International Journal of Trend in Scientific Research and Development (IJTSRD)
International Conference of Multidisciplinary Research – September 2023
Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

English Soft Skills for Engineers

A. Srinivas

Mentor of English, Department of Humanities,
Rajiv Gandhi University of Knowledge Technologies, IIIT Basar, Telangana, India

1. INTRODUCTION

There has never been a better time to be an engineer. In many sectors, new technologies mean there are a growing number of opportunities for individuals with the right training and experience.

Therefore, it can be frustrating when you think you've got the perfect CV but don't get that call back after your interview. The same applies when you don't get a promotion you think you're ready for. After all, you've got the right qualifications and technical abilities, so why didn't you get the job?

Technical skills alone are no longer sufficient for many employers. Furthermore, technical skills alone will only take your career and levels of job satisfaction so far. So, what can you do?

One Common Career Mistake Engineers Make

Too often, engineers focus only on their technical skills and abilities, largely ignoring soft skills. Soft skills, however, are very important in almost all roles and industries.

By paying attention to the following nine important soft skills for engineers, you'll make yourself more attractive to employers. You'll also become a more rounded engineer, enhancing your emotional intelligence and interpersonal skills, and improving your overall engineering abilities as soft skills work.

Essential Soft Skills for Engineers

Communication

Communicating complex technical solutions in a way that clients understand is becoming increasingly important.

For example, as an engineer, you might have a tendency to focus on the technical detail when clients are often more interested in finding solutions to their specific problem and understanding the benefits to their business, i.e., they are not necessarily interested in abstract theories or high-level science, particularly at management level.

So, practice delivering highly technical information in as simple a way as possible while keeping your client's perspective in mind.

Another thing to highlight when discussing communication skills is the fact that this is a category rather than a specific or isolated skill. In other words, improving your communication skills will involve improving a range of other soft skills. You may not need all the soft communication skills in the list below, but they include:

- Active listening skills
- Writing skills
- Presentation skills
- Non-verbal communication skills
- Empathy
- Patience

Problem-Solving

Problem-solving usually involves successfully considering the pros and cons of each solution and finding the path with the least risk involved.

Interviewers often consider problem-solving skills during the recruitment process because they show how candidates deal with challenges. After all, project managers and other leaders like having team members who don't bring every small difficulty to their doorstep.

Problem-solving skills can also help projects run more smoothly, as well as helping to improve the business overall.

You should also explore possibilities for improving other soft skills that are closely related to problem-solving skills. Examples include:

- Innovation skills
- Brainstorming skills
- Critical thinking skills
- Research skills

Having intellectual curiosity can also help improve your problem-solving skills. Being intellectually curious will help you think out-of-the-box, find solutions, and question why things are done the way they are.

Organisation

In some situations, you can classify organisational skills as technical rather than soft. For example, good code needs to be well structured and organised. That said, there are also organisational skills you should improve that are non-technical.

These include punctuality, task management, and not taking on more tasks than you can handle.

Specific skills that come under the organisation soft skills umbrella include:

- Time management skills
- Goal-setting skills
- Planning skills
- Prioritisation skills

Finally with this one, there are apps available that help you stay organised, complementing your soft skills development.

Leadership

A good definition of leadership as a soft skill is taking responsibility for yourself and also for the people you work alongside. Remember, you don't have to be in a managerial position to be a leader. Leadership is also about things like keeping the right distance from a task (so you can see the bigger picture), setting the right example, and motivating others when things get tough.

Hone this skill, and don't forget to celebrate your leadership successes. Remember them as best practice examples, too, so you can use them as a stepping stone for promotion.

Areas you can work on in relation to leadership skills include some already highlighted, such as communication skills and organisational skills. Strategic thinking, personal development, and team development skills are also important.

Teamwork

There are many engineering tasks that you will do alone. Writing code is a good example. Individuals can't complete large engineering projects alone, however. Instead, they require teams and, by extension, teamwork.

As a result, teamwork is usually a non-negotiable soft skill in engineering. In other words, employers want you to be just as committed to successfully achieving team and company goals as you are to personal goals.

Adaptability

With rapidly advancing technologies, the reality of clients changing requirements, the increasing use of agile development techniques, and other factors, adaptability is an essential soft skill to improve. In fact, being willing and able to quickly adapt to situations is a skill highly valued by employers.

Creativity

In engineering, creativity is about finding new ways of looking at things. By developing this valuable soft skill, you'll be able to, for example, develop innovative products or project solutions. Creativity can also help you solve a problem or successfully deal with an unexpected situation.

Interpersonal Skills and Emotional Intelligence

Interpersonal skills are, in a sense, an umbrella term for several soft skills, including active listening, social perceptiveness, and being able to handle feedback. They all centre on emotional intelligence.

While it may not be possible to have great relationships with colleagues and others in all situations, developing your interpersonal skills will help you, those around you, and the company you work for.

Customer service

Finally, giving customers more than they expect helps to nurture long-term and loyal relationships. After all, customers are crucial to the success of most businesses. As a result, companies are more focused on customers than ever before. Developing your own customer service skills will help you contribute to the company's efforts.

How to Improve Your Soft Skills

You can complete training courses to improve your soft skills. Experience is important, too, so be open to taking on leadership responsibilities while also being adaptable and flexible. For example, be willing to take on new roles or projects, even if they are outside your comfort zone.

You should always be ready to learn, embracing constructive feedback from wherever it comes from. Building strong relationships and regularly communicating with those who can help you grow and develop will help too.

Developing a Continuous Improvement Mindset

Becoming a master of the soft skills above is a lifelong objective, so don't expect to have all of them figured out quickly. Instead, focus on those you consider are your weakest, set goals, develop a plan, and constantly review your progress. The reward will be increased engineering success.

Engineers require both technical and soft skills to perform their duties effectively. Soft skills help engineers use their technical abilities and knowledge with fewer interpersonal issues. Knowing which soft skills to include on your engineering resume and how to improve them can help you get job interviews or promotions.

In this we define what soft skills for engineers are, list nine important engineering skills, provide five tips on how to improve your soft skills, and explain how you can highlight these skills on your resume, cover letter, and interviews.

Soft skills for engineers are non-technical abilities that help engineers relate well with their team members, managers, and clientele. As an engineer, you often network with other experts during your work, which requires a considerable amount of communication and cooperation. Having relevant soft skills can help you improve your partnerships and complete tasks more efficiently.

Examples of soft skills for engineers

Here are some soft skills you can include on your engineer resume:

Communication skills

Engineers communicate complex technical ideas and solutions to colleagues and clients. Excellent oral skills are necessary for you to express and interpret your ideas so others can understand. Written communication skills also enable you to write technical reports and manuals in a way that others can comprehend them. Refining your communication skills includes improving other related skills, such as active listening, presentation skills, non-verbal communication, and patience.

Emotional intelligence

Emotional intelligence involves understanding your personal attributes and developing empathy toward teammates, customers, and other contacts. By taking time to understand others, you can respond to their problems effectively. Empathy can include recognizing a team member who's struggling with a task and looking for ways to encourage and help them. Emotional intelligence, in relation to your personality, helps you to:

identify areas of improvement

develop your strengths

explore what inspires you

cope with high-stress environments

work efficiently in a team

develop a personal growth strategy of training and mentorship

Leadership ability

Leadership in engineering involves applying emotional intelligence to get the best from yourself and the team through incentives, appreciation, and support. You may require leadership skills to complete engineering projects. For instance, you need leadership abilities to coordinate several departments, engineering teams, and third parties.

Problem-solving skills

Problem-solving involves examining the benefits and limitations of potential solutions and choosing the option with the fewest risks. Employers and project managers prefer engineers with problem-solving skills because they can handle challenges, which helps streamline projects. It's also important to improve other skills related to problem-

solving, such as innovation, brainstorming, critical thinking, and research.

Organization skills

Engineers manage projects from beginning to end under the constraints of time and resources. Excellent organization skills enable you to manage your time, be punctual, and accept tasks you know you can complete. This also allows you to identify and assemble all the required resources in time. Other specific skills related to organizational skills include time management, goal setting, planning, and prioritization.

Read more: Developing Proficient Organizational Skills

Teamwork

In most cases, engineers work in teams when completing large projects. Most employers prefer candidates or employees who commit to achieving team success and business goals the same way they commit to achieving their own professional goals. Teamwork involves a willingness to accept your responsibilities and assist other team members as necessary.

Adaptability

With dynamic customer needs and the rapid emergence of new technologies, it's helpful for engineers to adapt to these changes to enhance customer satisfaction. Adaptability means recognizing that you require more knowledge or technical ability to complete a task. It also involves learning about new software, technologies, and resources. Being adaptable also means you can perform tasks outside your routine in case of delays or other issues that might affect project completion.

Creativity

Engineers often design new structures, systems, software, and machines. Creativity enables you to find innovative ways of approaching issues and developing new products and processes. It also helps you provide solutions to problems or handle any unexpected problems that may arise.

Listening skills

Most engineering roles involve consulting other professionals, organizing teams, and collaborating with clients, often requiring you to listen to concerned parties. Good listening skills not only include listening to what others are saying but also entail using body language, verbal prompts, or perceptive questions to gather more information. This helps you to know the motivations and goals of teammates, clients, and other project stakeholders.

Customer service skills

Customers are a vital component of a business. It's important for you as an engineer to develop ways to ensure customer satisfaction, including regular communication, expressing empathy, using positive language, and taking responsibility. Completing client projects on time and providing high-quality results also helps you build strong relationships with customers and increases their loyalty.

How to improve your soft skills as an engineer

Here are some tips to develop your engineering soft skills:

1. Prioritize the skills to improve

The first stage is to analyze your skills and identify your strengths and weaknesses. You can then choose which soft skills need improvement and prioritize them. For instance, if you're an excellent problem-solver but your teamwork requires improvement, you can prioritize developing your ability to work in a team.

2. Request feedback

Sometimes you might not be sure of the areas you could improve in, so it helps to seek a second opinion from a trusted colleague or mentor. This provides you with another view and offers insight into skills requiring improvement. For example, you can ask your mentor what they think about your ability to lead and what you can do to develop that skill.

3. Practise self-reflection

Self-reflection is an important exercise that can help you enhance your soft skills. After completing a task or meeting, take some time to think about how you acted or presented yourself, what you said, and how you said it. You can also think of responses you expected to receive or instances where someone might have misunderstood you. Doing so can help you identify areas to improve.

