their chosen roles. Internships similarly benefit industry by allowing companies to assess potential future employees without committing, and also to experiment with interesting new projects. As for undertaking projects outside of their coursework, a high percentage of Indian students report that their professors encourage them to do so. However most students do not follow through on these recommendations. Interventions both pedagogic and cultural are needed to change such behavior.

***Students are trapped in a college bubble. They have little industry exposure. Only 47% of students attend industry talks. Sixty percent of faculty do not discuss how engineering concepts apply to industry.***

Engineering students get very little industry exposure either in class or outside. Sixty percent of faculty do not discuss how engineering concepts apply to industry. Only 47% of students report the opportunity to attend a talk by industry personnel during their college career. Most talks that students attend are intra-departmental, rather than seminars, workshops, conferences or webinars that typically feature outside experts and scholars who present complementary or alternative perspectives. Colleges would better serve the intellectual and creative development of their students if they provided mechanisms by which students could connect with industries in the local ecosystem. Similarly, Indian higher education should develop scalable web-based mechanisms to connect students with national and international companies and institutions.When students are asked to list reasons for low employability, they often cite “lack of good faculty” among the top three. Systematic intervention is needed to attract high achievers to teaching careers. Programs and opportunities for the professional development of educators will be key to such an effort.

***Lack of counseling and direction is the key hurdle for students in finding jobs.***

Approximately 40% of students report that their primary challenge is finding the right company or the most suitable job profile to which to apply. Their second challenge is that of passing an interview, followed by the challenge of securing an interview. Our students need counseling to understand the kinds of jobs that are available; how to determine which job profiles match their interests and skills; the skill gaps that may disqualify them; and how to address those skill gaps. These issues can be addressed by a mix of counseling programs and technology including artificial intelligence. Tools that help students assess their skills, find company matches and prepare for interviews will come in very handy.

# RECOMMENDATIONS

As noted earlier, low employability is a stubborn issue that has shown little or no macro improvement over the last seven years. To address this, we need long-range system reforms and outside-the-box ideas. Government and other policy makers will have to play a key role, while all other interested stakeholders such as colleges and industry must be incentivized and equipped to respond to policy changes. In this section we propose recommendations for government; for higher-education institutions including colleges and universities; and for industry and university/industry cooperative entities. In addition to policy recommendations, we also present some open-ended ideas as well as lessons learned from other fields.

Three considerations inform our recommendations. The first is the need to improve the quality of education in our institutions. This will require new programs and resources, with a major focus on faculty development. Second is the need to provide and align incentives for all stakeholders to promote better employability outcomes. The final consideration is the need to strengthen connections between industry and academia to foster mutual value creation.

***Conduct employability assessments and training programs from the first year of university study***

Our research suggests that matriculating students are underprepared for university study. Many lack the necessary prerequisites for a university curriculum. Many also lack employability skills that should have been learned in school such as basic computer literacy, basic mathematics, English reading skills and deductive logic.

All incoming students should be assessed on basic skills. Such large-scale assessments could be developed and administered as part of college entrance exams. Based on the results, institutions could provide 3-6 months training programs in students' gap areas. The students should receive academic counseling to make them aware of their skills gaps and to provide them with a support strategy for addressing those gaps. This will help prepare students for higher level coursework in subsequent years, and boost achievement and graduation rates. It would also help colleges and universities realize a better ROI for their 3-4 year investment.

The federal government should develop ways to institutionalize and incentivize such assessments. The government could provide employability skills guidelines that can be incorporated into the AIEEE/JEE

exam and other university exams. Including such assessments as part of entrance exams will help institutionalize large scale deployment of tests of foundational employability skills at the time of admission. The government may further incentivize such tests and intervention programs by assigning them additional weight in the qualification criteria of AICTE, NIRF ranking, and NAAC accreditation, among others.

***Higher education should take a programmatic approach to improving student skills.***

Universities and colleges should take the initiate to improve the quality of their educational offerings. They should establish formal committees with decision-making power aimed at proposing and implementing reforms and interventions, and measuring the effect of those reforms on learning outcomes[6]. Measuring the impact of reforms and interventions through an evidence-based scientific process will help identify which efforts are most successful and capable of being scaled. This will go a long way toward improving higher education overall. Such strategies have been used in the primary education system by organizations such as Dell Foundation with good results[7]. Some of these approaches can be adopted to the higher education system.

A particular focus of reform should be faculty development, as well as new and greater online resources for students. The methods that have traditionally been used to train faculty can benefit from the substantial amount of new thinking in this area. The traditional one-to-many lecture model is not so well suited to the present era of cutting-edge technology and experimentation. Today's technology is best experienced through contemporary teaching practices that incorporate novel peer-to-peer and learn-by-practice methodologies.

Technology-based teaching methods are also becoming more critical. Technology in the classroom should go beyond just content delivery and extend to AI-based systems that actively provide students with feedback, hints and tips for individual learning strategies and skill-gap identification. Already tools exist for providing feedback and guidance on language skills, email writing skills and computer programming skills. We can expand these tools to other areas as well.

Institutionalizing such interventions in coordination with processes to properly measure intervention outcomes would provide us with a better idea of the advantages and shortcomings of our present system and help us direct our resources to where they are most needed. Funding for such efforts would have to come from the stakeholders themselves (federal and local government, higher education institutions, foundations and industry). By tying the grants to evidence-based measurement processes and improvement outcomes, these entities can retain autonomy over their contributions, which may further

6 We provide recommendations in the last chapter for overhauling the university examination system and how universities should measure outcomes.
7 https://www.msdf.org/press-releases/haryana-department-of-school-education-launches-learning-enhancement-programme-lep-in-over-3200-primary-schools/#, https://www.msdf.org/blog/2018/07/india-school-system/

incentivize them to participate.

***Create faculty development and continuous assessment programs***

The quality of teaching cannot exceed the quality of the teachers themselves. Universities and colleges should invest in faculty training and development programs. Companies undertake a wide variety of programs to enhance employee knowledge and performance. These include individual enhancement such as assessment centers, 360 degree feedback and online/offline training programs. But they also encompass programs focused on organizational health such as team building and motivational exercises; as well as programs to facilitate professional community and enhancement of the subject area itself, such as employee participation at conferences, workshops and events. These practices can be adopted by colleges and universities for faculty development, and to demonstrate that they recognize the central role of teachers in their institutional and academic mission. Such interventions must also be coupled with assessment tools to continuously measure the effect of the intervention on faculty skills (communication, subject matter, pedagogy, class management, administrative skills, etc.) and to provide faculty with constructive feedback for improvement.

Government and national policy makers should consider enacting a national system for faculty assessment. Expert panels at the IITs, could develop the testing materials, scoring standards and a system of improvement benchmarks to assist underperforming faculty similar to the process followed in GATE. The test could be administered 3-4 times per year, with each faculty person required to take the test once per annum. Those who score above a certain threshold could qualify to take the test less frequently, perhaps once every three years. Institutions could publish scoring averages as part of mandatory disclosure. These scores could then be factored into college/university ratings and accreditation.

We should also reconsider our traditional definition of faculty. Traditionally, a faculty member is an academic person who holds a masters or PhD degree. We should consider expanding the teaching talent pool to include individuals from industry. Such people could hold a part-time course schedule or run evening/weekend programs. They could work an intermittent schedule, semester by semester. AICTE has already taken a first step towards this by modifying their faculty qualification requirement. Other stakeholders should follow their lead and also devise additional innovations. For example, there could be a “Teach for Engineering” program along the lines of the “Teach for India” program. Would industry be willing to release their employees for six months to teach? Could CSR funds be used for such efforts? These are all areas for consideration.

***Incentivize student employability assessment and disclosure of results***

Employability assessment in the final year of university study serves multiple purposes. First, it provides feedback to students and colleges. Second, it testifies to credentials that students can then present to companies for consideration in hiring. Most importantly, it is a great indicator of college quality, and therefore a data point of particular value to potential students and parents when considering enrollment options. For the sake of credibility, such assessments must necessarily be conducted by a neutral third-party organization. This will incentivize colleges to improve the quality of their educational programs.

The government should help incentivize these assessments and compel the disclosure of results. The employability assessment and its scores can be made a part of the AICTE criteria, NAAC and NIRF ratings, for example. Then, the government and associated bodies can spur additional action by offering recognition and rewards to high-performing institutions and institutions that consistently achieve improvement benchmarks.

***Private colleges and universities should start building niche research programs***

At this point in time, the next evolutionary step for Indian colleges must be original research. Indian institutions must become creators of knowledge rather than just consumers and disseminators of knowledge. In pursuit of this, Indian colleges and universities would have to acquire great talent. If successful, then the resulting research and innovation would have natural spill-overs in uplifting the quality of teaching overall and in exposing students to cutting-edge technologies. In turn, this would lead to more project-based learning, which would spark interest from industry and spur collaborations.
However, research is expensive and usually pays off only in the long term. For this reason, it would be best for each private college to aspire to build a center of excellence in one area only, rather than try to spread their efforts more broadly[8]. They should work to build a program around a few high caliber PhDs with a zeal for research. This is the necessary first step toward achieving the next level of academic excellence.

***Institutions should be measured in terms of outcomes***

The necessity of measuring and rating colleges and universities by their outcomes is a common theme running through our many suggestions. Outcome measurement has to be central to policy. Traditionally, institutions have been measured on input: number of faculty, faculty qualifications, infrastructure, student body composition, etc. But to really understand how well institutions are performing, they must be judged by what they produce: student learning, employability, faculty skills, research papers, etc. An alternative focus on outcomes rather than inputs produces an objective yardstick by which to measure how well our institutions are performing. With objective data, we will be better able to set goals, plan

8 Chapter 10, Leading Science and Technology: India Next? By Varun Aggarwal (Author)

interventions and align incentives to spur improvement. All stakeholders must journey collectively toward this.

***Reform college examination system***

The examination system at our higher education institutions does not achieve its intended purpose. Most exam questions are based on rote learning. Most are repeats from previous exams. Even students with no requisite expertise in the subject matter can qualify for these exams and score well. The predictability of the exam system erodes the incentive to study and absorb the course material well.
The examination system is past due for a complete overhaul. New guidelines are needed to ensure that the structure of examinations and the student evaluation process in general actually measures student achievement in their subject areas. The higher education system as well as policy makers may make individual efforts in their local domains, but there should be a wider cooperative push on the national level for universal reform including the standardization of exams. Working together, higher education and national policy makers can devise model examinations that objectively assess student learning and set quantitative benchmarks for the learning outcomes that an engineer must meet before receiving her/his degree.

New guidelines for examinations should include one or more of the following:

- Exams should have a balance of theoretical questions, conceptual questions and application-based questions. The weight of each individual section would be defined for each subject area.
- An exam should contain no repeat of questions from the last 10 years.
- The criteria for determining passing grades should be absolute and not relative.

***Encourage internship programs and push project-based learning***

Professional internships are “win-wins” for students, colleges and industry. We consider internships to be so important that we recommend government mandates for companies, academic departments, research labs and PSUs to run large-scale internship programs. Such an initiative should include national programs with a competitive selection process as well as state-level programs for invigorating local systems. The federal government has the influence to compel internship programs that are actually worthwhile and that serve a compelling public interest, while competitive selection for such national-level programs would ensure the high caliber of student applicants. Successful programs at the national level would affect macro-level change that would disseminate to local level efforts. In addition to leading by example, the government could incentivize private industry to sponsor internship programs. Such incentives might include reimbursing industry for a portion of the internship stipend, paid from Corporate Social Responsibility (CSR) funds. The government could also consider tax breaks for companies that employ

interns. As the primary architect and sponsor of such programs, the government would retain wide authority to prevent abuse: for example, setting restrictions on the definition of an intern (i.e., a full-time student employed in short-term work, less than six months).

A robust internship program would result in more project-based learning among students. The impetus for project-based learning is a cultural issue as much as a bureaucratic-administrative issue. A solution will require the cooperation of all interested stakeholders from government, higher education and industry to build a proper ecosystem that motivates and mentors upcoming generations of engineers and provides resources and incentives for research and innovation. Examples include a competitive process with Request for Proposals (RFP) for the distribution of funds and resources. Such programs already exist through the Department of Science and Technology (DST) for research projects at the graduate level, but a similar program at the undergraduate level would go far in persuading engineers-in-training to continue with their studies. MeitY offers an ITRA program that is instructive for developing and scaling a research ecosystem[9].

***Build faculty capacity in cutting-edge skills***

India needs to train its engineers in cutting-edge digital and data skills including AI, IoT, data engineering, robotics, and mobile technologies. The initial focus must be on building capacity in faculty that are already familiar with information age technology. The government could institute a national program to train a number of engineering faculty (10,000 for example) in new skills. The program could take the form of a fellowship, for which participants are selected through a competitive process involving skills assessment. The competitive process would help ensure that only motivated and highly qualified candidates win sponsorship. The content of these fellowship programs could take many forms depending on the subject area and could include a blend of online and offline material. Online resources would allow participants to remain at their institutions and involved with their research projects, while immersive offline components could take place during semester breaks. We expect that the IITs and other elite institutions would be enthusiastic about hosting such sessions. When we finally achieve a critical mass of highly skilled faculty, many other necessary interventions will follow and begin paying dividends.