4. Actively listen

Active listening is an important part of most engineering soft skills. It's helpful to learn how to listen to understand, not just respond. Active listening involves understanding other peoples' perspectives and being able to represent them well, even if you may disagree with them.

5. Develop your writing skills

Writing is an important soft skill for engineers as you often prepare reports, respond to e-mails, or write meeting notes. If you want to practise your writing skills, you can find resources on how to write professionally. There are courses available on business writing, which you can use to practise your writing.

Get interview-ready with tips from Indeed

Prepare for interviews with practice questions and tips

How to highlight soft skills for engineers

Here's how you can highlight your engineering soft skills while job searching:

Soft skills in your resume

Consider the following tips on how to highlight your engineering soft skills for a resume:

Align your skills with those listed in the job posting to show that you're the right candidate for the position.

Mention these skills in the experience section of your resume.

Include your soft skills in the career objective segment at the top of your resume. For example: A committed, self-motivated software engineer with 8+ years of experience.

Provide a detailed list of your soft skills in a separate section, which you can label as the "Skills" section.

Soft skills in a cover letter

Here's how you can include your engineering soft skills on your cover letter:

Use keywords such as designed, developed, analyzed, and trained when discussing your soft skills.

Apply phrases used in your previous appraisals, especially those that relate to engineering. Such phrases include detail-oriented, committed, hardworking, and resourceful.

Review the job posting and align your skills to those listed in the job description. For example, if the company is looking for a person with strong communication skills, you can highlight this skill in your cover letter.

Use verbs and adjectives to describe your soft skills, for instance, dependable, responsible, and creative.

Be clear and brief when discussing your soft skills for this profession. For example, I am a fast learner who can adapt to new technology quickly.

Soft skills for a job interview

It's helpful to provide evidence of how every skill has helped you accomplish your goals. For instance, you can explain how you employed communication and problem-solving skills during a customer escalation. As important as it is to prove to the hiring manager that you have certain soft skills, it's equally important to explain how your skills can benefit the company's success.

2. INTRODUCTION

Many engineering professionals assume that their technical expertise and experience are the most important skills that will get them a job.

However, this is rapidly changing as engineers are increasingly expected to work with many areas, divisions and people, across a single organisation. Soft skills – when coupled with the right combination of technical skills – are in great demand, and can significantly set you apart in a highly competitive jobs market.

But what exactly are soft skills in the world of work today? And which soft skills are the most valued and therefore, will help your case to be interviewed for the best engineering jobs?

What are soft skills?

Soft skills are personal attributes that sit outside of your professional qualifications and work experience. They're non-technical skills, meaning they refer to how you interact, lead and communicate with other people, how solve problems and also manage your workload.

Today, soft skills are an essential foundation for any successful career. Thanks to the advent of technologies like artificial intelligence (AI) and automation, there's a fast-growing need for soft skills in the workplace as the crucial 'human element' to tech-enabled data analysis and interpretation.

As technology, globalisation and changing demographics continue to shape the business landscape, the importance of soft skills is only set to grow. In fact, a report by Deloitte Access Economics predicts that two-thirds of all jobs by 2030 will rely on soft skills.

The top 5 engineering soft skills

In order to emphasise your soft skill abilities in your next engineering job interview, here are five essential soft skills to consider.

1. Strong communication skills

Solid, effective communication skills are essential in the engineering field, as you may often need to explain technical information to a non-technical or "lay" audience. Technical knowledge is critical, but the ability to communicate it accurately and concisely to an uninitiated or non-expert audience is just as important so that all stakeholders are included in the conversation, understand the content or information and are on the same page.

2. Leadership skills

For real career progression, professionals in the engineering sector will typically need to display management potential. This may involve managing teams, individuals, projects or entire organisations. Some people have natural leadership abilities, but good management skills can be sharpened with the right training and development.

3. Lateral thinking

Whatever your role is, lateral thinking and problem-solving skills are always beneficial. Organisations will always appreciate someone who can keep a cool head in a crisis and find innovative, creative solutions to complex business issues.

4. The ability to influence others

Interpersonal skills, emotional intelligence and the ability to negotiate with people at all levels of the business, forge productive relationships, and persuasively present ideas and opinions is an important part of modern engineering roles. Confident influencers and decision-makers are always in demand.

5. Problem-solving skills

Potential employers look for a proactive approach to tackling problems where textbook knowledge may not offer up an immediate solution.

A problem-solver who takes a creative approach to interrogate business issues is desirable in any industry – but especially in engineering where innovation and effective solutions are critical to success.

How to showcase your soft skills in an interview

Don't underestimate the importance of your soft skills to a prospective employer. Although a strong CV, track record and technical abilities may get you to the interview stage, they may not always get you the job.

During an interview, an employer will be looking for strong, clear evidence of your soft skills. How you present yourself in the actual interview will be telling, but you might also be asked to provide examples of your soft skills in action.

Try to outline a number of scenarios where you displayed solid soft skills and how they positively influenced business performance or stakeholder relationships. For example, if you managed to get stakeholder buy-in for a project, you can demonstrate both your technical skill as an engineer and your interpersonal skills as a communicator and business partner.

Whether you're looking to move upwards in your organisation, or to a new engineering job, always remember to promote a good mix of technical ability and soft skills like leadership qualities and communication skills to help you stand out from the crowd.

Human Sciences is the science that aims to understand and explain how the cultural, historic and political context plays a role in shaping human behavior, and help explain the apparent paradox of humans' behavior of being both unique individuals and social beings (Vasconcelos, 2018).

Socio-emotional skills, also known as soft skills, are related to those characteristics that one uses to relate to others, and that help to build their so-called social web (Itani & Sprour, 2015). These skills are not only limited to relational characteristics, but also englobe other behaviors, such as Social Responsibility, Creativity, Ethics and Emotional Intelligence.

Driven by the globally connected economy, the labor market has shifted to emphasize and legitimize the importance of soft skills for employability mostly in all the careers.

Over the years, various US organizations such as the National Academy of Engineering (NAE) and the Accreditation Council for Engineering and Technology (ABET) have taken proactive steps to address and respond to the importance of soft skills in Engineering. However, from a broader perspective, still little effort has been conducted to connect the pieces and understand which soft skills have a stronger impact on each career or field, especially on those fields in STEM (Science, Technology, Engineering and Mathematics).

The NAE report addressed the technological, social and global contexts implications for engineering education and pointing out a set of desirable attributes in the future Engineer professionals. Although many of these attributes are similar to the ones required in the past and currently, the study highlights the greater complexity of them, due to the impact of new technology. Stronger analytical forces, creativity, communication, and high ethical standards are some of the skills listed in the report (Vasko, Al-Masoud, & Baumann, 2011; Koen & Kohli, 1998).

The lack of knowledge and organization on studies related to the importance of soft skills for STEM professionals is linked to the fact that these skills are usually taken for granted. It also reflects the low emphasis on the soft skills in the STEM education and the consequent egress panorama (Ríos Carmenado, López, & García, 2015; Veiga, 2017; Pereira & Costa, 2017).

To legitimize the Humanities in Engineering they need to be validated in the same way as Technology, using trustful sources to support it (Marrocu & Paci, 2012).

This highlights the importance to structure the current state of the art about soft skills in the STEM field, as a way to connect the Academia and the market. In the present work, the main focus will be the Engineering field, given its good representative of the STEM field.

The main objective of this paper is to gather and present in a structured manner the current studies on soft skills for Engineering and to discuss not only how they relate to employability, but also on how they need to be developed and approached in the educational context to make fresh-graduate Engineers in line with the market's needs.

1. Theoretical Framework

Employability of Engineers

Employability is defined as a group of social and cultural evidences which serve as an indicator of economic and social development (Silva et al., 2019). The rapid transformation of the workplace to a more inclusive environment and a highly competitive labor market has changed the nature of employability today. In addition to the job-related technical knowledge, job seekers need to be proactive and flexible in identifying career opportunities.

Zaharim et al. (2009) defined employability skills as those needed to obtain and keep a fulfilling job, as well as the ability to teach and transfer their knowledge within the work environment. The OECD commissioned studies on employability from 2016 and 2015 (OECD, 2016a; OECD, 2016b; OECD, 2015) pointed out that the desired skills for employability involve good text interpretation, mathematical knowledge and other soft skills. The study highlights information management and problem-solving as key factors for employability. These include the ability to evaluate, access, communicate and analyze information—both interpreting text-based information and handling mathematical data (OECD, 2015).

A study by the Australian Employment Agency, the Monarch Institute (Monarch Institute, 2015), found that 85% of the desirable skills for employability are related to soft skills, while 15% are technical skills, highlighting the importance of the need to teach and highlight soft skills during the academic period.

Studies show that Engineers should be responsible for appropriating new knowledge, expressing their ideas proactively, critically and independently. The studies also point out that already during university, Engineer students need to start developing the ability to provide original and creative solutions to real-life problems. Furthermore, working in teams, managing interdisciplinary groups, understanding society demands taking into perspective the ecological, ethical and political repercussions of their actions also arise (Klafke, 2005).

According to Caten et al. (2019), the importance of soft skills required for current and future Engineers exceeds the importance of the technical ones. Leadership, creativity, communication, management, professionalism, ethics, agility, resilience and flexibility are some examples of skills that go beyond the technical competence and which give professionals more ability to take ownership of their own career and deal with the current market's demands. As Compton (2008) has studied, the skills that will be required for post-university management and leadership positions are those that develop based on the Humanities and Social Sciences, such as: demonstrating passion and interest, taking on current roles and responsibilities that seek continuously opportunities for improvement; volunteering to get involved in other projects and working groups, developing the perspective of resolving organizational challenges; and self-assessment to learn from mistakes and cultivation with demonstration of value characteristics that promote trust.

Organizations have been looking for Engineers who not only have the technical knowledge, but also have the ability to bridge this knowledge with their employees and social needs. According to Ajit and Deshmukh (2013), a newly graduated engineer who joins an organization already faces the first challenge when having to prove the ability to fit to the company's culture well as being able to deliver performance according to the demands.

Other studies reinforce that employers hope to recruit engineers with soft skills. Firstly, they reflect a person's commitment to developing their professional future in line with personal values, professional aspirations and social perspective (Bates et al., 2019). Consequently, it reflects better performance in innovation, such as sustainable technological development and infrastructure, matching the society's expectations (Kulkarni et al., 2017).