9 https://itra.medialabasia.in/wp-content/uploads/2014/03/ITRA.Brochure.Sep17.updated_20.9.2017.red.size.pdf

# METHODOLOGY

This report is based on a sample of more than 170,000 engineering students from 750+ engineering colleges across multiple Indian states. The entire sample group graduated in 2018[10]. It also includes a section that compares India's performance with China (sample size: 30,000+) and the USA (sample size: 40,000+). The findings and analyses of the report are based on student test scores from the AMCAT: Aspiring Minds' Computer Adaptive Test, which is India's largest and only standardized employability test. AMCAT measures all objective parameters including English comprehension, quantitative ability, problem-solving skills, and domain area knowledge (computer programming, mechanical engineering, and electrical engineering, etc.) that determine employability in the IT/ITeS and other core engineering sectors. The AMCAT test is administered in a proctored and secure environment as determined and regulated by Aspiring Minds.

Employability is quantified according to benchmark studies performed by Aspiring Minds at various companies in various sectors. Currently, AMCAT is used by more than 6000 companies—including seven of the top ten IT services companies in India—for their assessment and recruitment solutions. The benchmark for employability in a specific job profile and industry sector is defined by a theoretical understanding and empirical validation of the knowledge, cognitive skills and domain expertise required for success in that role. The benchmarks established for various profiles ensure both the disqualification of all candidates deemed unqualified for a job (elimination of type I error) and the inclusion of all candidates deemed suitable (elimination of type II error). Our predictions have been validated by multiple companies across various sectors.

This report also includes a section on the aspirations of engineers, as well as a study that attempts to explain the factors that are most instrumental in landing an engineering job in India. The data for these studies was captured by means of a scientific survey on a stratified sample of approximately 30,000 engineers. The Aspiring Minds' testing platform also captures participant demographics to provide a more in-depth and comprehensive analysis of the engineering labor market.

10 The sample was statistically balanced across various parameters to be representative of the true technical graduate population. A carefully chosen stratified sample was used for the study.

# 1 EMPLOYABILITY BY ROLES

Engineers are hired in many different job profiles and sectors. Within the IT sector we study employability in IT Product, IT Services and ITeS companies. With a variety of start-ups coming up as well as students showing an inclination towards joining them, we have also included the employability of engineers in start-up roles. The design engineer role is further sub-categorized for better understanding. Other than IT and core engineering profiles, we also look at alternate careers that are available to engineers. These include roles such as technical content developer, analyst and sales engineer. Given that IT jobs are not growing at the same pace as before, engineers are pursuing different kinds of roles that draw on their analytical/technical skills. The employment of engineers in these roles will only grow with time and it is important to see what the employability trends in these roles are.

| ROLE | EMPLOYABILITY |
|---|---|
| **IT ROLES** | |
| Software Engineer – IT Product | 3.40% |
| Software Engineer – IT Services | 16.25% |
| Start-up Ready – IT Services | 3.74% |
| Associate – ITeS Operations (Hardware and Networking ) | 36.20% |
| **ENGINEERING ROLES** | |
| Design Engineer – Non IT | 6.62% |
| Sales Engineer – Non IT | 19.85% |
| **NON-TECH ROLES** | |
| Business Analyst – KPO | 9.39% |
| Associate – ITeS/BPO | 39.35% |
| Technical Content Developer | 12.15% |
| Creative Content Developer | 17.03% |

**Table 1: Employability percentage of engineering graduates in different roles**

The criteria for employability is based on the studies conducted with various corporations in these sectors, benchmarking their current employees in various profiles through an objective assessment based on AMCAT and establishing feedback through on-job performance data. These benchmarks serve as a standard for several large-sized companies across the nation.

| ROLE | EMPLOYABILITY |
|---|---|
| **Design Engineer** | |
| Chemical Design Engineer | 8.11% |
| Civil Design Engineer | 5.03% |
| Electrical Design Engineer | 5.90% |
| Electronics Design Engineer | 6.90% |
| Mechanical Design Engineer | 7.03% |

**Table 2: Employability percentage of sub-categories in design engineer role**

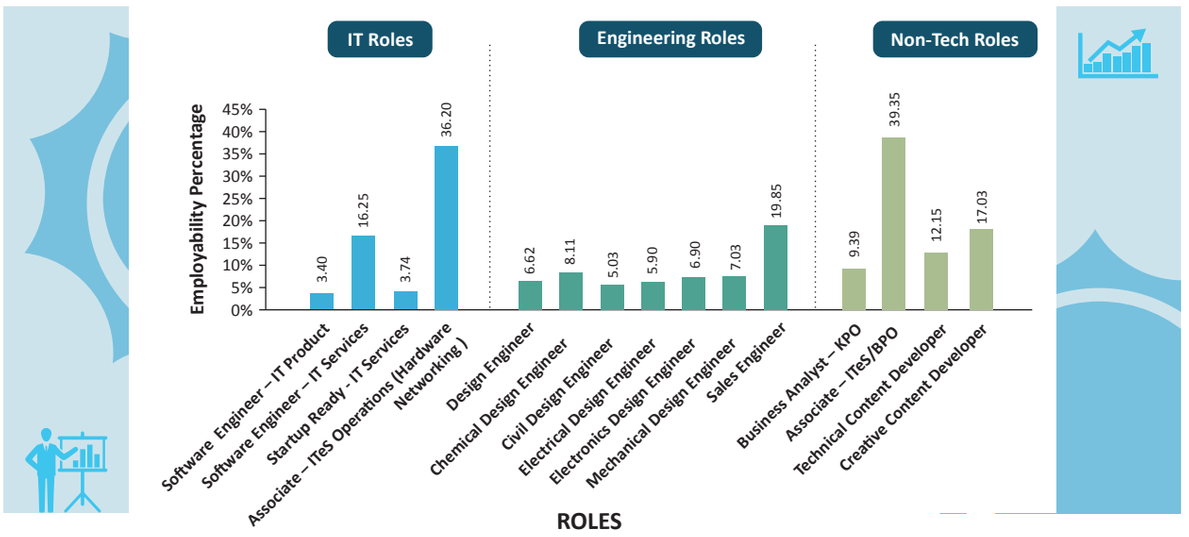



**Figure 1: Employability percentage of engineering graduates in different roles**

The employability of engineering graduates in different roles is shown in Figure 1. The following bservations can be made:

**Software Engineer - IT Product:** : A worryingly low employability percentage of 3.40% has been observed for this role. This is because jobs in IT product companies require a strong understanding of computer programming and algorithms. The study found that a majority of the candidates lacked the required skills:

around 90.92% of graduating engineers do not have the desired programming and algorithm skills required to work in IT product companies, whereas 55.90% show lack of soft skills and 65.14% lack cognitive skills. There have been new innovations to test programming and algorithms using compiler-integrated programming assessment[11] to find the right candidates quickly and effortlessly. Other than finding whether a program is correct or not, these tools can automatically find code complexity and programming practices used. One may note that the skills required by IT product companies at the entry-level are very much a part of the curriculum of engineering colleges. Low performance on these skills is a worrying sign for higher education system. Using assessment tools as mentioned can also serve as a boon for students, if the colleges start assessing their programming skills early-on in their curriculum.

**Software Engineer - IT Services:** The employability of engineers in IT services companies is 16.25%. It should be noted that this has been calculated according to the current hiring principles of IT services companies, where the candidate is not expected to already possess the required software skills or soft skills, but is imparted the required training over a period of 3 to 6 months. The hiring criterion for this industry, thus, is that the candidate should be trainable in technical and soft skills. This requires both a basic command of language and technical skills, together with requisite cognitive skills to respond to training in a short period of time. Considering these bare minimum requirements, the fact that only 16.25% of the graduates are trainable to become software engineers, is alarming to say the least.

The research further shows that approximately 55.90% engineers are rejected because they are not soft-skill trainable in a short period of time, whereas around 56.58% lose on technical trainability. The IT services industry is not growing at the same pace as before and the growth of entry-level jobs is diminishing. Given that companies have lower requirement and want to reduce training cost, there is a slow but definite trend towards hiring candidates who already have expertise in basic programming. At least three out of the top ten IT services companies in India have already started using programming assessment in their entry-level hiring process. Secondly, IT services companies today realize that within two years of the job, the candidate will have to communicate with international customers. This makes English proficiency a very important parameter right at the time of entry-level hiring. As these trends catch-up across industry, the employability for the IT services sector, which is the largest employer in engineering will diminish further. To remain competitive in the job market, both colleges and students need to have a sharp focus on programming and English (both written and spoken).

**Start-up Ready- IT Services:** Investments and growth of technology start-ups is the new business story in India. To sustain this growth, we need candidates with high technology caliber, comprehensive understanding of products and the attitude to work in a start-up. With this in mind, start-ups want to hire ready-to-deploy manpower. Unfortunately, we find that only 3.74% of engineers qualify for a start-up technology role. This is a big concern and a potential roadblock to start-up growth in India.

11 http://www.aspiringminds.in/researchcell/articles/aspiringminds_launches_automata_pro_the_worlds_most_advanced_simulated_programming_assessment.html

**Design Engineer-Non IT:**We use the term design engineer for all core engineering roles, such as those in the semiconductor industry or the automotive industry. In these roles, the candidate basically applies his or her core engineering knowledge towards solving real world problems, for e.g., an electronics engineer designing a digital library of components for a new chip technology or an automotive engineer designing an automobile or its engineering sub system. Design engineers may even be involved in the entire lifecycle of a product/service, be responsible for making corrections and requested changes and for providing support and maintenance services. These roles require high analytical skills and good command over the domain knowledge. It is important that the candidate has the ability to go beyond rote learning and apply the domain knowledge to solve problems. Good command over English is required to understand instructions and be able to respond to them, but the requirement is not as high as the IT services role which requires communicating with international clients. The need for such a diverse skill set makes the employability in this role one of the lowest at 6.62%.

Within this job role, we tried to investigate trade-specific employability. The engineers belonging to civil, chemical, electrical, electronics and mechanical backgrounds were analyzed for their employability for a design engineer role. Herein, the chemical design engineers were found to be the most employable of the lot (8.11%), followed by engineers with a mechanical engineering background (7.03%). The lowest employability amongst these roles was recorded for civil design engineers (5.03%). The reasons for the same can be attributed to the current industry and market needs which in effect decides the prospects and pursuits of these trades.

On an average, 68% candidates lose due to lack of requisite domain knowledge, something they should learn in college. There is a general argument that this is because of the outdated courses. This is a misnomer since the basic concepts in most of these fields have remained same over the years and industry can quickly train candidates in emerging technologies if their basic concepts are clear. The industry has no further expectations from the candidate than a clear understanding of the fundamentals of the topic. Unfortunately, most students do not know the same.

**Sales Engineer-Non IT:** In this profile, a candidate has to sell, market or assist in selling a technical product. Here, buying decisions are based more on technical information and rational analysis rather than style, fashion or impulse. Therefore, selling in these markets relies heavily on technical information and problem-solving to convince buyers that they should spend money on the seller's products or services, in order to meet a business need. A sales engineer is hence both an engineer who understands and can apply concepts of engineering and a salesperson who knows how to sell engineered systems. Thus, a sales engineer not only sells but also provides advice and support. Such a role requires an individual to have technical understanding of the complexities of what his/her company supplies together with excellent communication skills. Besides these, the role requires an individual to have a pleasing personality, an ability to build trust with the client and be dependable at work. Sales being a customer-oriented skill

directly correlates with agreeableness and conscientiousness – two of the five big five personality traits. Only 19.85% of the candidates are employable in this role given the role requires good English communication, reasonable analytical skills and domain skills together with a sales-oriented personality.

**Business Analyst - KPO:** As revealed by the research, the Knowledge Process Outsourcing (KPO) industry is likely to find only 9 out of every 100 engineers employable for analytics roles. Highly developed written communication and analytical skills are a must for this sector. Though most engineers (76.78%) do not exhibit the required competence in English communication, a considerable number (65.14%) miss out on analytical and quantitative skills. To continue to remain competitive in this new emerging industry, a fundamental shift in college instruction and assessment methodology is required, which is inclined towards developing analytical thinking and critical reasoning rather than learning by rote.

**Associate – ITeS Operations (Hardware and Networking):** The hardware and networking sector comprises of roles involving technical support and network management. Candidates employed in this sector manage ITeS operations within corporations or carry out servicing roles providing support to consumers. A good 36.20% candidates are employable in roles in the hardware and networking sector, according to the study. A person trainable in this role should exhibit basic understanding and usage of computers—both hardware and software—as well as be comfortable in English and exhibit a problem-solving approach.

**Associate – ITeS/BPO:** A large proportion of candidates (39.35%) are eligible for the BPO industry, both in tele-calling and backend processes. However, graduate engineers do not form the preferred employable group for these companies due to the belief that these roles cannot match their expectations, both in terms of remuneration and job satisfaction.

**Technical Content Developer:** A technical content developer is responsible for managing the technical aspects of content. He/she may be responsible for writing manuals that explain the technical complexities of products, technical terminology or training content in the technical domain. A technical content developer is required to possess reasonably good technical knowledge of his/her domain subjects and a flair for writing. With just 51.57% engineers possessing the required domain knowledge and about 17.75% possessing the required English skills, the employability in this role stands low at 12.15%.

**Creative Content Developer:** Creative content developers deal with the non-technical or creatively challenging aspects of content. Depending on the company and requirements, a creative content developer is expected to create new content from scratch, re-write existing content or proofread content. He/she might also be required to manage content on social media and develop new ideas for web content. The role requires a person to have exceptional command over written English, basic analytical skills, and attention to detail and be high on openness to experience – a personality trait associated with

being broad-minded, unconventional, curious and imaginative. With just about 17.75% engineers exhibiting the required competence in English, an employability percentage of 17.03% in this role is not surprising.

To summarize, it is evident from these grim employability figures that there exists a deep chasm between the actual skills of engineers and the skills expected from them on the job. The chasm, if not overcome timely will result in an inevitable loss of human resources.  There is thus a dire need of assessments that can be used to test engineers, provide them with relevant feedback and help them improve their skills.

# 2 NEW AGE IT SKILLS

The focus of employability skills in the software industry has been on programming and understanding of algorithms for the last couple of decades. The work in IT is way more diverse spanning web development (frontend and backend), mobile app development and DevOps (development operations). More recently, a lot of work in companies has been linked to Artificial Intelligence: data engineering and data science (machine learning). More and more, companies now demand these skills and foundational understanding of these areas from incoming engineers to effectively deliver the wide variety of work in companies. While many of them overlap with programming, or in other words, basic programming skills is an important ingredient of most of them, they all have their own conceptual frameworks and nuances. Programming is slowly becoming an essential skill, but employers hire candidates who bring expertise in one or more additional areas, in line with their work. For start-ups and deep tech companies, skills in these areas are especially important.

| | MODULE | TRAINABLE | EMPLOYABLE |
|---|---|---|---|
| **AI: Data Science and Data Engineering** | Hadoop | 10.90% | 4.60% |
| | MongoDB | 4.80% | 1.60% |
| | Hive | 12.20% | 1.20% |
| | Pig | 12.50% | 3.80% |
| | Apache Spark | 8.90% | 1.30% |
| | Hbase | 11.80% | 1.20% |
| | Data Science | 6.80% | 2.50% |
| **Mobile** | Android Development | 12.80% | 2.80% |
| | iOS Development | 14.70% | 5.30% |
| **Web Development** | HTML/CSS | 26.00% | 9.50% |
| | JavaScript | 10.70% | 4.20% |
| | jQuery | 9.90% | 3.90% |
| | Node.js | 11.40% | 5.30% |

**Table 3: New age IT skills- percentage of trainable and employable students**

With this changing landscape in mind, we did the first study of new age IT skills in engineers. Here, all AMCAT takers were asked to choose one or two skills of their choice among the new age skills, and appear for a 15 minute test in this skill. The students were free to choose a skill they believed they had ability in and those that matched job roles they are interested in. In Table 3, we report the percentage of students who were found trainable and employable in each of the skills.

We find that the percentage of engineers employable in new age skills ranges from 1.2%-5.3%. The only skill higher than that is HTML/CSS at 9.5%. This is as expected since HTML/CSS doesn't use hardcore programming and computer science. For all the other new age skills, the performance is poorer than that in programming (5.5% employability). One may also note, that when combined with other required skills such as English comprehension and basic cognitive skills, the aggregate employability will slip even lower, approximately to 60% of these numbers (0.7%-3.8%).

Among the new age skills, we see the lowest employability for artificial intelligence and data science related skills. In a world where AI is being increasingly used and helping businesses become differentiated and efficient, this is a big concern. The US and China are marching ahead in AI and India needs to develop a critical mass of engineers with AI skills. One may note, that the employability percentages reported here are not on the whole engineering population, but only those who chose to take a test in these skills. The aggregate percentages will be even lower.

We find that the percentage of engineers trainable in these skills is also low, at around 10-15%. By trainable, we imply engineers who have some basic exposure to the skill and will be able to pick the skill in a short period of time. Colleges and universities need to work to give this basic exposure to students, and also to understand where to develop their skills further. Without such basic exposure, India may lose the race in the new AI-driven digital world.

# 3 GLOBAL SKILL COMPARISON: INDIA, THE US AND CHINA

Companies are becoming global today in more than one way. First, companies are not competing just in their local ecosystem but with companies across the world. The competitiveness of a company's product/services is highly correlated with the quality of its people. Thus, in some ways there is a much greater competition between the human capitals in different countries. Second, companies today have technology workforce not in a single nation, but across multiple nations. For instance IT and ITeS companies in India have increased their workforce in the US. The US companies for a long time have had workforce in India. Chinese companies have increasingly opened offices in the Silicon Valley and made a strong bid to attract American talent. Companies thus would finally build their workforce where the right kind of talent is available and is cost-competitive.

With the understanding that Indian talent will increasingly compete in the global talent market, we have made a beginning by providing comparison of programming skills across India, the US and China. We use test scores of engineering job applicants of IT majors hiring for entry-level roles in these countries. All the companies considered are large IT services/product companies and hire entry-level engineers in the range of thousands to tens of thousands every year. We provide in Table 4, a comparison of the programming skills across India, China and the US. This comparison is based on the scores of candidates in AUTOMATA, a machine-learning based simulated test of programming skills.

| PROGRAMMING ABILITY LEVELS | CHINA | INDIA | USA |
|---|---|---|---|
| A4: write functionally and logically correct code | 2.1% | 4.7% | 18.8% |
| A3: write functionally correct code with few anomalies | 6.5% | 5.2% | 15.3% |
| A2: not able to write functionally correct code | 81.0% | 52.5% | 61.8% |
| A1: not able to write compilable code | 10.4% | 37.7% | 4.1% |

**Table 4: Programming skills comparison across countries**

4.7% of Indian, 2.1% of Chinese and 18.8% of the US job applicants to IT and software industry have good coding skills (write functionally correct code). As we include candidates who can write correct code with few errors, the gap between China (8.6%) and India (9.8%) becomes much lesser. Interestingly, whereas India does much better than China in terms of number of candidates who code well, we find that a much higher proportion of Indian engineers (37.7%) can't write compilable code, as compared to China (10.4%). This means India needs to do much more work to impart coding skills to the masses. The US engineers, on the other hand do four times better than Indian engineers in coding, and have only 4.0% candidates who can't write a compilable code. Interestingly, the base of engineering population in the USA is approximately four times smaller than India. In the global talent war, India needs to significantly up its game in IT skills.

# 4 EMPLOYABILITY BY GENDER

In India, there are 940 females for every 1000 males making the male-to-female ratio (MFR) 1.06. In contrast, the MFR in engineering colleges is 1.79. This shows that a lower proportion of females make it to engineering courses as compared to males. This has increased when compared to the MFR reported in the previous edition (1.68).

Apart from discussing the proportion of males and females in the engineering discipline, throwing some light on the comparative analysis of their scores and employability figures would be interesting. The table below illustrates the same.

| ROLE | MALE | FEMALE |
|---|---|---|
| **IT ROLES** | | |
| Software Engineer – IT Product | 4.03% | 2.54% |
| Software Engineer – IT Services | 16.67% | 15.49% |
| Associate – ITeS Operations (Hardware and Networking ) | 35.81% | 36.88% |
| **ENGINEERING ROLES** | | |
| Design Engineer – Non IT | 6.92% | 5.99% |
| Sales Engineer – Non IT | 19.74% | 20.05% |
| **NON-TECH ROLES** | | |
| Business Analyst – KPO | 9.76% | 8.73% |
| Associate – ITeS/BPO | 39.08% | 39.82% |
| Technical Content Developer | 12.37% | 11.77% |
| Creative Content Developer | 17.07% | 16.96% |

**Table 5: Employability percentage – males vs. females**

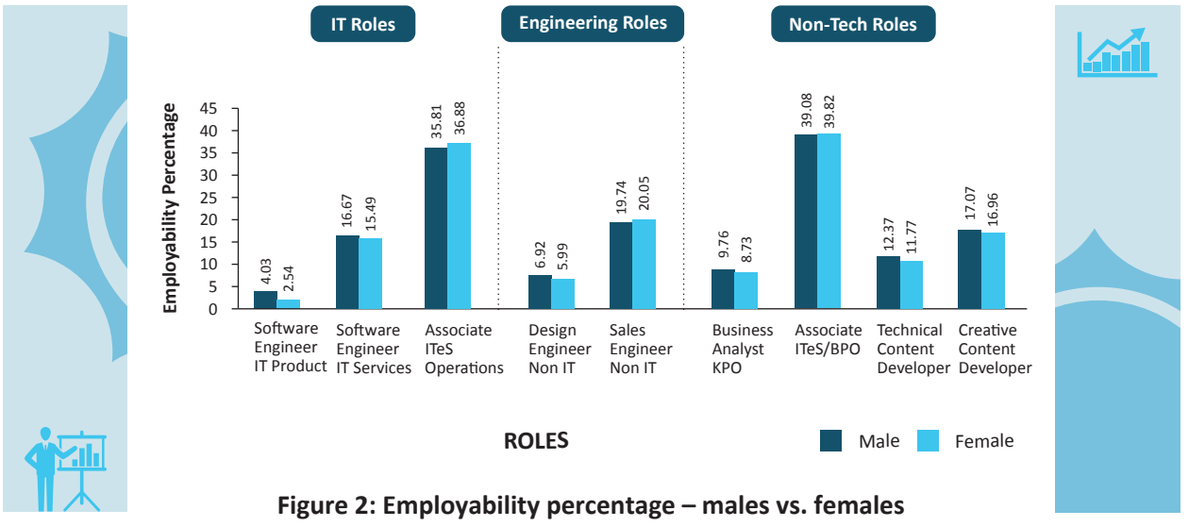



**Figure 2: Employability percentage – males vs. females**

The analysis shows that employability for males and females is almost equal, making each role bereft of any gender-bias.

The reason for employability of males being slightly better than females might be attributed to their performance on Quantitative Ability. The following table shows the mean scores of male and female engineers on AMCAT modules which test their English comprehension skills, cognitive skills and domain knowledge. A 25-point difference is observed between the Quantitative Ability score of males and females. Though these results show the same trends as observed globally, they need to be interpreted from a nuanced perspective, given the debate on the bias of standardized testing scores with regard to gender.

| AMCAT MODULES | MALE | FEMALE | DIFFERENCE |
|---|---|---|---|
| English | 469 | 472 | -2 |
| Quantitative Ability | 470 | 445 | 25 |
| Logical Ability | 458 | 461 | -3 |
| Computer Programming | 389 | 393 | -4 |
| Mechanical Engineering | 374 | 381 | -6 |
| Electronics & Semiconductor | 331 | 324 | 7 |
| Telecommunications | 338 | 332 | 6 |
| Civil Engineering | 362 | 365 | -3 |
| Electrical Engineering | 397 | 388 | 8 |

**Table 6: Average AMCAT scores[12] – males vs. females**

12 All scores in AMCAT modules are on a scale of 100 to 900

In spite of the equal employability of males and females, the ratio of males and females in the national workforce is about 3.0[13]. This is higher in comparison to the ratio found in engineering campuses. We find that the ratio of male-to-female engineers is 1.79, which is almost 1.7 times the population ratio (1.06) but much lower than that of other countries such as the United States of America (4.43). Though the employability of male and female engineers is similar, the current ratio of employed males to females in the workforce is higher than that of the engineering population.

13 https://www.business-standard.com/article/economy-policy/just-around-25-of-india-s-workforce-is-female-says-mckinsey-report-118062000034_1.html

# 5 EMPLOYABILITY BY REGION

By examining the employability of a region we can widen our understanding on employability and decipher the answers to certain critical questions such as: Do the demographic factors of a region influence its employability? Do certain cities exhibit very different employability patterns than their state? This section looks at employability percentages by grouping campuses (and students' permanent address) by their region, the regions being defined according to different demographic parameters. In cases where significant differences emerge, an attempt is made to understand the causes. Very likely, the observation of these differences will prompt other studies to find the causes for these differences, leading to proposals of intervention.

In this section we look at the employability by tier of city, across states and the employability variation between metros and non-metros and some key large cities.