To apply and practice knowledge effectively in the workplace, Engineers need to be endowed with soft skills, as companies increasingly require creative and innovative engineers, thus establishing competitive advantages for their companies (llamas et al., 2019).

While the current hiring trends for engineers suggest the need to emphasize soft skills, according to the report by major US companies—Q21: Partnership for 21st Century Learning— (Casner-Lotto & Barrington, 2006), only a quarter of university fourth graders are perceived as excellent in many skills, including reading, math and

sociability. The others are considered unprepared for written and communication, mathematics and reading.

All the above stated clearly shows a gap between Engineering education and job market expectations, reemphasizing the importance of the present study as a way to bring to light studies already developed on soft skills for Engineers.

2. Methodology

As the main objective of the present work is to gather studies already present in the current state-of-art, the chosen methodology was a Systematic Bibliographic Review (SBR). According to Conforto, Amaral, & Silva (2011: p. 3), "Systematic literature review is a scientific method for searching and analyzing articles from a particular area of science".

2.1. Selection Criteria

Firstly, it is important to note that the SBR was based on articles published in journals, as the topic was more likely to have been approached in articles than in patents and other kinds of academic work.

For this method, the choice of key words was the first criteria used for selection of relevant work. As this study bases itself on two major nuclei, Engineering and Humanities, Human Sciences, Human Skills, Engineering Education and Engineering Degree were chosen as the relevant key words. From there, 20 combinations of keywords in English language were used.

2.2. Data Bases

The selection of Data Bases was based on those that showed greater proximity to the Research Area, These were the following: Science Direct, Web of Science and Scopus. Although the European Journal of Engineering Education (EJEE) is indexed on the Scopus science base, it was also used as an individual search reference because of its self-indexed scope.

Furthermore, Journal of Engineering Education (JEE) articles from 2006 to 2015 were also performed, as this is a journal with the highest impact factor-, 1.739-, within the area of Engineering Education, and is not indexed in the previously mentioned Data Bases.

As some articles were indexed in more than one scientific Database, it was also necessary to remove duplicates.

3. Results and Discussion

The most relevant soft skills for Engineers according to the mentioned methodology are presented and discussed in this Section. These skills are grouped into six main groups, as a way to structure interrelated skills.

The discussion starts by highlighting the main pillars of the knowledge needed by an Engineer and how the main groups of soft skills support this knowledge.

3.1. Problem Solving and Critical Thinking

Problem-solving can be considered the core soft skill expected from an Engineer. Figure 1 is adapted from, Thibault et al. (2002), in which the author visually represents Planning and Problem Solving as the two milestones in Engineering career. From there, the author presents different skills and, according to which triangle they fall into predominantly, it is possible to see to which milestone they relate at most.

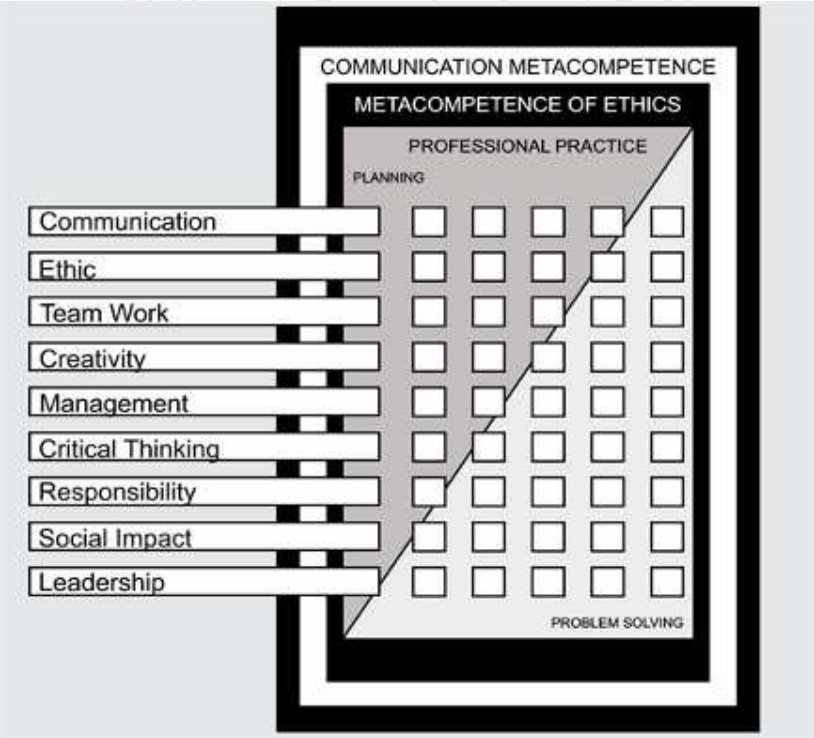


Figure 1. Interaction in engineering practice between science & technology skills and soft skills. Source: Adapted from Thibault et al. (2002).

Firstly, it is important to understand that the nature of Engineer career demands the ability to solve problems and, more than that, both the problems and the solutions need to be connected to the society's needs. That is why Problem Solving is presented in this study as the first group of soft skills important for an Engineer.

Downey et al. (2006) and Jesiek, Borrego, Beddoes (2010) define the Engineering work as activities that

demand the interpretation of technological problems that need to be solved.

Therefore, all the other soft skills needed for an Engineer are those which, directly or indirectly, help and support them with the Problem-solving.

The first skill which directly relates to Problem-solving is Critical Thinking, as it could be considered one of the main pillars to develop problem solving capability. In fact, the item "Critical Thinking", shown in Figure 1, falls predominantly in the light gray region belonging to "Problem Solving".

Critical thinking is the ability to analyze a situation through different perspectives, taking into account minimum time waste and, cost-savings inside a globally interconnected economy (Meireles & Bonifácio, 2015; Barrera, 2017).

The relevance of "Critical Thinking" in the professional construction of Engineering has been discussed as early as 1990. O'Neal (1990) defines "Critical Thinking" as the aptitude to make judgments, based on appropriate questioning, including questioning of authority as well as the competence to act independently and wisely. The faculty of "Critical Thinking" provides greater assertiveness in decision making.

That is the reason why Engineering courses should encourage their students to discuss past or present standards and to question the status quo when they feel appropriate.

3.2. Communication

The second group of competences found to be relevant for Engineers is Communication. According to the OECD (2015), communication in its entirety is achieved with effective and accurate writing, interpretation and speaking.

The ability to correctly search for data and to interpret information, avoiding bias, is also interrelated to the already mentioned critical thinking and, consequently, problem solving. Second, the capacity of presenting this information in an easy and clear manner also helps others with problem solving and information analysis. That is why these are so important for Engineers.

3.2.1. Verbal and Written Communication

Studies suggest a great link between Engineering failures and lack or inefficient communication. The areas usually associated with humanities could be better approached in Engineer's courses to help decrease communication errors (May & Deckker, 2009).

In Engineering, "Verbal Communication" facilitates dialogue and helps develop arguments to state or defend an idea. It also helps when orientating new collaborators, communication between colleagues and the effective communication of project concepts and scopes to clients and/or managers.

Fletcher, Sharif and Haw (2016), on the other hand, focus on 'Written Communication'. In their research, they use as an example the Chemical Engineering students, for which the writing ability was said to be "unsatisfactory". As a consequence, the authors proposed a writing course as a way to strengthen the communication ability.

The P21 report (Casner-Lotto & Barrington, 2006) also highlights speaking a foreign language as an important employability factor, when he says that those able to communicate in another language are way ahead in business than those limited to their native language.

The importance of communication is strongly related to the characteristics of the Engineering profession. As Engineers are constantly in contact with other people, such as clients, vendors, consumers, clients and even authorities, as well as other colleagues from different fields, the ability to express in an efficient and clear way is key. The knowledge in a foreign language is obviously an asset for those working in a foreign environment, either a foreign country or dealing with costumer from across the globe.

3.2.2. Reading

As expected, the writing and verbal communication are related to the effective reading ability, which is also an ability required different job positions. Figure 2 shows the average Engineering salaries in different countries, according to different requisites, surveyed by the OECD (2016b).

An analysis of Figure 2 clearly shows that, in most of the countries, the best-paid jobs will require reading at work. Contemporary society requires not only a professional capable of communicating through different channels, but especially a professional able to interpret data and information. Engineers are frequently dealing with data. The common sense tends to associate Engineers with mathematical or modelled data, which is just half of the picture. Engineering is a broad and very interdisciplinary profession.

As many Engineers deal with projects, they have to go through safety and environmental regulations, local laws and many other requirements out of their main domain of study. Although they are not specialists, they still need to be able to read documents and regulations and interpret this information in an appropriate manner.

3.2.3. Active Listening

"Active Listening", considered in the list of soft skills as necessary for the engineer, coined by the OECD (2015) for "Attentive Listening", was categorized as

"very important" for the exchange of views between people. Andersen and Hansen (2002), call "Empathic Listening" the ability to listen attentively and communicate unambiguously, thus facilitating the resolution of engineering problems.

The Active Listening still falls back into the interdisciplinary of the profession and the necessity to transition into different fields. As an Engineer comes across some field they are not familiar with, they need to communicate to specialists in that field and, in this case, the Active Listening will be the main skill required inside the communication group of skills.

3.3. Team Work

As already mentioned, the interdisciplinary nature of an Engineering work brings to light the importance of interpersonal skills. Some of these interpersonal skills are implicit in some of the previously mentioned features, such as verbal communication, active listening and even in critical thinking, for example. However, some skills explicitly account for the competence to relate to others. This group of skills is presented here as Teamwork.

Colby and Sullivan (2008) highlight the Team Work skills for high quality Engineering work. Andersen and Hansen (2002) are also emphatic on its importance for Engineers, mentioning it as a fundament for their career, both domestically or internationally.

Downey et al. (2006) and Jesiek, Borrego, & Beddoes (2010), in the same work where they define an Engineer as a Problem-solver, also highlight that for the problem-solving, the negotiation and discussion of potential solutions, both among Engineers peers and non-Engineers—clients, authorities, colleagues, experts—is necessary. Also according to Casner-Lotto & Barrington (2006), the greater the improvement of information technologies used by companies, the more diverse and skilled their workforce, as they solve problems based on very different points of view, expertise and experience.