## A. Employability by Tier of Cities

It may be argued that colleges located in Tier 1 cities provide better exposure to students. They may also be the preferred destination for students who have the luxury of choice (and are hence academically superior) and probably the first choice for candidates permanently residing in Tier 1 cities. Tiers were allocated to cities according to population, with the following benchmark (Table 7):

| TIER | POPULATION |
|---|---|
| 1 | Greater than 2.5 million |
| 2 | 0.5-2.5 million |
| 3 | 0-0.5 million |

**Table 7: Classification of tier of cities**

For the analysis, the top 100 campuses were removed from the data set, since these have their own brand presence attracting students from across the country, and are therefore outliers in their respective cities. Most of these colleges are the IITs and NITs, which source candidates through a nationwide exam. The results of the analysis are presented in Table 8.

| ROLE | TIER 1 CITIES | TIER 2 CITIES | % DECREASE (T1 to T2) | TIER 3 CITIES | % DECREASE (T2 to T3) |
|---|---|---|---|---|---|
| **IT ROLES** | | | | | |
| Software Engineer – IT Product | 3.13% | 3.43% | -9.68% | 2.92% | 15.00% |
| Software Engineer – IT Services | 17.27% | 15.95% | 7.63% | 12.71% | 20.36% |
| Associate – ITeS Operations | 37.93% | 35.41% | 6.64% | 32.55% | 8.08% |
| **ENGINEERING ROLES** | | | | | |
| Design Engineer – Non IT | 7.51% | 5.98% | 20.47% | 4.39% | 26.51% |
| Sales Engineer – Non IT | 21.15% | 19.08% | 9.75% | 16.87% | 11.60% |
| **NON-TECH ROLES** | | | | | |
| Business Analyst – KPO | 10.07% | 9.14% | 9.32% | 6.62% | 27.54% |
| Associate – ITeS/BPO | 41.15% | 38.60% | 6.20% | 35.65% | 7.63% |
| Technical Content Developer | 13.39% | 11.48% | 14.26% | 8.62% | 24.88% |
| Creative Content Developer | 19.31% | 15.83% | 18.02% | 12.38% | 21.82% |

**Table 8: Employability percentage across tier 1, tier 2 and tier 3 cities**

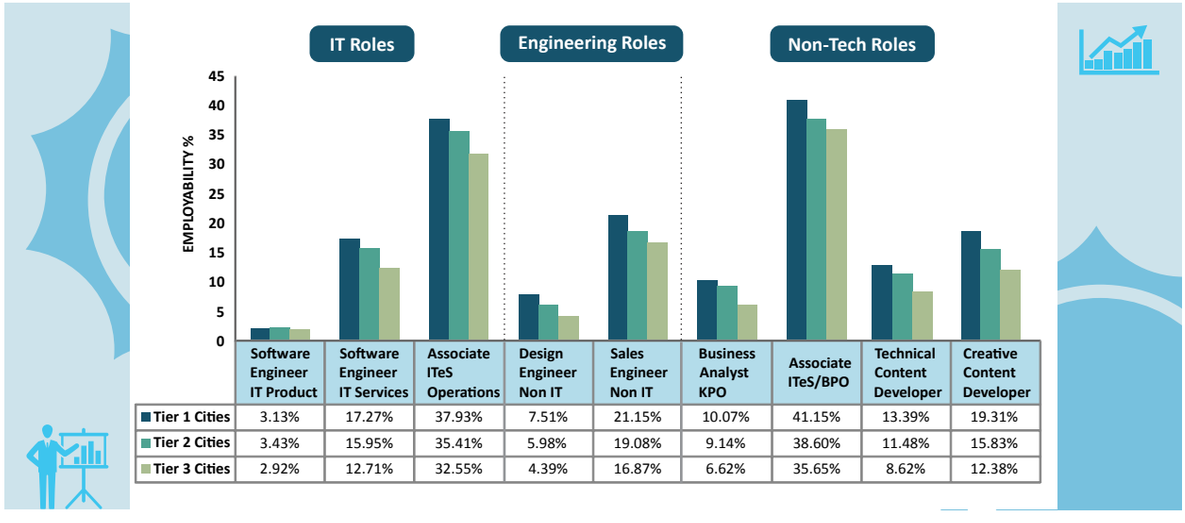



**Figure 3: Employability percentage across tier 1, tier 2 and tier 3 cities**

As expected, a drop is observed in employability of most roles according to the tier of city of the campus location from Tier 1 to Tier 2 cities and similarly from Tier 2 to Tier 3 city of campus location. Compared to the previous edition of the report, the employability in Tier 1 city colleges has marginally decreased for all roles except for design engineer, sales engineer and content developer roles. We observe a declining trend of employability from Tier 1 to Tier 3 cities for all the roles but the employability in IT Product is quite similar for Tier 1 and Tier 2 cities. Tier 3 has a substantial percentage of employable candidates and clearly shows that Tier 3 cities cannot be neglected from a recruitment perspective. The data shows that at least one out of every five engineering colleges is in a Tier 3 city. This means that at least 12.71% of engineers employable in IT Services are in Tier 3 cities – an absolute number of approximately 21,600. These candidates could possibly fill up entry-level hiring needs of several IT services companies.

| AMCAT MODULES | TIER 1 | TIER 2 | TIER 3 | DIFFERENCE BETWEEN TIER 1 & TIER 2 | DIFFERENCE BETWEEN TIER 2 & TIER 3 |
|---|---|---|---|---|---|
| **English** | 480 | 465 | 450 | 15 | 14 |
| **Quantitative Ability** | 462 | 463 | 443 | -1 | 20 |
| **Logical Ability** | 462 | 458 | 450 | 4 | 8 |
| **Computer Programming** | 386 | 393 | 388 | -6 | 4 |
| **Mechanical Engineering** | 381 | 371 | 365 | 10 | 7 |
| **Electronics & Semiconductor** | 330 | 327 | 322 | 2 | 6 |
| **Telecommunications** | 333 | 337 | 331 | -4 | 6 |
| **Civil Engineering** | 362 | 362 | 362 | 0 | 0 |
| **Electrical Engineering** | 399 | 389 | 388 | 10 | 1 |

**Table 9: Average scores across tier 1, tier 2 and tier 3 cities**

The table above shows mean scores in language, aptitude and domain modules across the three tiers of cities. The gap in computer programming has lowered between tier 1 and tier 2 in comparison to tier 2 and tier 3 city students. This explains the pattern of gap in employability seen above.

The study also investigated the skills deficient among students in Tier 3 cities (see Table 9). Contrary to popular opinion, English language is not the only area with the widest gap. English along with Quantitative Ability and Computer Programming make these students ineligible for employment. We find there is a difference in the scores in other core engineering modules across cities which varies according to the city tier. Given the low average scores in these modules across cities, it may be the case that none of the colleges are doing a good job in imparting these skills. The difference in English and cognitive skill modules

may only be a function of the input quality of the students. When compared to the previous edition of the report, there is a consistent trend that the maximum gap (between tier 1 & tier 3 cities) is observed in English, cognitive skills and computer programming and least in other domain skills.

## B. Employability across States

The research looked at the employability according to states where the different engineering campuses are located. The states were placed in four bins in the decreasing order of employability i.e. the states with highest employability percentages were placed in the top 25 percentile bin while those with lower employability percentages were placed in following bins.

The observations are given in Table 10.

| SOFTWARE ENGINEER – IT SERVICES | 2019* |
|---|---|
| Top 25 Percentile | Bihar+Jharkhand<br>Delhi<br>Haryana<br>West Bengal |
| 75 to 50 Percentile | Orissa<br>Telangana<br>Uttarakhand<br>Uttar Pradesh |
| 50 to 25 Percentile | Chhattisgarh<br>Karnataka<br>Punjab<br>Rajasthan |
| Bottom 25 Percentile | Andhra Pradesh<br>Gujarat<br>Madhya Pradesh<br>Maharashtra<br>Tamil Nadu |

*States in each quartile mentioned in alphabetical order

**Table 10: States categorized in 25 percentile bins basis employability in software engineer- IT services role**

We also wanted to see how the results compared vis-a-vis the findings of the previous study[14] . As compared to the previous edition of the report, Bihar + Jharkhand and Delhi have managed to retain their positions; Punjab and Karnataka have fallen to the 3rd quartile (50 to 25 percentile bin) and Orissa to 2nd quartile (75 to 50 percentile bin). Haryana and West Bengal are the new entrants in the top 25 percentile bin. Gujarat and Tamil Nadu continue to lurk in the bottom 25 percentile bin. Uttar Pradesh and Uttarakhand have shifted from the 3rd quartile to the 2nd quartile (75 to 50 percentile).

It may be observed, like the previous employability reports that states with the highest number of colleges show the lowest percent employability. We find a correlation[15] of 0.55 between the logarithm of number of colleges and the percent employability in the state. This is in sync with Arrow's hypothesis, that higher

14 National Employability Report - Engineers 2016
15 Correlation is a statistical measure that indicates the extent to which two or more variables fluctuate together

education acts as a filter and if everyone starts becoming an engineer, the percentage of employable candidates will sharply decrease.

Based on these observations, in 2016, we had recommended that there is a greater need for improvement in the quality of education in colleges rather than concentrating on building new colleges. Capacity building in engineering education with 3000+ colleges will pay a long-term dividend only if there is healthy competition leading to improvement of education. Interestingly, in the last couple of years, the same opinion has been echoed by several stakeholders. Whereas several states have requested AICTE to reject proposals[16] for new colleges, colleges have shut down in certain areas and the media has actively championed the cause of better education rather than focusing on number of engineering colleges. In our own interactions with colleges, they show deep interest in improving employability and are adopting the idea of employability assessment from the first year onwards to identify gaps and fill them.

16 http://articles.timesofindia.indiatimes.com/2012-02-28/news/31107310_1_aicte-engineering-colleges-management-colleges

## C. Employability in Metros vs. Non-metros

The research brings forth the employability of candidates graduating from colleges in metro cities, in comparison to those in non-metro cities. The general view remains that colleges in metros produce more employable candidates due to better exposure and education, which explains why parents often prefer colleges in metros as opposed to others while making an admission decision. The employability figures based on the analysis are reported in Table 11:

**Metros vs. Non-metros by college city**

| ROLE | METRO | NON METRO | % DECREASE FROM METRO TO NON-METRO |
|---|---|---|---|
| **IT ROLES** | | | |
| Software Engineer – IT Product | 3.43% | 3.39% | 1.17% |
| Software Engineer – IT Services | 18.11% | 15.07% | 16.79% |
| Associate – ITeS Operations | 38.57% | 34.71% | 10.01% |
| **ENGINEERING ROLES** | | | |
| Design Engineer – Non IT | 8.47% | 5.71% | 32.59% |
| Sales Engineer – Non IT | 22.11% | 18.64% | 15.70% |
| **NON-TECH ROLES** | | | |
| Business Analyst – KPO | 10.92% | 8.42% | 22.89% |
| Associate – ITeS/BPO | 41.80% | 37.81% | 9.55% |
| Technical Content Developer | 14.84% | 10.71% | 27.83% |
| Creative Content Developer | 21.02% | 14.90% | 29.12% |

**Table 11: Metros vs. non-metros- employability by city of college**

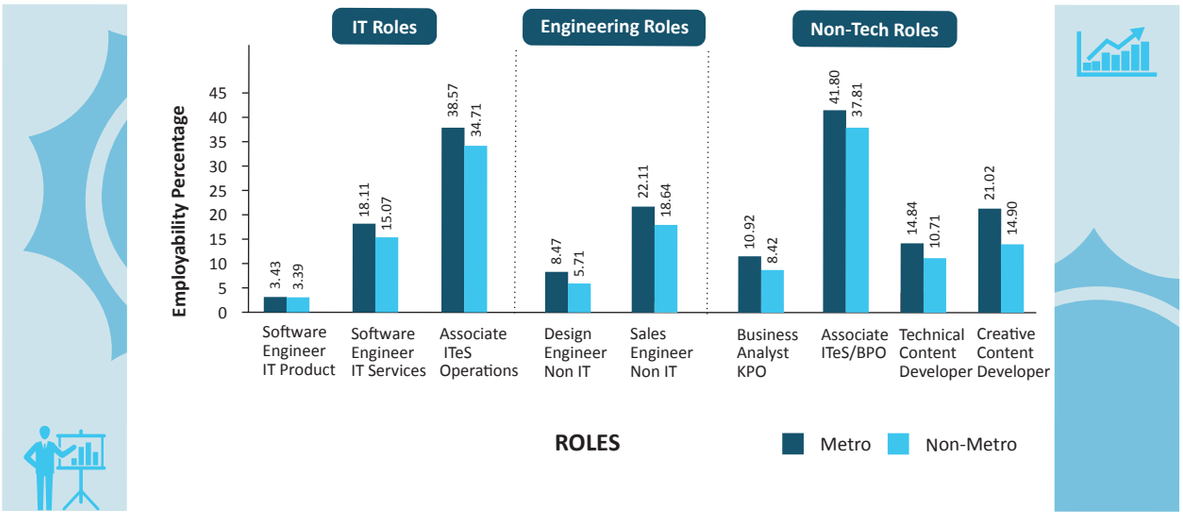



**Figure 4: Metros vs. non-metros- employability by city of college**

It may be noted that even though colleges in non-metro cities have lower employability, the difference is not too much. Among all roles, the decrease in employability in software engineers – IT Services, business analyst, content developers and design engineer roles is higher compared to the rest. The table below which shows the difference in mean AMCAT scores between metros and non-metros.

| AMCAT MODULES | METRO | NON METRO | DIFFERENCE |
|---|---|---|---|
| English | 485 | 461 | 25 |
| Quantitative Ability | 465 | 458 | 7 |
| Logical Ability | 464 | 456 | 8 |
| Computer Programming | 388 | 392 | -4 |
| Mechanical Engineering | 385 | 370 | 15 |
| Electronics & Semiconductor | 331 | 326 | 5 |
| Telecommunications | 334 | 335 | -1 |
| Civil Engineering | 364 | 362 | 2 |
| Electrical Engineering | 402 | 391 | 11 |

**Table 12: Metros vs. non-metros- mean AMCAT scores by city of college**

From the table we can see that students studying in metro cities have higher scores in almost all the modules than students studying in non-metro cities. We also observe that the widest gap is in English scores whereas the gap in other modules is less. This can be attributed to the fact that the campuses in

metros have better exposure to English. Since English comprehension and writing skills are very important for business analyst, technical and creative content developer roles, difference in English scores explains for the gap in employability. Strong hold on domain knowledge along with basic to advanced English are a must for those in design engineering roles. Employability gaps in these roles can be attributed to the differences in English scores as well as minor but existent difference in domain modules.

**Metros vs. Non-metros by permanent residence**

| ROLE | METRO | NON METRO | % DECREASE FROM METRO TO NON-METRO |
|---|---|---|---|
| **IT ROLES** | | | |
| Software Engineer – IT Product | 3.76% | 3.27% | 12.94% |
| Software Engineer – IT Services | 20.05% | 15.01% | 25.13% |
| Associate – ITeS Operations | 40.76% | 34.72% | 14.82% |
| **ENGINEERING ROLES** | | | |
| Design Engineer – Non IT | 8.76% | 6.06% | 30.80% |
| Sales Engineer – Non IT | 22.52% | 19.01% | 15.55% |
| **NON-TECH ROLES** | | | |
| Business Analyst – KPO | 12.64% | 8.33% | 34.09% |
| Associate – ITeS/BPO | 44.10% | 37.81% | 14.26% |
| Technical Content Developer | 17.19% | 10.57% | 38.48% |
| Creative Content Developer | 24.45% | 14.71% | 39.84% |

**Table 13: Metros vs. non-metros- employability by city of permanent residence**

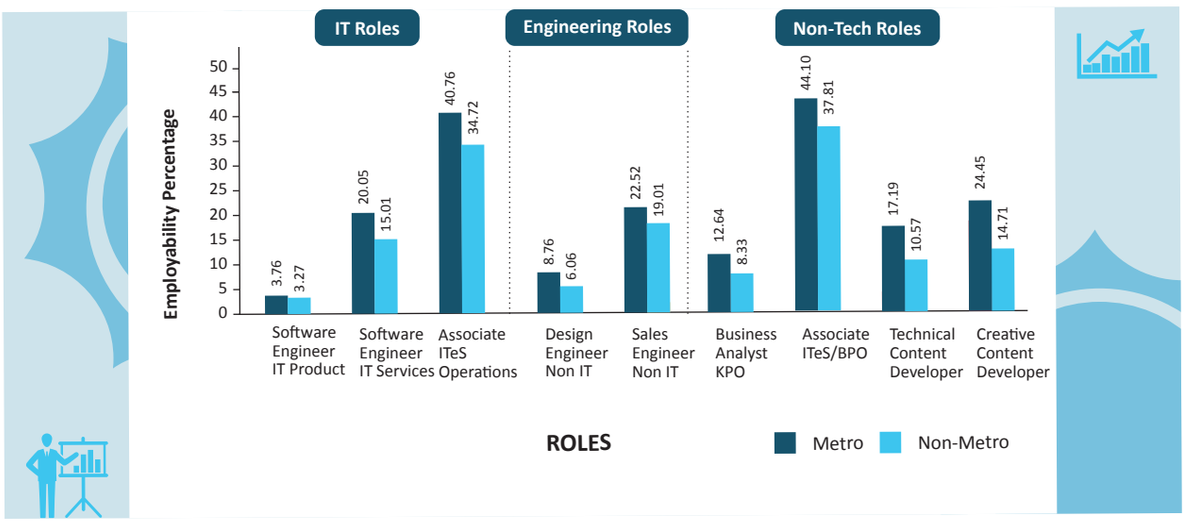



**Figure 5: Metros vs. non-metros- employability by city of permanent residence**

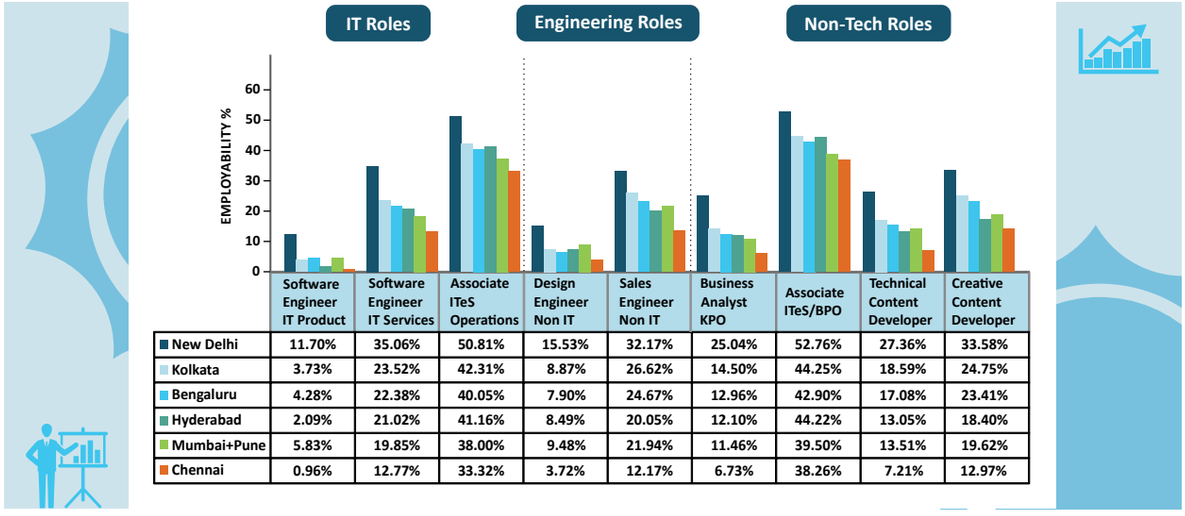
When the average scores of candidates with permanent residence in metros and non-metros were compared (see Table 14), the trends came out to be quite similar to that of the comparison based on college location. There is an appreciable gap in employability for all roles except IT-Product, ITeS roles and sales engineers. On looking at the mean scores in the table below, it can be seen that the difference has gone up in English. These results are better in comparison to those observed in the previous edition of the report, wherein the differences in cognitive ability and programming were also high.

| AMCAT MODULES | METRO | NON METRO | DIFFERENCE |
|---|---|---|---|
| English | 501 | 460 | 41 |
| Quantitative Ability | 469 | 458 | 10 |
| Logical Ability | 467 | 456 | 11 |
| Computer Programming | 394 | 389 | 5 |
| Mechanical Engineering | 383 | 373 | 11 |
| Electronics & Semiconductor | 329 | 327 | 2 |
| Telecommunications | 335 | 335 | 0 |
| Civil Engineering | 361 | 363 | -2 |
| Electrical Engineering | 402 | 392 | 9 |

**Table 14: Metros vs. non-metros- mean AMCAT scores by city of permanent residence**

## D. Employability in Key Cities

The study also compared employability within students graduating out of different metro cities in the country. The results are reported in Figure 6.




| | Software Engineer IT Product | Software Engineer IT Services | Associate ITeS Operations | Design Engineer Non IT | Sales Engineer Non IT | Business Analyst KPO | Associate ITeS/BPO | Technical Content Developer | Creative Content Developer |
|---|---|---|---|---|---|---|---|---|---|
| New Delhi | 11.70% | 35.06% | 50.81% | 15.53% | 32.17% | 25.04% | 52.76% | 27.36% | 33.58% |
| Kolkata | 3.73% | 23.52% | 42.31% | 8.87% | 26.62% | 14.50% | 44.25% | 18.59% | 24.75% |
| Bengaluru | 4.28% | 22.38% | 40.05% | 7.90% | 24.67% | 12.96% | 42.90% | 17.08% | 23.41% |
| Hyderabad | 2.09% | 21.02% | 41.16% | 8.49% | 20.05% | 12.10% | 44.22% | 13.05% | 18.40% |
| Mumbai+Pune | 5.83% | 19.85% | 38.00% | 9.48% | 21.94% | 11.46% | 39.50% | 13.51% | 19.62% |
| Chennai | 0.96% | 12.77% | 33.32% | 3.72% | 12.17% | 6.73% | 38.26% | 7.21% | 12.97% |

**Figure 6: Employability percentage in different metro cities**

The following observations are made:

The trends are similar to those with regard to employability in states. Delhi (North) shows the highest employability, followed by Kolkata. The lowest employability figures were observed among colleges in southern cities. The skew in employability is quite high, for instance, the IT product employability in Delhi is as high as 1 in every 8 candidates and as low as 1 in every 100 in Chennai. Even though Mumbai/Pune have similar IT services employability as compared to other southern cities, the city shows much higher employability for IT product companies. This indicates that candidates in Mumbai/Pune region do much better at computer programming and algorithms, even though they show similar English and cognitive skills. This could be due to better exposure to computer programming either at home, schools or colleges.

The reason for this skew in employability is explained by the trend in number of colleges in each of these cities. The proliferation of engineering colleges in southern India has brought down the employability figures. In comparison, there are far fewer engineering colleges in Delhi. This is despite the fact that Delhi's population is much more than southern cities (see Table 15).

| CITY | APPROXIMATE NUMBER OF COLLEGES | POPULATION |
|---|---|---|
| Delhi | 30 | 190 lakhs |
| Kolkata | 28 | 45 lakhs |
| Bengaluru | 47 | 123 lakhs |
| Hyderabad | 49 | 68 lakhs |
| Mumbai and Pune | 67 | 215 lakhs |
| Chennai | 64 | 71 lakhs |

**Table 15: Number of colleges and population in major cities**

In summary, the study found that employability trends show significant variation with respect to the location of the campus. The employability gap was found to be substantial between the tiers of college cities (classified by population). The major gap in skills was observed in command over English language. With regard to employability percent in different states, it was found that employability decreases logarithmically with the number of colleges in the state (in sync with Arrow's hypothesis). Also, whereas there was no appreciable difference in employability of students coming out of colleges in metros and non-metros, there was a significant difference between employability of candidates living in metros versus the rest. This clearly shows that candidates who have spent a significant part of their lives in metros gain better exposure to English helping them become more employable. The key learning of this study is that we need to emphasize more on quality than number of colleges.

# 6 EMPLOYABILITY VARIANCE IN CAMPUSES

Across more than 3000 engineering campuses in India, the employability varies dramatically. This can be accredited to the synergic effect of multiple parameters viz. the quality of intake, education, infrastructure, location and the likes. Understanding this employability variance, its intensity and causes is of extreme importance. The following detailed analysis throws light on this realm.