Other important characteristics inside Team Work are Optimism, Common Sense, Empathy, Collaborative Spirit and Negotiating Skills. They also include situational awareness to take the decision that produces the best outcome for everyone involved (Kamin, 2013).

3.3.1. Multiculturalism

Many people associate multiculturalism to living in a completely different culture, usually another country. However, as each human is an individual and has its own values, multiculturalism refers more broadly to the respect of other's individuality, including choices, values, believes. The employability studies contained in the P21 report (Casner-Lotto & Barrington, 2006) and the OECD (2015, 2016a, 2016b) point to the need to learn to work in diversity.

For Engineering, the importance of diversity, both in the academic environment or in the job market, is also noted by scientists and scholars in the field. Li and Fu (2012) point out that cultural and ethnic diversity must be addressed in all educational projects in the area of Engineering.

3.3.2. Network

The Contact Network also stands as a valuable factor for employability. It is defined as one's ability to form a web of meaningful contacts. The Contact Network is internationally recognized by the word Networking (Perkins, 2001). An extended network also expands the employability of Engineers. According to Becker (2006), positions such as sales and marketing require the bachelor of engineering to sharpen their social skills in order to build a solid professional contact network as an important resource for career success. Although they might seem unrelated to Engineering, many Engineers today are employed in sales positions and sales and marketing competences can be applicable to anyone's daily lives and are not limited to a specific career.

3.3.3. Leadership

Another very remarkable attitude or competence in the Team Work group is Leadership. The surveys conducted by P21 (Casner-Lotto & Barrington, 2006) and OECD (2016a, 2016b) reports recognize that the adoption of Leadership and Management practices in the workplace creates opportunities for skills and productivity boosts

Leadership is not only related to managing others, but also to be able to lead a specific project, to take ownership and responsibility on one's own actions and to be able to stand for what one considers to be correct. Still related to the problem-solving, Engineers need to be proactive to recognize a problem and take leadership when proposing a solution within a group.

Other studies in the field have shown that people with comparable intelligence were judged differently based on their leadership attitudes (O'Neal, 1990). More recent studies, Passino (2009), Kasamoto (2000) and Lyman (2002), advocate the inclusion of leadership subjects within the curricula of all Engineering.

3.4. Ethical Perspective: Ethics per se, Professionalism and Social Responsibility

In this topic, "Ethics per se", "Professionalism" and "Social Responsibility" were combined into a major called "Ethical Perspective", as they all relate to ethics and its consequences when taking action and decision making.

An ethical person is said to be one who has a good character. Defined in report P21 (Casner-Lotto & Barrington, 2006) and by the OECD (2015, 2016a, 2016b), ethics is the demonstration of personal accountability and effective work habits (i.e., punctuality, productive work with others, time and workload management). It is also a desired virtue in human relationships According to Chauí (2011) and Cotrim (2002), ethics, greater than common sense and morality a universal principle and has to accompany an individual throughout their lives.

As Engineers solve problems, they make decisions and these decisions have to be taken considering their potential consequences. They need to be able to have a broader view on how their decisions can have an impact on the society.

Rugarcia et al. (2005) and Lathem, Neumann, & Hayden (2011) stated Engineers often make decisions disregarding the moral, ethical and social consequences of their with the mistaken belief that the potential damages brought by their decisions are the responsibility of others.

The development of ethics in Engineering students develops a future professional that knows the importance of considering the responsibility for their actions and decisions. These professionals will have more assertiveness in their decision making process (Beever & Brightman, 2016). Jones, Michelfelder, & Nair (2017) point out that engineers must direct their actions ethically to the social, economic and ecological needs, which represents their "Social Responsibility".

A survey of the corporate world (OECD, 2015; Casner-Lotto & Barrington, 2006) certifies that 80.3% of respondent employers classified working with ethics as "very important".

According to Rondon (2016), professionalism is diametrically associated with attributes such as good character, seriousness, competence and responsibility, permeating the field of ethics. In the survey of the P21 report (Casner-Lotto & Barrington, 2006) 80.3% of the interviewed employers, also claimed to be "very important" for job seekers to have a personal responsibility, "Professionalism" and commitment to the work. For McAloone (2007), an Engineer must articulate their performance with "Professionalism" in order to have the ability to operate in global companies respecting its place and culture.

3.5. Emotional Intelligence: Emotions Control, Motivation, Lifelong Learning and Self Direction

Emotional Intelligence stands for one's capability of perceiving, understanding and controlling their own emotions (Petrides et al., 2016). This is the reason why Emotions Control, Motivation, Lifelong Learning and Self-Direction are said to be part of the Emotional Intelligence.

With the cultural diversity of work environments, it is necessary to consider the most diverse points of view that can end up impacting people's emotions. Emotional control, focus on achieving one's goals, an interest in continuing one's lifelong empowerment, and self-direction are characteristics that belong to IE and are also desirable for maintaining the harmony of the engineer's work environment.

The report on Competencies for Social Progress (OECD, 2015) reports that the Dominican Republic already implements a program called Youth and Employment, which provides classroom training for future workers. The program englobes self-esteem promotion, work motivation and communication skills. This type of initiative ensures that the content of vocational training is facilitated according to the demands of employers.

Already in 2004, Hansen suggested that companies wishing to improve their Engineers skills should provide favorable environments for their development throughout their career path. According to him, Lifelong Learning through further education should be seen as part of this development. Jiusto and Dibiasio (2006) emphasize that Lifelong Learning is achieved through continuous personal development.

The resulting reports from a research on employability around the world (Casner-Lotto & Barrington, 2006; OECD, 2015, 2016a) also bring up Self-Direction as a characteristic linked to Lifelong Learning and highlight the importance of one's own initiative for staying up-to-date through studying and focusing on developing their strengths and overcoming their weaknesses.

3.6. Creative Thinking: Creativity and Innovation

Creativity is the ability of providing and applying new ideas into Problem Solving (Hasanah & Surya, 2017). As a fundamental element of Engineering, Creativity facilitates the generation of effective and innovative solutions to various problems (Cropley, 2016).

Among the many skills listed as important for employability in the 21st century, Creativity has both cognitive and soft skills elements. This competence is also called Divergent Thinking, as it involves the production of content not only innovative, original and unexpected, but bold, useful and adapted to a given task (Casner-Lotto & Barrington, 2006). In its study on employability, the OECD points out that creative people tend to be more open to new experiences, more imaginative, more impulsive and more outgoing (OECD, 2015).

Engineering science as well as Management and Leadership skills are often referred to as sources of innovation within companies. However, according to the results of studies by Schneider, Günther, & Brandenburg (2010) and Jesiek, Borrego, & Beddoes (2010), a large portion of technically qualified employees is not sufficient for a company to be innovative, and does not imperatively make these employees creative and proactive.

Differently than most people think, Creativity is not an inspiration, nor is it a gift. It is the result of a structured path of thinking, which also requires enough background and repertory to occur. Inside the Engineering field, Creativity is achieved through constant personal improvement and through keeping up-to-date with the most current technologies

3.7. Compilation and Analysis of Results

As a result of the conducted SBR for this study, the main soft skills discussed were compiled in Figure 3, through a graphical representation oriented by related areas. This circle represents all the skills needed for an Engineer to succeed in their profession, considering success not only as economical terms, but also considering their role and responsibility to solve society's problems and needs.

According to SBR, the most frequently encountered soft skills are those of the outer circle of the figure that were, as proposed in this research, systematized into the six categories described in the results of this study and ordered in the inner circle. A successful Engineer can bridge soft and technical skills (Pereira & Costa, 2017).

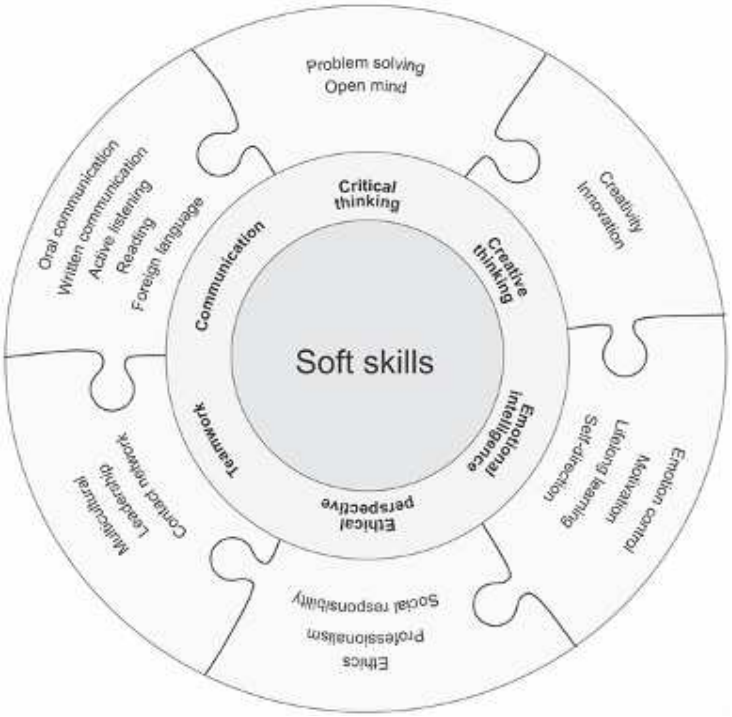


Figure 3. Compilation of the important soft skills for engineers grouped by their core competences. Source: Own authorship (2020).

All the presented studies converge to the concept of an Engineering education which not only requires the students to understand traditional Engineering fundamentals such as Mechanics, Dynamics, Mathematics and Technology, but also to develop the so-called situational skills. These account for skills needed to handle real situations and are englobed in the six categories of soft skills into which the present work is based.

The society expects Engineering graduates to be able to absorb and develop new technologies by acting critically, boldly and creatively when identifying and solving problems. Therefore, they need to be able to consider the political, social, environmental and cultural aspects, always in an ethical manner.

4. Final Considerations

As initially proposed, this structured the social and emotional skills (soft skills) in the lenses of Engineering employability, highlighting the relationship between each skill and an Engineer work.

Through a high-quality SBR, it was found out that the most important soft skills for Engineers can be categorized into six main groups: Problem Solving, Communication, Team Work, Ethical Perspective, Emotional Intelligence and Creative Thinking. All these are composed of different soft skills, but summarize in a structured way the core competencies an Engineer has to have, always keeping in mind the problem-solving nature of the profession.

In order to be aligned with the current demands of the market and the society, the Engineering education must go beyond its technical and theoretical pillars, as there is no Problem Solving capability without all the other soft skills presented during this work.

Undoubtedly, there is much more to be reflected and discussed regarding the existing gap between Engineering Education, Job Market and Society's needs. The main aim of this article is neither to answer this question, nor to exhaustively present all the possible solutions. The intent is to raise this as an important topic for the Scientific Community and promote reflection not only for Companies and Education Professionals, but also on the current and future Engineers. After all, education has an impact on the acquisition of the required soft skills, but it is important not to forget the Life-Long Learning and Self-Direction mentioned as important soft skills. Both the university or trainings and the work environment need to give the Engineer the necessary tools for self-development and self-knowledge. However, it is up to the professional to use these tools to take ownership of their own career, working to be updated on technical knowledge and on development of weaknesses and strengths.

3. INTRODUCTION

Communication exists at the very core of our existence. Humans communicate with each other using different languages and hence the need of impressive and effective communication skills in every profession is most important. . Today, most employers seek employees with excellent communication skills and it has become a prerequisite in addition to the required qualifications.

Today, all graduates as well as undergraduates, irrespective of their chosen subjects need to have great communication skills to learn and interact with their counterparts. Most notably, engineering students need to have good understanding of English language and should have great communication skills. Good spoken English and commendable communication skills can make you stand out from the crowd. Surveys show that big scale employers prefer people with not just a degree from a reputed institute but people who also possess the art of positive communication. English can be considered to be a language which serves as a link between all types of people. The influence of English in the world especially in India cannot be undermined.

Why is English important for the better future prospects of an engineering student/ graduate?

The learning and proficiency in English for engineering students is extremely important if they want to pursue their career aspirations globally. The use of English language is very widespread and it is one of the most commonly used languages used by the professionals to interact with one another. With globalization, there has been a sharp rise in the number of engineering graduates being assigned international projects, which means they have to communicate with people across various cultures and nationalities. English is the most commonly used language by most professionals. English is considered to be the basic language of science and technology, business affairs as well as diplomacy.

During the years of studies that all engineering students have to undergo, English is the language of instruction. Engineering student work hard and have to attend seminars, lectures etc, which are all in English. The medium of instruction of engineering studies is English in all colleges and universities in India. Mostly all papers and technical journals are written in English and if not written, are eventually translated to English. When engineers secure jobs in various corporate organizations, most of them are assigned and expected to work in a group which involves extensive use of good language and effective communication skills. While the importance of spoken English skills cannot be overemphasized, the significance of written English skills cannot be ignored either. In many sectors engineers are now required to do technical writing and their work is expected to be factually accurate and grammatically error- free.

The lack of good communication skills and command over English language in many engineering students can be attributed to the fact that even though the language used for instruction is English it is not a criterion for admission into engineering institutions. Even for the students who may have acquired basic schooling in English medium only, the linguistic proficiency can be questionable. It is imperative and has been emphasized by industry experts over the years that engineering aspirants need to have excellent communication skills in addition to the mandatory technical skills.

The outcome of any engineering degree should be analyzed as having two core components; the technical and the communicative component. The technical parts involve the science and the mathematical part. Other things like skill development, ability to focus on problem solving and working together to find a solution etc can be considered to be another set of imperative skills that an engineering degree can provide.

Communication skills extend beyond just being eloquent and articulate. Good listening as well as writing skills is also

considered to be a part of good communication skills. Engineering students can increase their employability by practicing effective communication skills.

The problem lies in the fact that English is the second language for most people in India. So due to lack of ample exposure, most students have underdeveloped linguistic skills by the time they get to college or universities. This eventually means that many students do not have proficiency in English by the time they begin their graduate programmes.

Being competent both technically as well as communicatively can establish an engineering graduate securely in the competitive workplace. Working in a knowledge intensive environment like engineering requires the students to be at the top of their linguistic as well as communicative game. A graduate engineer who possesses exceptional technical knowledge must be able to interact and communicate his knowledge effectively with his team. The technical expertise has to be supplemented with good communication skills and one cannot be effective in isolation without the other. Today a successful graduate engineer can boast of the tremendous technical expertise as well as the ability to interact effectively using perfect communication skills.

Dr. Mitalee Shome is a top English Language & communications Expert, based in Mumbai, India. Dr. Mitalee is a PhD in English literature, with over 30 years of rich and varied teaching experience. She has taught at Business colleges, Engineering Colleges and at Arts colleges. For all your communication skills requirements, please contact us at English Expert India.

The employability skills refer to the required skills to acquire, keep and doing well on a job (Robinson 2000). Skill is an ability to perform a specific task (DEST, 2006) and employability is about having the capability to gain initial employment, maintain employment and obtain new employment if required (Hillage, 1998). Liz Reisner explained that there is a way to measure some of these skills (Elena, 2009). He said that “it might be possible to assess decision-making skills by analyzing the middle school participants’ selection of high-quality college preparatory high schools”. A report by Elena Silva, a Senior Policy Analyst, revealed that the skills "can be measured accurately and in a common and comparable way" (Elena, 2009). Studies on employability skills differed with regards to direct or indirect measurement depend on occupational title, qualification and level of education, years of work experience and numbers of training (Ashton & Green, 1996). Measuring the scores of the employability skills is subjective and depends on the perception of evaluators. The employability scores are determined by the particular combination of soft skills, and by the personal knowledge of the individuals

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

4. INTRODUCTION

English language teaching is an essential component of international communication and education, as English is widely spoken and used as a lingua franca in most parts of the world. English language teaching can take place in various settings, such as classrooms, online or distance learning, and language schools.[1] It is usually led by certified and experienced English language teachers who use various teaching tools and materials to facilitate learning, such as textbooks, audiovisual resources, and language software. [2]The English language is one of the most widely spoken languages in the world.[3] It is the official language of over 50 countries, and it is estimated that over 1.5 billion people speak English worldwide.[4] The language has its roots in the Germanic languages, but it has been heavily influenced by Latin and French, which were brought to

England by the Romans and the Normans, respectively. One of the reasons for the widespread use of English is its role as the language of international communication. It is the language of business, science, technology, and the internet, and it is used as a lingua franca in many parts of the world. English proficiency is also a key factor in many job markets, and it is often a requirement for higher education and professional development. English is a complex language with many nuances, and it can be challenging to learn for non-native speakers. It has a vast vocabulary, with over a million words, and it is known for its irregular spellings and grammar rules. However, the language is also highly adaptable and has absorbed many words from other languages, making it rich and diverse.[5] In addition to its practical uses, English is also a significant cultural force. It has produced some of the most influential literature, music, and cinema in the world, and it continues to shape the cultural landscape. English is also the language of diplomacy, with the United Nations and many other international organizations using it as their official language.[6] Despite its global reach, English continues to evolve and change. New words and phrases are constantly being added, and the language is adapting to new technologies and ways of communication. As such, English remains a dynamic and fascinating language, with a rich history and a bright future.[7] The Concept of Soft Skills Soft skills refer to a set of personal attributes and interpersonal abilities that enable individuals to interact effectively with others. These skills are often related to emotional intelligence and are crucial for success in both personal and professional settings. Some common examples of soft skills include communication, leadership, teamwork, problem-solving, time management, adaptability, creativity, emotional intelligence, conflict resolution, and networking. Soft skills are becoming increasingly important in the modern workplace as employers recognize the value of employees who possess these skills.[8] In fact, studies have shown that soft skills are often more important than technical skills when it comes to job performance and success. One of the key benefits of soft skills is that they enable individuals to work well with others. This is essential in today's collaborative work environments, where teamwork and communication are often critical to success. Soft skills also help individuals to manage conflicts effectively and build positive relationships with colleagues and clients.[9] Soft skills are also important in personal settings, as they can help individuals to build stronger relationships with friends and family members.[10] For example, effective communication skills can help individuals to resolve conflicts and misunderstandings, while emotional intelligence can help individuals to understand and respond to the emotions of others. In summary, soft skills are a set of personal attributes and interpersonal abilities that are essential for success in both personal and professional settings. These skills enable individuals to work effectively with others, manage conflicts, and build positive relationships. As such, they are becoming increasingly important in today's modern workplace and society as a whole. English Language Teacher Development Policy English language teacher development policy refers to the set of guidelines and strategies aimed at enhancing the professional growth and development of English language teachers. The goal of such policies is to improve the quality of English language teaching, which ultimately benefits learners and the wider community. One of the key components of an effective English language teacher development policy is providing opportunities for ongoing professional development. This may include access to training programs, workshops, and conferences, as well as mentoring and coaching from experienced teachers. Such initiatives can help teachers stay up to date with the latest teaching methodologies and technologies, and enable them to share best practices with their colleagues.[11] Another important aspect of English language teacher development policy is the recognition of teachers' achievements and contributions. This may take the form of promotions, awards, or other forms of recognition, which can motivate teachers to continue improving their teaching skills and knowledge. In addition, an effective policy should ensure that English language teachers have access to the necessary resources and support to facilitate their professional growth.[12] This may include access to teaching materials, technology, and administrative support, as well as opportunities to collaborate with other teachers and education professionals. Lastly, an English language teacher development policy should address the issue of teacher retention. This may involve strategies to improve working conditions, such as salary increases, benefits, and opportunities for career advancement, as well as initiatives to enhance job satisfaction and work-life balance. In summary, an effective English language teacher development policy should provide ongoing opportunities for professional development, recognize and reward teachers' achievements, provide necessary resources and support, and address the issue of teacher retention. By investing in the professional growth and development of English language teachers, countries can improve the quality of English language education, which has far-reaching benefits for learners and society as a whole.The research demonstrates how crucial it is to build soft skills in order to compete on a global scale; these abilities are crucial for aspiring engineers and can be seen as an investment. Universities and instructors must recognize the value of soft skills for their pupils and implement efficient teaching methods and activities to develop soft skills alongside hard skills. According to the research, teachers should push their pupils to be as creative and thorough as possible. Students should participate in groups and take on leadership roles when developing the social skills necessary for collaboration. We observe that conversation skills are more difficult because pupils prefer passive communication to active communication. Therefore, through practice of communication skills, extensive instruction and learning on strengthening their communication potentials should be offered. As evidenced by our study, teaching and learning English can be crucial in helping students improve their soft skills. The success of developing soft skills can be influenced by using the right learning resources, learning methods, and exercises.