**Employability in top-tier campuses vs. the rest**

Using the campus-rankings provided by various credible public surveys, we analyzed the employability on engineering campuses in India and segregated the top 100 campuses from the rest. The following table present the comparative analysis of the employability for Top 100 colleges versus the rest.

| ROLE | TOP 100 COLLEGES | REST OF THE COLLEGES | % DECREASE (TOP- REST) |
|---|---|---|---|
| **IT ROLES** | | | |
| Software Engineer – IT Product | 22.67% | 3.18% | 85.97% |
| Software Engineer – IT Services | 36.29% | 15.83% | 56.36% |
| Associate – ITeS Operations | 50.68% | 35.90% | 29.16% |
| **ENGINEERING ROLES** | | | |
| Design Engineer – Non IT | 23.34% | 6.22% | 73.36% |
| Sales Engineer – Non IT | 42.49% | 19.44% | 54.26% |
| **NON-TECH ROLES** | | | |
| Business Analyst – KPO | 27.84% | 9.01% | 67.65% |
| Associate – ITeS/BPO | 52.20% | 39.09% | 25.12% |
| Technical Content Developer | 40.91% | 11.63% | 71.58% |
| Creative Content Developer | 46.55% | 16.49% | 64.56% |

**Table 16: Employability percentage- top 100 colleges vs. rest**

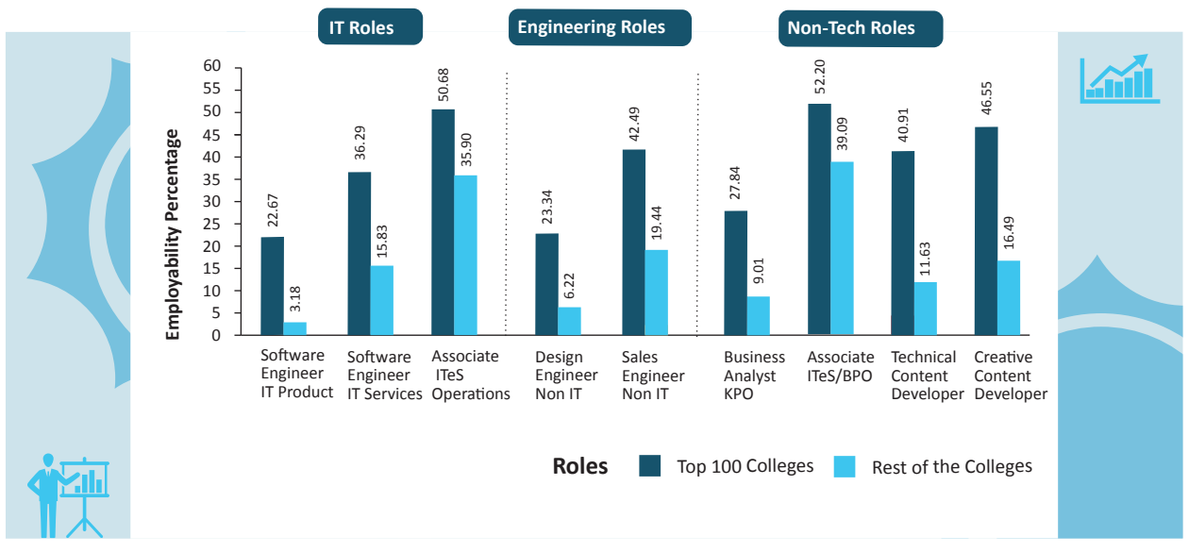



**Figure 7: Employability percentage- top 100 vs. rest**

The following trends were observed:

- The maximum drop in employability figures for top 100 campuses vs. the rest has been observed in the following sectors: IT Product (86%) followed by design engineer (73%), content developers (72% to 65%) and business analyst (68%), while the minimal difference is observed for Associate – ITeS/BPO.

- Given that the ratio of the number of top 100 campuses to the rest is almost 1 is to 10, one can conservatively estimate that more than 60% of the employable engineers for the IT product role and more than 80% for IT services and KPO roles, are in the so-called tier 2 campuses. According to current trends, IT product and KPO companies do not source candidates from tier 2 campuses which creates a large artificial dip in the supply of eligible candidates. This is in line with what was reported in the 2016 and 2014 national employability reports for engineers by Aspiring Minds.[17]

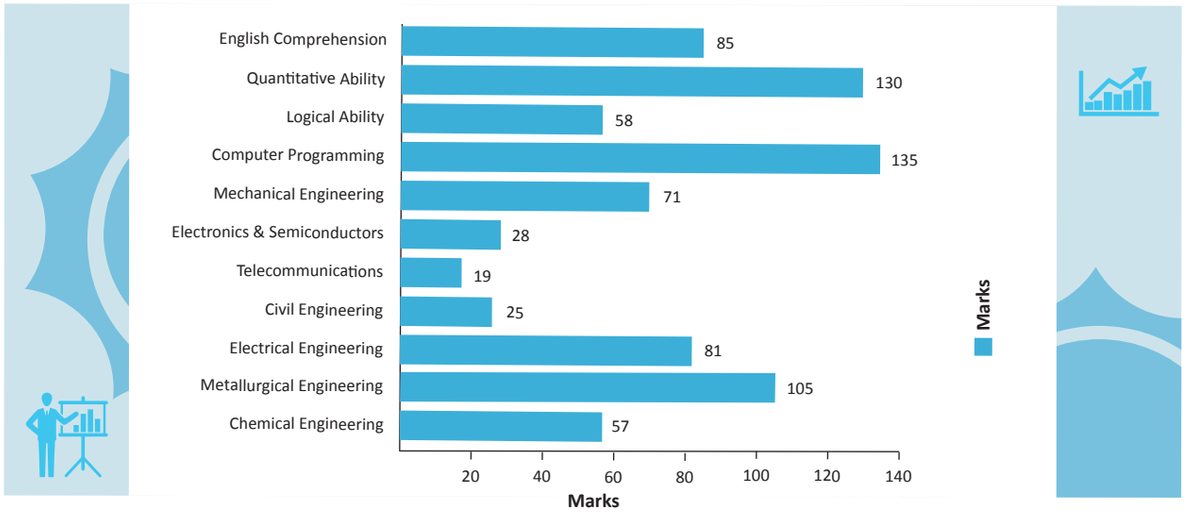



**Figure 8: Skill gap- top 100 vs. other campuses**

17 National Employability Report Engineers 2016; National Employability Report Engineers 2014

The study also investigated what skills are lacking in students of tier 2 campuses (see figure above). There is a gap of 85, 58 and 135 marks in English Communication, Logical Ability and Computer Programming, respectively, whereas the gap in Quantitative Ability is 130 marks. In other domains like Civil, Electrical, Mechanical and Electronics the difference is around 19-81 marks. This clearly shows that maximum effort is required to hone mathematical skills of the students, whereas consistent effort is needed in other areas as well. These results are congruous to the observations in the previous edition of the report.

# 7 JOB ASPIRATIONS OF ENGINEERS

After studying the employability trends of engineers across roles and sectors, we will now delve into aspirations of engineers in terms of the job function, type of company, sector and compensation strived for by engineers. We devised a methodical survey to understand these aforementioned aspirations of engineers and rolled it out to a sample of about 30,000 engineering students across India. Basis the survey responses, the aspirations of engineers were studied. We also explored the effect of parameters like branch of study, gender, tier of city and tier of college on job aspirations of engineers and came up with following set of interesting inferences.

A brief explanation of the classifications used in this section is provided below.

**Branch of study**

The Computer/IT branch includes engineers in Computer Science & Information Technology. The circuit branches include Electronics Engineering, Electrical Engineering, and Instrumentation Engineering. The core engineering branches include other branches like Mechanical Engineering, Civil Engineering, etc.

**Tier of city**

Tiers were allocated to cities, where the colleges were located, according to their population. The classification of the tier of cities was followed as per Table 7.

**Tier of college**

All the colleges were ranked basis the employability of their students. Those in the top 33 percentile were considered as tier 1 colleges, those in mid-33 percentile range were considered as tier 2 colleges while those in the bottom 33 percentile set were taken as tier 3 colleges.

## A. Type of Company

Here we asked students about their top preference among a large company, an SME (less than 100 employees) and a start-up.

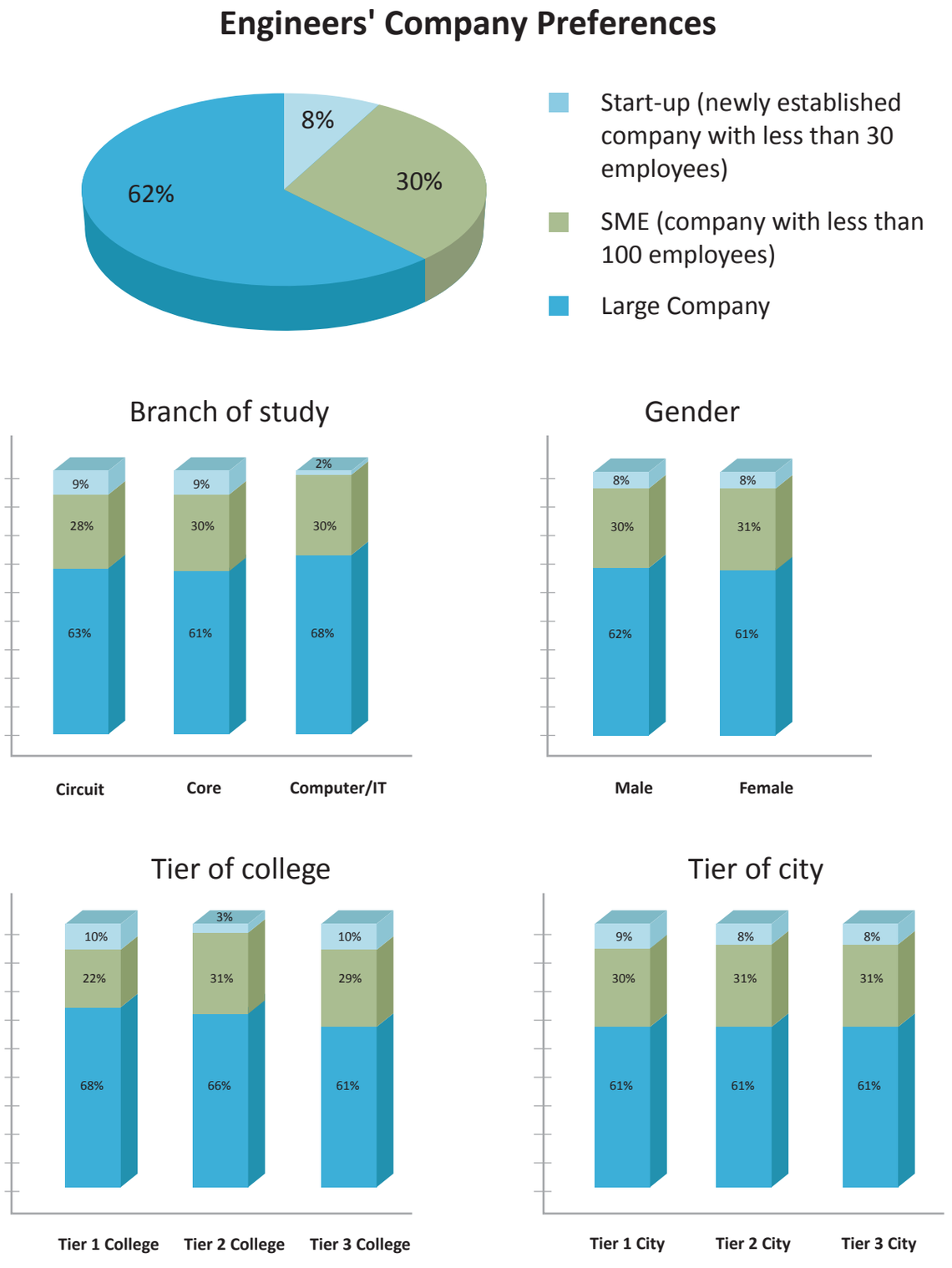



**Figure 9: Preference among a large company, an SME and a start-up**

## Observations

In comparison to the previous edition, the aspirations of engineers to work for a large company has decreased by 15%. A slight increase is observed in the inclination of students towards start-up jobs. Given this evident trend and the rapidly blooming start-up ecosystem in the country, the aspirations of engineers to work for start-up is bound to increase.

**By branch of study:** The aspirations of engineers across all three branches of study are similar. Irrespective of the branch of study, maximum engineers opt for a job with a large company while a small but appreciable set of engineers opt for jobs with start-up.

**By gender:** Both males and females strive to work for a large company. Females are more inclined to work for SMEs than their male counterparts. A small percentage of males as well as females wish to work for start-ups.

**By tier of college:** Similar to the observations in the previous study, we find that students from lower tier institutions are less interested to work in larger companies. This is mostly because they believe that while getting a job in a large company would be difficult, the probability to get the job at an SME is fairly high. The tier 2 college students show minimum inclination towards start-up jobs.

**By tier of city:** One finds that students from all tiers equally prefer to work for large companies. The students from tier 1 are most motivated to work for a start-up than students from other tiers.

## B. Role Aspirations

We surveyed the students about their top preferences in the kind of job roles: software development, core engineering jobs (like mechanical, electrical, electronics or civil engineer) and management related jobs.