Soft Skills Workshops
Advance your key competences
Course offer

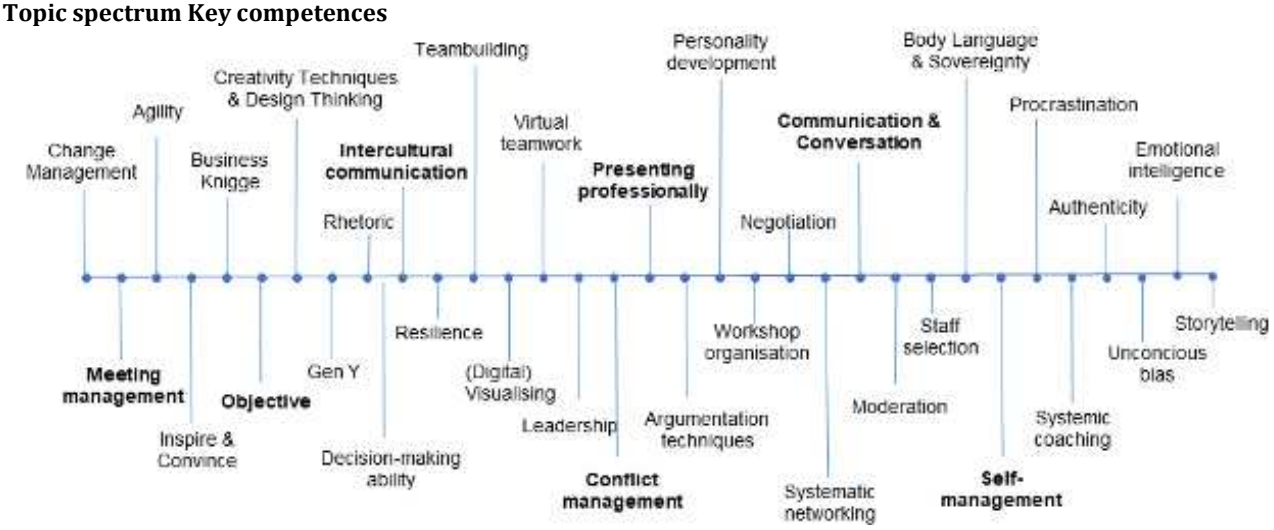
The Center for Key Competencies offers you pedagogically and didactically sound training at a high level. Our qualified trainers and multipliers provide a comprehensive repertoire of training courses for pupils, students and doctoral candidates at the TUM School of Engineering and Design.

Soft Skills

Our soft skills workshops enable bachelor and master students to develop and expand their own key competences. Adapted to the respective life situation, we offer half-day or

two-day workshops in the areas of social competence, methodological competence and self-competence. Our courses support Bachelor students in building their soft skills for dealing with other people and with themselves. The main focus is on your personal development, which you can use profitably for your studies or private goals. By acquiring soft skills, master's students can get off to an easier start and find their way in the professional world. You can develop personally and increase your employability.

Topic spectrum Key competences



5. Introduction

Soft skills are vital for succeeding in all careers. The workplace is changing rapidly, and, over the course of our careers, we will all be expected to work in multiple roles. To do this effectively, we need to be prepared to be flexible and adaptable. Soft skills are the skills that help us learn new things well and quickly. They help us develop creative and innovative solutions to the problems that arise.

Employers tell us that the market is filled with graduates who possess the required technical skills. What differentiates some applicants are their soft skills.

So, how do you develop soft skills?

One way is to purposefully select your complementary studies courses during your B.Eng degree.

- Interested in improving your writing? Pick a course with a significant writing component like English.
- Want to improve your intercultural competency? Consider a humanities or social science course with a global outlook, for example something in Sociology, Anthropology, or History.
- Looking to develop your visual competency? How about an Art History course?

Think about the soft skills you want to focus on and choose your complementary studies courses wisely.

In India, around 600,000 engineers graduate annually from various colleges; while some of them chose the profession because of their engineering passion, some of them were pressurized from their parents.

But a new study has revealed that most of them aren't even qualified for a job in knowledge economy.

Aspiring Minds, a leading employability credentialing firm, has revealed that only 18.43% of all engineering graduates are eligible for a software engineer's job in India.

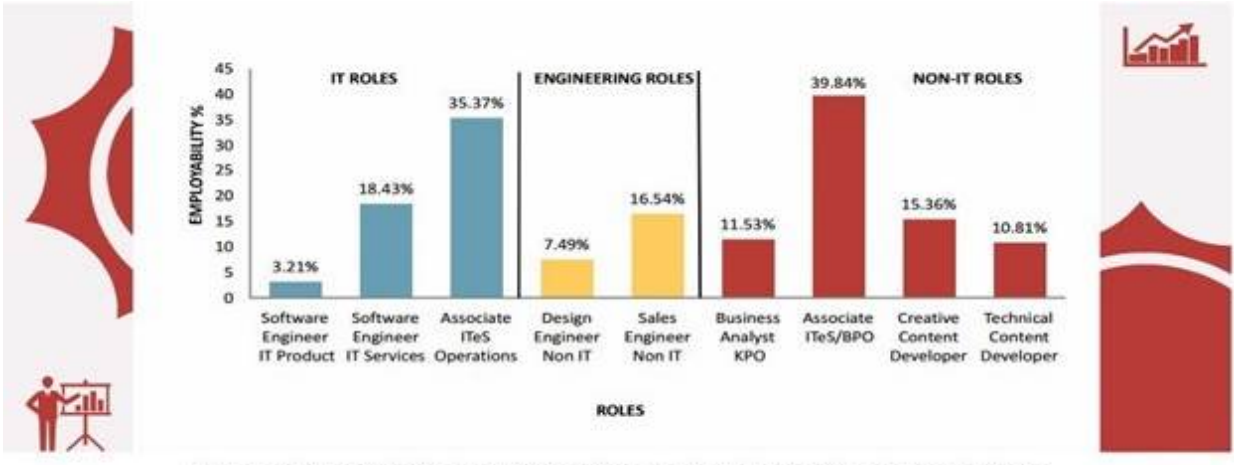


Figure 1: Employability Percentage of Engineering Graduates in Different Roles

And the worst part is that such incompetency has nothing to do with their engineering skills: its their proficiency in English language & soft skills which makes them lose out on opportunities.

As per their study, 97% of Indian engineers cannot speak English, which is one of the mandatory requirements for working in any software or IT firm. In fact, 67% of all engineers do not possess any English language skills (reading, speaking, comprehension), which are required for a high-end job in business consulting, software, IT and other knowledge economy jobs.

It is a shocking reality indeed, which can have major implications on the current job market in the country.

These results were derived from two studies:

A. 'The National Spoken English Skills of Engineers Report', where in English language skills were tested on 30,000 would be engineers from 500 engineering colleges across the nation

B. 'National Employability Report for Engineering Graduates', where in 1.2 lakh engineering students from 520 engineering colleges were surveyed for employability skills (which included logic, aptitude and more tests besides English language). This particular test was conducted on those students who passed out in 2013

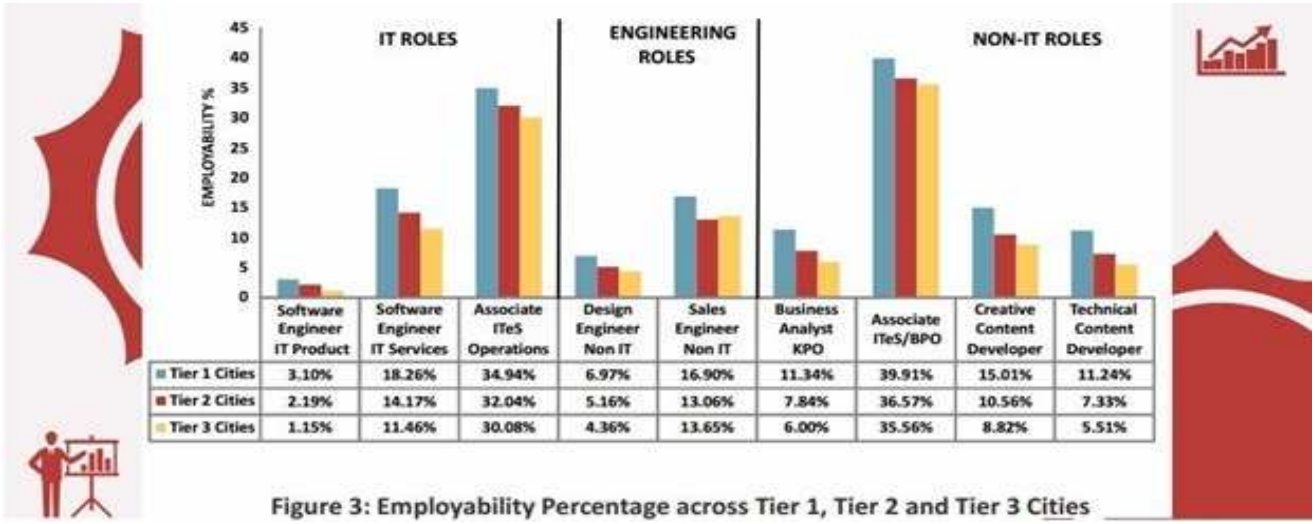
Interesting facts from these studies:

- 91.82% of the students lacked programming and algorithm related skills
- 71.23% of the students lacked soft and cognitive skills
- 60% of the students lack domain skills (example civil engineering, mechanical engineering etc)
- 97% of the students cannot speak English which is required for getting a IT job
- 57.96% of students lacked analytical and quantitative skills
- 61% of students possess grammar skills which is almost equal to a class 7th student
- Only 7.1% of students can speak English which is considered as meaningful, and presentable during an interview
- The major problem was witnessed with pronunciation, followed by fluency skills, grammar and sentence construction. Understanding spoken English and vocabulary showcased less problems
- Girls had better command over written English, while men were more proficient with spoken English (comparably)

Providing a possible explanation for these shocking results, Aspiring Minds CEO & Co-founder Himanshu Aggarwal said, "The low employability among engineering graduates is a cumulative outcome of poor education standards and higher demand of skilled employees thereby creating a drastic skill gap in the country,"

If we are assuming that this problem mainly exists in students from Tier 2 colleges, then we are wrong here. Even IITs and NITs are not spared, when it comes to English language skills.

Gautam Biswas, director, IIT Guwahati said, "We get students from different backgrounds and regions, and they are mostly not comfortable with English. Quite a few students appear for the joint entrance examination in their mother tongue. It becomes very difficult for them to follow the curriculum."



	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	Creative Content Developer	Technical Content Developer
Tier 1 Cities	3.10%	18.26%	34.94%	6.97%	16.90%	11.34%	39.91%	15.01%	11.24%
Tier 2 Cities	2.19%	14.17%	32.04%	5.16%	13.06%	7.84%	36.57%	10.56%	7.33%
Tier 3 Cities	1.15%	11.46%	30.08%	4.36%	13.65%	6.00%	35.56%	8.82%	5.51%

Figure 3: Employability Percentage across Tier 1, Tier 2 and Tier 3 Cities

Have we put too much focus on Maths, Science and Biology that we have left our students paralyzed when it comes to soft skills and English language proficiency?

UB Desai who is the director of IIT Hyderabad certainly thinks so. He said, "Over the years, the focus in the education system has shifted to chemistry, maths, physics. Focus on soft skills has reduced. Students may lose out on good job prospects as many companies come to campuses for global positions as well,"

As per Aspiring Minds, a fresher can easily lose 30-50% of salary, in case his English language and soft skills are below expectations.

6. Introduction

A Provisional History of the Idea of "Soft" vs. "Hard" Skills in Engineering Education soft adj. 1. not hard, firm, or rough. 2. not loud or bright. 3. gentle. 4. (too) sympathetic and kind. 5. weak, foolish. 6. (of drinks) nonalcoholic, 7. (of drugs) not highly addictive. soft option easy alternative. soft-pedal v.

refrain from emphasizing --Oxford Mini Reference Dictionary and Thesaurus, p.598 disparage v. suggest that something is of little value or importance. syn. belittle, criticize, decry, denigrate, deprecate, minimize, run down, undervalue. --Oxford Mini Reference Dictionary and Thesaurus, p.172 The definitions above capture three important dimensions of the word "soft." First, it is often defined in the negative, as the absence or opposite of something. Second, it is vague in the sense that it means very different things in different contexts. Third, in most contexts, it is fundamentally disparaging. As a term used in engineering education, "soft skills" is filled with contradictions and ambiguity. For example, the "hard" skills map easily onto recognized academic disciplines (mathematics, basic science, engineering), while the expertise that constitutes "soft" skills is difficult to locate in academic disciplines and departments. Still, whatever these "soft skills" are, they are significant predictors of future success in engineering. All of the humanities and social sciences have the potential to contribute to the development of "soft skills," but none can lay exclusive claim to them. The multidisciplinary nature of "soft skills" means that they are both everywhere and nowhere in an academic context. Both the "soft" and the "skills" elements of the concept have been called into question. In both categories, alternatives have been proposed, but none has become widely accepted. This paper reports on the first phase of a work-in-progress: a historical and philosophical inquiry into why the terminology of soft versus hard skills emerged, how it has evolved, why it has been so persistent, why it is problematic, and how we might be able to move beyond it in engineering education. Here, the focus is on the circumstances that led to the emergence and prevalence of the term in two different contexts: (1) the discourse community of speakers of English as represented in the Oxford English Dictionary (OED) and (2) the discourse community of engineering education as reflected in papers published by the American Society for Engineering Education (ASEE) in the period 1996-2020. The combination of these two perspectives reveals that (1) the conversation on soft skills is by no means limited to engineering education; (2) interest in the topic has increased dramatically since 1996; and (3) implementation of the EC2000 accreditation criteria provided the impetus for the dramatic increase in interest within ASEE. Research Approach: Qualitative and Quantitative Analysis of Publications Over Time The research approach used here starts with the assumption that the circumstances in which a term emerges offer valuable insight into the function it was created to fulfill. More specifically, this study combines qualitative and quantitative methods and draws on the conventions of the history of ideas, which traces the origins and development of the beliefs that guide decisions and actions (see, for example, Skinner, 1969 and Bevir, 2000). In its most basic form, the history of ideas traces change over time and consists of three sequential steps: 1. focus on the emergence of new terms as an indication of broad cultural changes, 2. identify influential authors and publications on those terms, and 3. correlate the emergence of terms and authors with events that could motivated them. As Philip Wiener put it in the preface to his five-volume Dictionary of the History of Ideas: Studies of Selected Pivotal Ideas (1973), "the historian of ideas makes his [sic] particular contribution to knowledge by tracing the cultural roots and ramifications of the specialized concerns of the mind" (p. vii). The approach to the history of ideas outlined above is greatly facilitated by what has come to be termed "text mining," "an artificial intelligence (AI) technology that uses natural language processing (NLP) to transform the free (unstructured) text in documents and databases into normalized, structured data suitable for analysis" (Linguamatics, What Is Text Mining). Search engines provided by Google and others have made the quantitative analysis of large bodies of texts far less labor-intensive than it was in the days of card catalogues. Although it is possible to do sophisticated assessments of the impact of publications, the approach taken here rests on a simple premise: an increase or decrease in the number of publications indicates increasing or declining interest in a topic or idea. Such an approach is appropriate because scholarship in the history of ideas seeks correlation rather than causation and advantageous because it allows for efficient discernment of changes over time across disciplines and domains. In sum, the comprehensiveness and scope of the history of ideas approach make up for what it lacks in specificity and causality. The text mining capability provided by document repositories such as ASEE's PEER database, makes it possible to do quantitative analysis that provides at least a rough outline for the history of particular ideas in engineering education. Given the size and scope of ASEE as an organization, it seems reasonable to infer that papers published in the proceedings of the various conferences that ASEE sponsors are broadly representative of trends in engineering education since 1996. Humphreys and Wang (2018) explain the theoretical foundations of quantitative text analysis (including automated text analysis) as consisting of three basic propositions: (1) "by studying language [we] study thought. . .language is conversely important because it shapes thought" (p. 1278), (2) "language represents attention in two ways. When [people] are thinking of or attending to an issue, they tend to express it in words. Conversely, when [people] are exposed to a word, they are more likely to attend to it" (p. 1279), (3) "Word frequency, measuring how frequently a word occurs, is one way of measuring attention" (p. 1279), and (4)

utomated text analysis provides "tools for analyzing language, aggregating insight, and distilling knowledge from this overwhelming amount of data" (p. 1275), including "prediction of variables outside of the text" (p, 1291).1 Using the framework Humphreys and Wang provide, the analysis described here takes a "top-down approach" (p. 1284) because it began with a focus on a particular language construct, "soft skills." A search of PEER using the term "soft skills" yielded the details presented below in two different domains: (1) the numbers of papers featuring that terminology over time and (2) the pervasiveness and distribution of the scholarly discourse on soft skills based on the number of divisions treating the topic and the divisions in which the topic seems to play the most important role. Understanding the origins of the term, however, requires going back to a time before automated text analysis and the establishment of the PEER repository. Qualitative Results: The Story of Origin That Emerges in the First Published Attempts to Define "Soft" vs. "Hard" Skills According to the Oxford English Dictionary (OED), the leading historical dictionary in the English-speaking world, the first published mention of "soft skills" occurred in 1957 in an article published in the Atlanta Constitution. The first systematic scholarly publication on "soft skills"originated from a conference convened by the U.S. Continental Army Command (CONARC) in 1972. The screenshot below shows the entry on

"soft skills" in context. The astute reader will notice that the report from the 1972 conference is not recorded, a surprising omission on the part of the OED. Still, the publications included in the entry on "soft skills" provided an entry point for identifying other publications, including the CONARC report. Experts in the social and behavioral sciences were convened at the CONARC conference to develop a model of systematic training that would help military personnel cultivate the capability "to command, counsel, supervise, and lead." It is worth noting here that the connection of "soft skills" and leadership has been an enduring theme in engineering and beyond. Even at that early stage in deliberate use of the terminology, the participants in the 1972 conference recognized "that the use of the terms 'Soft Skill' and 'Hard Skill' [should] be discontinued" (p. I2). Nearly 50 years later, the use of the distinction is still common.

The reports on the CONARC conference use the soft-hard distinction to differentiate between specialized and non-specialized skills, or perhaps more accurately, domain specific vs. generally applicable or transferable expertise. When Turley (1981) used the hard-soft distinction in an assessment of U.S. mobilization of manpower [sic] during a national emergency, he used "technical" and "nontechnical" as synonyms and provided these examples: a "signal corps repeater man" or an "electronics mechanic" exemplify "hard skills," while cooking, driving, and handling various forms of paperwork exemplify "soft skills" that do not become obsolete in the way "hard" or technical skills do (Turley, 1981, p.11). From the beginning, the soft skills proved devilishly hard to define. One of the experts at the 1972 conference observed somewhat wryly that the CONARC definition of soft skills as "job-related skills involving actions affecting primarily people and paper (II-4). . .leaves much to the imagination" [emphasis added] (p. II-5). Eventually, the same expert concluded that soft skills could only be clearly defined in the negative: "Those job functions about which we know a good deal are hard skills and those about which we know very little are soft skills" (p. II-7). This conclusion bears remarkable resemblance to a remark made to the author of this paper at an ABET annual meeting in the late 1990s: "Soft is what an engineer calls anything he [sic] doesn't understand." On one hand, these difficulties make it even more puzzling that the idea and terminology of "soft skills" have persisted. On the other hand, the ambiguity is probably an indicator of the enduring appeal of "soft skills," especially in the context of engineering education: it provides a way to name something important without being overly specific about what is being named. Quantitative Results: A Burgeoning Conversation Prompted by the EC2000 Criteria The frequency data from PEER reveal a burgeoning conversation that grew from 4 papers in 1996 to 23 in 2001, 51 in 2007, 94 in 2015, 117 in 2017, and 124 in 2020. Although the pattern is a little irregular, the overall picture is one of rapid growth. Figure 1 below correlates significant changes in the total number of papers on "soft skills" with developments within ASEE and engineering education more broadly. These trends and correlated events suggest that "soft skills" provided a readily available name for competencies in the EC2000 criteria that were outside of the STEM disciplines. In other words, engineering educators needed a name for the heterogeneous set of abilities that were not developed systematically in their own areas of specialization. Beyond that, it seems reasonable to infer that the categories of "hard" vs. "soft" appealed because they reflected a binary, hierarchical framework in which the "hard" (STEM) disciplines were superior, even when the outcomes grounded in the HSS outnumbered those developed through STEM.