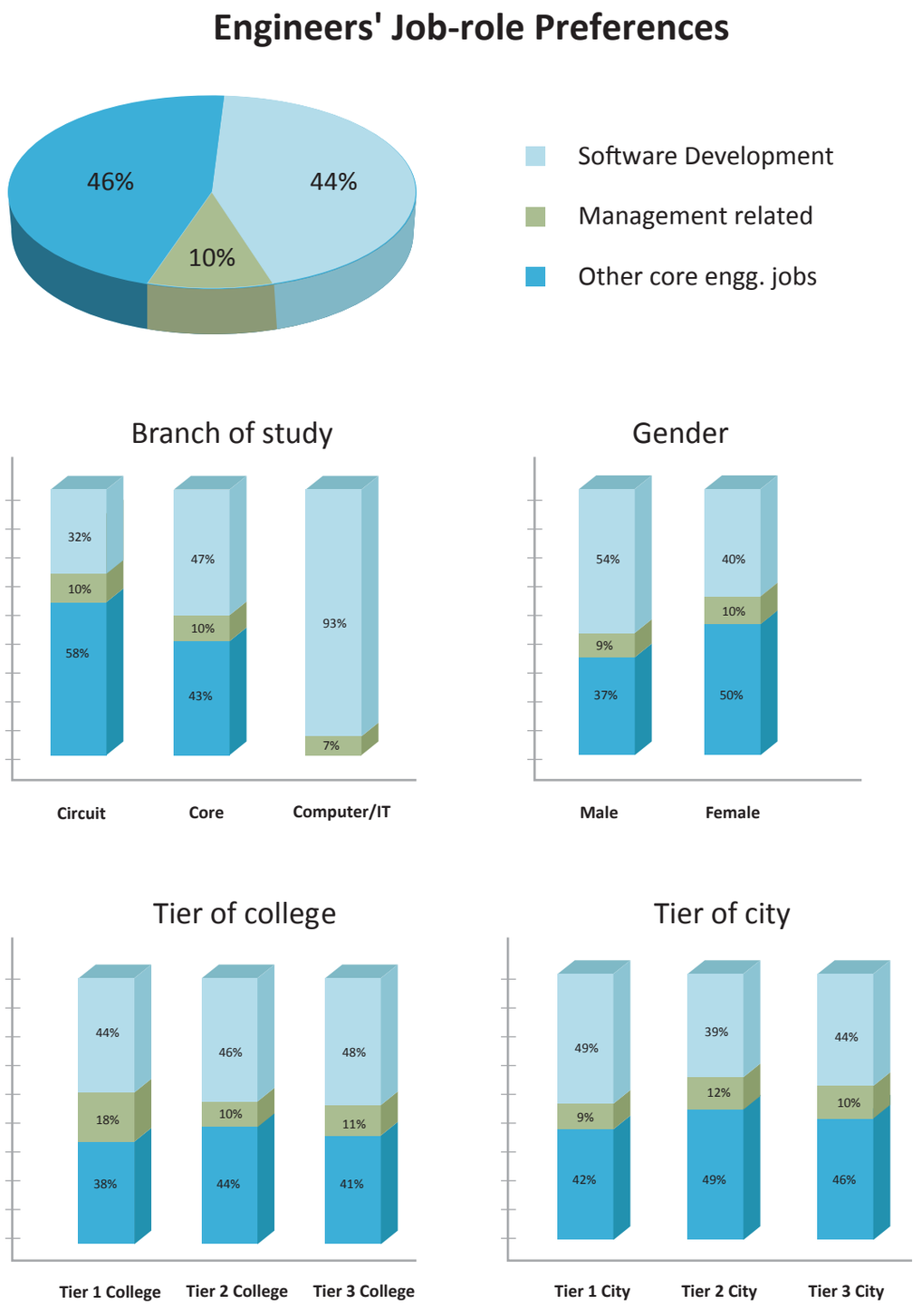



**Figure 10: Job-role preference among software development, core engineering jobs (like mechanical, electrical, electronics or civil engineer) and management related jobs**

More than 46% of engineers seek core engineering jobs followed by software jobs (44%). Despite of the mushrooming job opportunities in managerial roles like technical sales, marketing and content development, engineers do not seem to prefer these jobs as yet.

**By branch of study:** Students with Computer/IT background are mostly interested in software jobs while students with core engineering branches equally prefer software and core engineering jobs. The students from circuit branches are more inclined towards core engineering jobs. This aspiration fails to appear rosy as the employment statistics for core engineering jobs are grim.

**By gender:** More females aspire to work in managerial as compared to males. Males are more inclined towards software developer roles, while more females seek core engineering roles. This trend is in-contrast with the observations of the previous study.

**By tier of college:** Students from tier 3 institutions opt for software development roles more than other tiers whereas core engineering roles are preferred more by students from tier 2 colleges. For management related roles, students from tier 1 colleges show maximum inclination.

**By tier of city:** Engineers from tier 1 city aspire for software development roles more than those from tier 2 and tier 3 cities. Interestingly, students from lower tier cities aspire for management related roles more than the students from tier 1 cities.

## C. Salary Aspirations

Students were asked about their salary expectations.

| EXPECTED SALARY (in INR Lakhs) | MEAN | STANDARD DEVIATION | MAXIMUM | MINIMUM |
|---|---|---|---|---|
| **2018 Batch Engineers** | 4.18 | 1.55 | 20 | 1 |

**Table 17: Salary expectations of students**

**By branch of study**

| EXPECTED SALARY (in INR Lakhs) | MEAN | STANDARD DEVIATION | MAXIMUM | MINIMUM |
|---|---|---|---|---|
| **Computer/IT** | 4.16 | 1.15 | 8 | 2 |
| **Circuit Branches** | 4.05 | 1.41 | 20 | 1 |
| **Core Engineering** | 4.23 | 1.61 | 15 | 1 |

**Table 18: Salary expectations of students of different branches**

Consistent with previous edition's inferences, core branch engineers aspire for a higher salary than other engineers. Though this is not in-line with market trends as it is well known that software development jobs are the ones that command the highest pay.

**By gender**

| EXPECTED SALARY (in INR Lakhs) | MEAN | STANDARD DEVIATION | MAXIMUM | MINIMUM |
|---|---|---|---|---|
| **Male** | 4.24 | 1.63 | 15 | 1 |
| **Female** | 4.03 | 1.41 | 20 | 1 |

**Table 19: Salary expectations of males and females**

On an average, females aspire for a slightly lesser salary than males do. This shows females are less ambitious, as congruous to other studies in the world[18].

18 http://www.telegraph.co.uk/women/womens-business/10116221/Female-grads-expect-to-earn-less-than-men-prompting-concerns-they-are-less-ambitious.html

**By tier of college**

| EXPECTED SALARY (in INR Lakhs) | MEAN | STANDARD DEVIATION | MAXIMUM | MINIMUM |
|---|---|---|---|---|
| **Tier 1** | 5.07 | 1.91 | 20 | 3 |
| **Tier 2** | 4.39 | 1.65 | 15 | 1.5 |
| **Tier 3** | 4.01 | 1.37 | 12 | 1 |

**Table 20: Salary expectations of students of different tier of colleges**

Engineers from tier 1 colleges aspire for a much higher salary in comparison to tier 2 and tier 3 college engineers. This is in-line with our observation on role aspirations wherein tier 3 students don't opt for large companies simply because they think they won't make it. They limit their salary aspirations likewise and don't aspire for a good pay.

**By tier of city**

| EXPECTED SALARY (in INR Lakhs) | MEAN | STANDARD DEVIATION | MAXIMUM | MINIMUM |
|---|---|---|---|---|
| **Tier 1** | 4.23 | 1.69 | 20 | 1 |
| **Tier 2** | 4.26 | 1.53 | 15 | 1 |
| **Tier 3** | 4.00 | 1.38 | 15 | 1 |

**Table 21: Salary expectations of students of different tier of cities**

Mean salary which engineers from tier 1 and tier 2 cities aspire for are relatively similar while it is lower for those from tier 3 cities.

# 8 FACTORS INFLUENCING EMPLOYABILITY

We did a survey to find the level of seriousness and to check job readiness measures taken by students and universities. We tried to understand the reasons for the low employability. This survey's aim was to discern if the students take less initiative or is there a dearth of opportunities in the market. The observations of the survey are given below.

## A. Student Initiative

This section looks at the kind of initiatives students take, towards being job-ready. This includes performing internships, doing technical projects and attending industry talks.

**Internships:** We asked the students if they had done any two month long internship and the kind of work they did at the internship

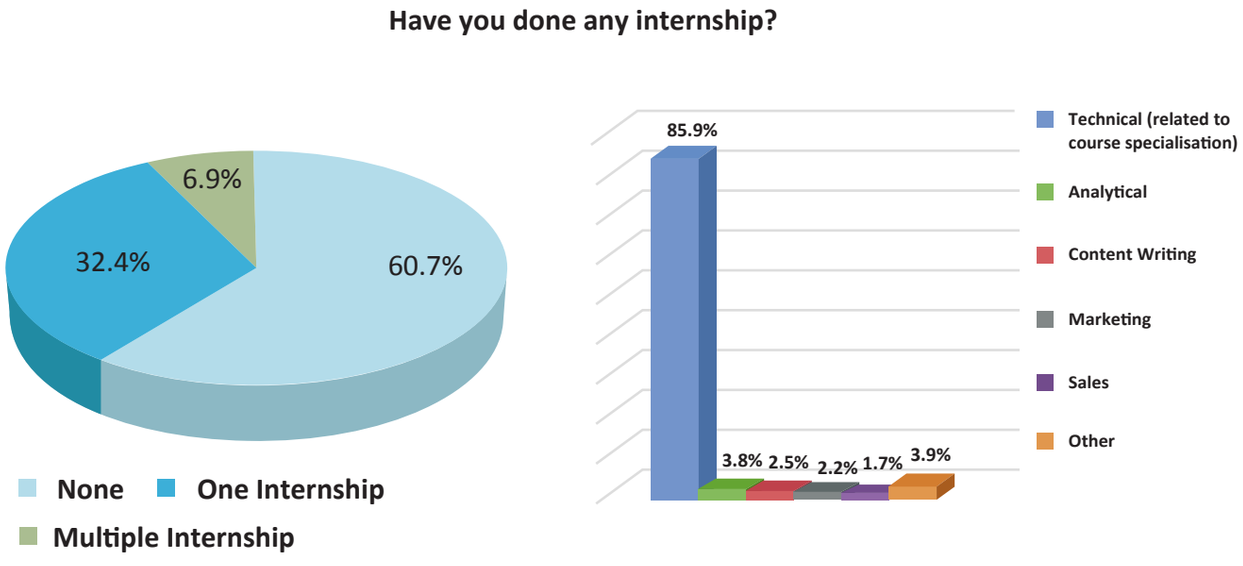



**Figure 11: Internships done and the kind of work done at internships**

The two month internships done show the extent of initiative taken by students and their seriousness towards being job ready as the internships are launching pads for final jobs.

Only 40% of the candidates are serious about taking up internships. A mere 7% of the candidate pool did multiple internships. Of those who performed internships, the work was related to their field of study for the majority of them (86%).

There is a need for intervention from colleges to encourage students to take up internships. Credits

should be awarded to students for internships in third and fourth year of graduation.

**Technical Projects:** We asked the students about the technical projects undertaken by them and if they got any support from faculty members to take up projects outside their curriculum

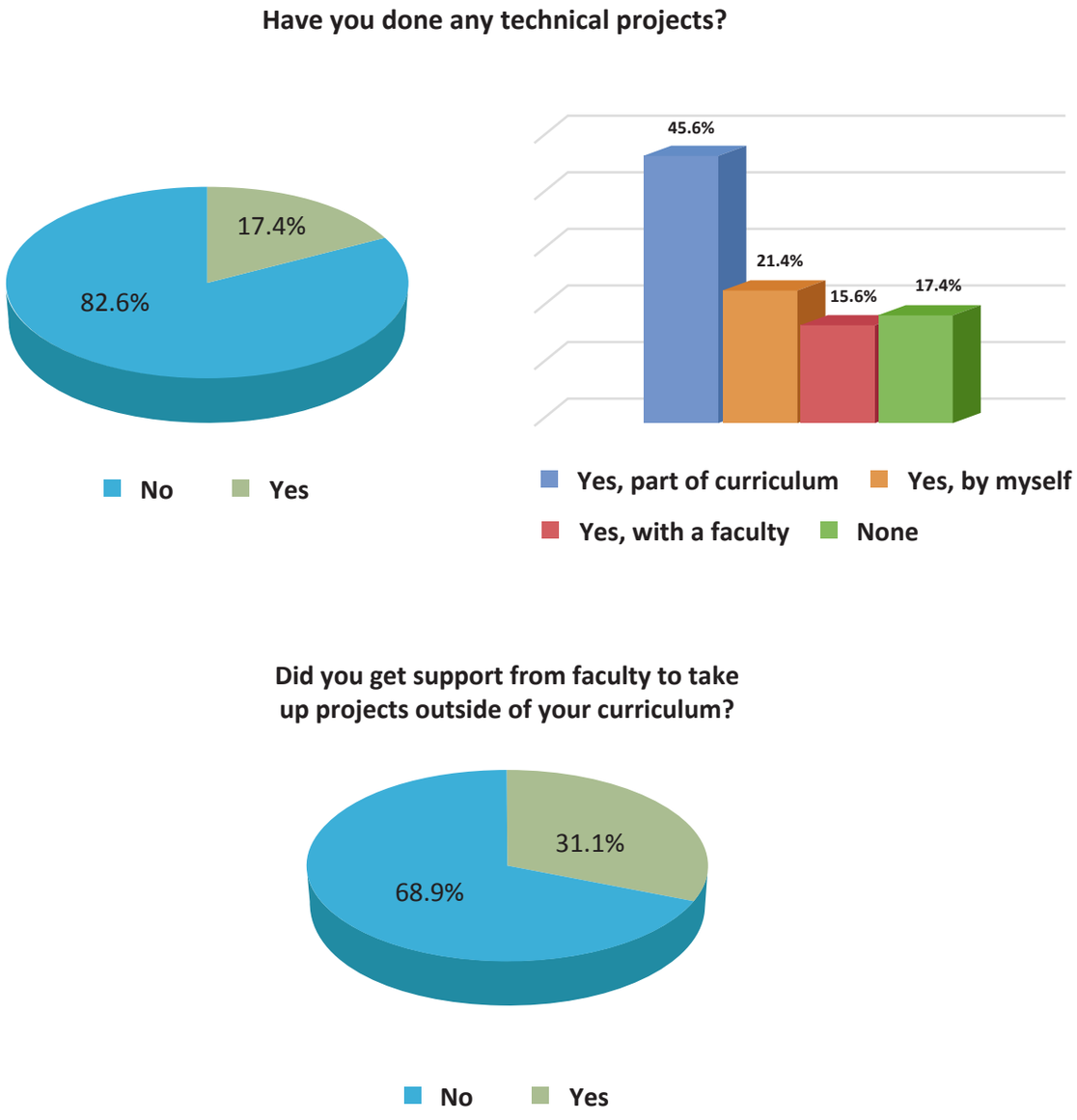



**Figure 12: Technical projects undertaken and support from the faculty**

The projects cover the technical aspects that a student learns throughout his course.

A good percentage (82%) of the students apply their knowledge obtained through their coursework by working on technical projects. But 45.59% of these students do these technical projects only because it is part of their course curriculum.

**Talks Attended:** Here we asked the students about any industry talk that they may have attended during their college years

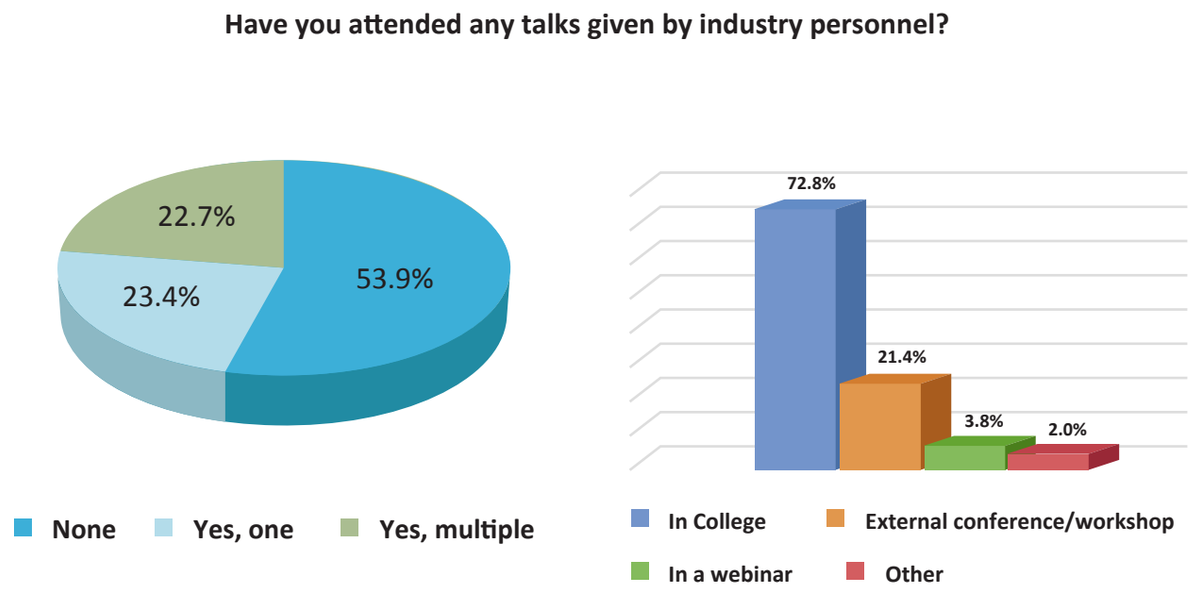


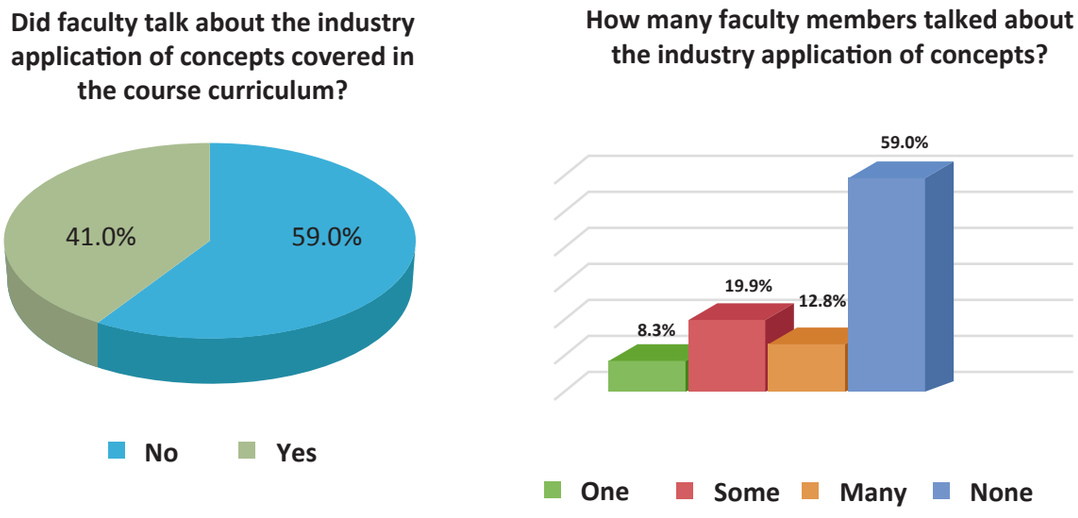

**Figure 13: Talks attended**

The talks by industry personnel provide exposure to students and keep them updated on current industry trends.

Only a small percentage (22.73%) of students have attended multiple talks, while over 50% of students have not attended even a single talk by an industry personnel. Over 72% of students have attended talks within their college and have rarely been to seminars, workshops or conferences outside college.

## B. Faculty Support

In this section, we explore the support offered by the faculty members and college administration for students to improve their skills and acquire practical knowledge.



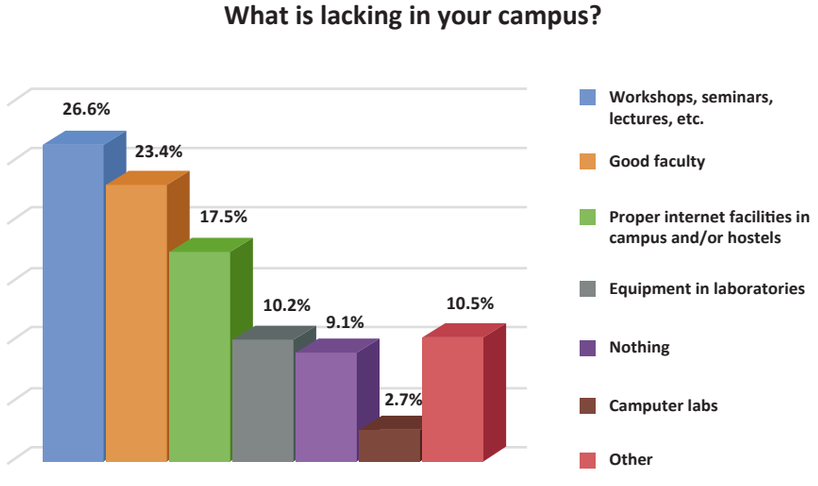




**Figure 14: Support from college and faculty**

The support and motivation from colleges and faculties helps students to boost their confidence and become industry-ready. However, the current state of affairs is not very encouraging.

Almost 60% candidates feel that focus on practical applications by faculty is very low. Half of the students point out that there is low focus on workshops and seminars along with unavailability of good faculty in colleges.

Teachers and colleges should focus on industry applications of the concepts covered in the curriculum which enable students to overcome the gap between theoretical knowledge and industry requirements. This can be done by organizing workshops and seminars and talks by industry personnel.

## C. Employability Challenges

This section focuses on the major challenges faced by the students in getting jobs which can help highlight the necessary initiatives that need to be taken to improve employability.

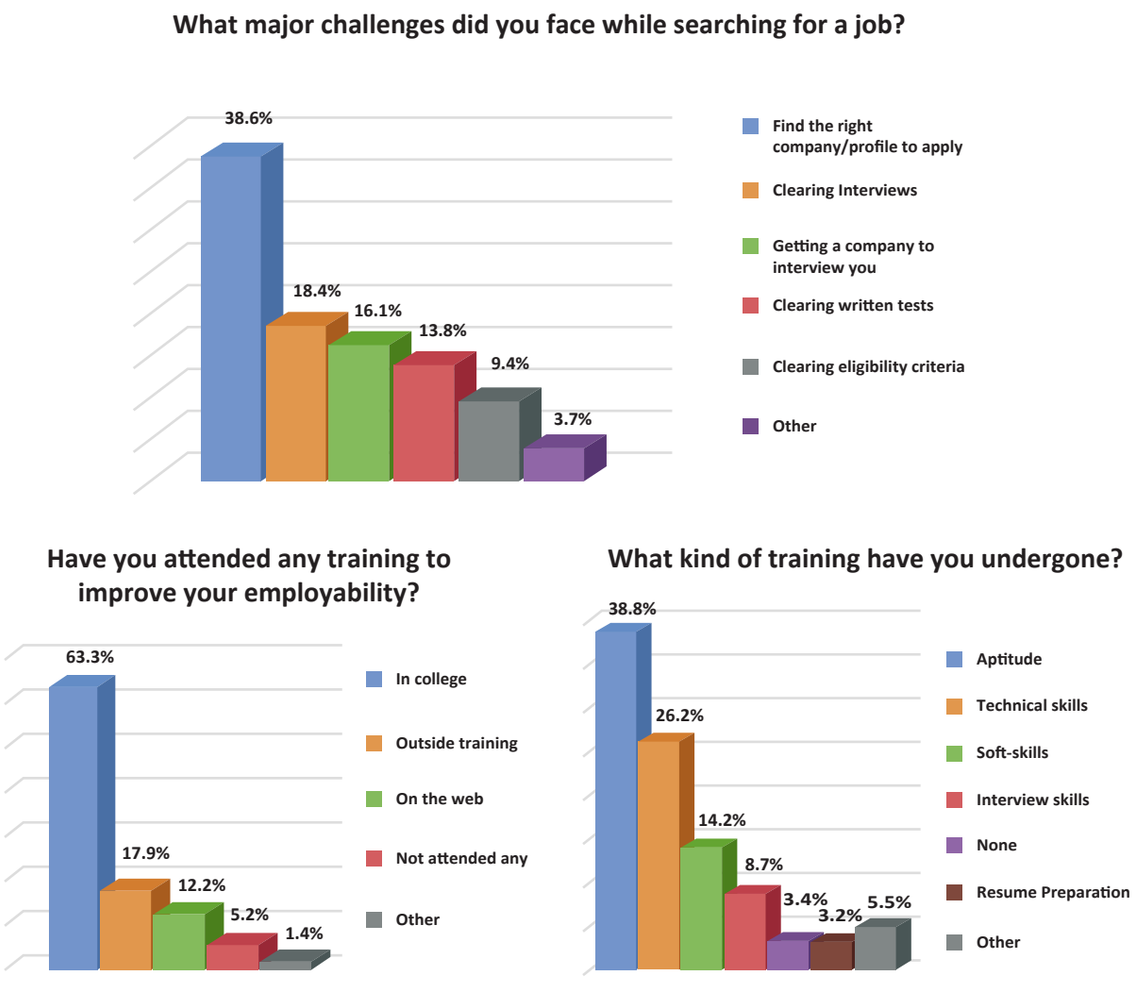



**Figure 15: Employability challenges**

The candidates feel that finding the right company and profile to apply for is their biggest challenge followed by clearing the interviews. Over 95% of students have undertaken some kind of training to improve their employability but it was mostly in college.

There is a lack of initiative and measures taken by students to improve their chances of getting a job. Most students only focus on aptitude and not on interview preparation and therefore they find it hard to clear interviews.

# NOTES

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AI-powered Talent Evaluation

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