The evidence and analysis presented in this paper suggest that the terminology of "soft skills" emerged in the context of leadership development in the military and as part of an effort to systematically develop an evidence-based approach to cultivating those skills. Although it has proved remarkably persistent, the terminology of "soft" vs. "hard" skills was not the result of a deliberative process (at least there is no evidence of such a process). It seems to have been chosen ad hoc as a readily available option whose limitations were recognized at the outset. Interest in "soft skills" within ASEE increased dramatically as the EC2000 criteria were implemented. It seems likely that it persists because of (1) its vague, capacious nature; (2) the way it maintains a hierarchy of knowledge in which engineering in particular, and the STEM disciplines more generally are at the top while also recognizing what employers want in the engineering graduates they employ; and (3) the non-technical skills are recognized as essential to career success in engineering. As the title of this paper indicates, the historical narrative presented here is provisional. Nonetheless, it provides a high-level view and the beginnings of an understanding of the factors that contributed to increased use of the terminology "soft skills." The documentary evidence cited here is deserving of deeper analysis. It should be possible to identify the authors and publications that have been important in the discourse on "soft skills." Additionally, this paper has skirted both the debate over what should replace the hard-soft distinction and the relationship between the scholarly and popular press discourses on "soft skills." There seem to be an increasing number of businesses that purport to develop "soft skills," and the efforts of the various professional societies with respect to professional skills deserve mapping in greater detail. The longer-term goal of this project as I currently envision it is to get beyond inventories of soft skills (of which there are many) and what appears to be perpetual discovery of the fact that they matter so much in engineering. To develop the "soft skills" systematically, we have many conceptual knots to untangle, including the skills-proficiencies-individual trait relationship; the core-periphery distinction that is central to engineering education; how the professional skills differ from the capabilities considered to be the "core" that engineering education in the various disciplines seeks to develop; and how we can structure and assess the efficacy of educational experiences that cultivate those capabilities. At a minimum, though, I hope this provisional account demonstrates the validity of pursuing a historical and philosophical inquiry into the vocabulary of "soft skills."

7. Introduction

Changing the world through digital experiences is what Adobe's all about. We give everyone—from emerging artists to global brands—everything they need to design and deliver exceptional digital experiences! We're passionate about empowering people to create beautiful and powerful images, videos, and apps, and transform how companies interact with customers across every screen.

We're on a mission to hire the very best and are committed to creating exceptional employee experiences where everyone is respected and has access to equal opportunity.

We realize that new ideas can come from everywhere in the organization, and we know the next big idea could be yours!

The challenge

The Adobe Globalization team is looking for a software developer to work on the design and development of features for Adobes' international customers, and other Adobe globalization initiatives such as globalization libraries, services, and tools. We are looking for someone with a passion for different languages and cultures, has strong technical skills necessary to translate this passion into world class, world ready software. The successful candidate will work with members across different countries and time zones, so the ability to communicate effectively across cultures and time zones is essential. If you have experience developing software on the web for an international audience, are comfortable working in a fast-paced, agile environment, like to be hands-on and deep dive into code, and can deliver working software on schedule with little supervision, then we want to talk to you.

What you'll do

- Assess a software application's internationalization gaps, and to come up with technical recommendations to fill the gaps
- Work closely with the core development teams to design and develop internationalization and localization infrastructure for their products
- Contribute to the design and development of new internationalization and localization technologies, such as services, libraries, tools and ML solutions
- Resolve internationalization bugs
- Add new features to software applications to delight international customers

What you need to succeed

Technical Skills

- Knowledge and/or experience with software architecture design and implementation, especially on the Web, front and backend
- Hard core software developer with a passion for technology and strong hand-on programming experience including but not limited to:
- Langage: JavaScript, TypeScript, C++, Python, Java
- Framework: React.JS, Node.JS, Redux, Vue, Sprint
- Knowledge and experience with ML technologies especially in the field of GenAI is strongly desirable
- Knowledge and experience with software internationalization and localization is desirable

Soft Skills

- Good verbal and written communication skills
- Good time management and organizational skills
- Self-motivated, self-starter, quick learner, independent, love of learning
- Team player
- Good social and presentation skills

Education and Experience

- Bachelor of Science in Computer Science or related field
- 2+ years of large commercial software design and development experience
- 1+ years of software internationalization experience is desirable

Our compensation reflects the cost of labor across several U.S. geographic markets, and we pay differently based on those defined markets. The U.S. pay range for this position is $101,500 -- $194,300 annually. Pay within this range varies by work location and may also depend on job-related knowledge, skills, and experience. Your recruiter can share more about the specific salary range for the job location during the hiring process.

At Adobe, for sales roles starting salaries are expressed as total target compensation (TTC = base + commission), and short-term incentives are in the form of sales commission plans. Non-sales roles starting salaries are expressed as base salary and short-term incentives are in the form of the Annual Incentive Plan (AIP).

In addition, certain roles may be eligible for long-term incentives in the form of a new hire equity award.

Adobe is proud to be an Equal Employment Opportunity and affirmative action employer. We do not discriminate based on gender, race or color, ethnicity or national origin, age, disability, religion, sexual orientation, gender identity or expression, veteran status, or any other applicable characteristics protected by law.

Adobe aims to make Adobe.com accessible to any and all users. If you have a disability or special need that requires accommodation to navigate our website or complete the application process,.

Adobe values a free and open marketplace for all employees and has policies in place to ensure that we do not enter into illegal agreements with other companies to not recruit or hire each other's employees.

8. Introduction

Snap Inc is a technology company. We believe the camera presents the greatest opportunity to improve the way people live and communicate. Snap contributes to human progress by empowering people to express themselves, live in the moment, learn about the world, and have fun together. The Company's three core products are Snapchat, a visual messaging app that enhances your relationships with friends, family, and the world; Lens Studio, an augmented reality platform that powers AR across Snapchat and other services; and its AR glasses, Spectacles.

Snap Engineering teams build fun and technically sophisticated products that reach hundreds of millions of Snapchatters around the world, every day. We're deeply committed to the well-being of everyone in our global community, which is why our values are at the root of everything we do. We move fast, with precision, and always execute with privacy at the forefront.

We're looking for a Solutions Engineer to join Snap!

What you'll do:

- Build new products and improve existing ones
- Collaborate with Snap product engineering teams and cross functional partners to meet business needs
- Understand and apply deep knowledge of products, technologies, and business to build solutions to solve for problems at scale

- Design and build end-to-end systems and launch-plan strategies
- Use broad range of technical and soft skills to build productive relationships with partners and independently resolve complex technical and business needs while contributing to partner documentation
- Apply expertise and product insight to deliver high-quality project/integration/partner engagements, while influencing product roadmap to meet the business needs
- Write and ship reliable, scalable, and efficient code
- Build and improve solutions in collaboration with engineering, product, and cross functional partners
- Identify and surface insights using metrics on product usage to increase adoption and provide new solutions that address the needs of partners
- Work with partners to develop a long-term strategic plan, grounded on business objectives, and manage partners during integrations with Snap's platform products and ensure value creation

Knowledge, Skills & Abilities:

- Ability to work with open source technologies
- Ability to mentor and provide guidance to more junior team members
- Strong written and verbal communications skills
- Strong relationship development and collaboration skills

Minimum Qualifications:

- BS in a technical field such as computer science or equivalent years of experience
- Substantial experience as a software or solutions engineer shipping reliable, scalable, and efficient code
- Experience coding in Javascript, building applications and APIs/SDKs for internal and external developers.

Preferred Qualifications:

- Advanced degree in computer science or computer engineering
- Experience working with cross functional stakeholders to define business requirements and product roadmaps
- Experience working with large SaaS, PaaS and cloud platforms and building applications for third-party marketplaces

The Accreditation Board of Engineering and Technology [1] identifies preparing students for engineering practice as one of the critical criteria for evaluating engineering education. The expected student outcomes outlined by ABET include non-technical or soft skills such as ability to communicate effectively, function in teams, and the knowledge of the social, political, economic, and global context of their work and the impact of their work in these contexts [2]. Even though ABET articulates the need for engineering education to also support the acquisition of non-technical skills and knowledge, it does not identify a specific set of soft skills on which engineering programs should focus. Because the primary goal of engineering education is to prepare engineers for professional practice, university engineering departments need to turn to industry to understand what soft skills employers want their entry-level engineers (newly hired engineers) to possess and if employers are satisfied with the soft skills these new-hires demonstrate. This study identifies and reports industry assessment of specific soft skills necessary to meet the ABET criteria. The outcomes of the research enable engineering education programs to be responsive to industry needs for non-technical entry-level skill proficiency.

In order to foster the development of program specific skills, engineering curricula place primacy on hard skills (technical skills) over soft skills [3]. The soft skills are not skills or abilities in a traditional sense, but rather they constitute a combination of interpersonal skills and personal attributes [4] that augment the technical skills traditionally seen as paramount to engineering success. There is growing evidence and impetus for focusing intentionally on soft skills within technical and professional curricula [5]. Changes in technology, increasing reliance on automation, transnational production processes, and the sheer complexity of work in the 21st century demand that employees demonstrate skills sets that machines cannot master [6,7]. Workplace situations and interactions that require social and interpersonal skills cannot be automated easily [6]. There are increasing expectations, therefore, for people in technical work places to focus on supplementing and complementing the growing capabilities of machines [3]. Qualities, such as the potential for non-routine interaction, ability to understand people's intentions, actions to successfully collaborate, decision making, leading, and adaptation to a changing environment, give human beings an edge over machines and enable employees to leverage human capabilities that machines cannot successfully master [6,7,8]. Moreover, there is additional evidence within labor economics, which underscores the need for social, interpersonal, and non-cognitive skills even within professions traditionally deemed technical. Labor economists have established that jobs demanding higher levels of social skills grew more between 1980 and 2012 in contrast to jobs requiring higher math but lower social skills [7]. Furthermore, jobs that will be available for the human workforce in the 21st century and those that will grow and flourish, even within technical fields, demand higher levels of interpersonal and social skills [3].

Concerns related to a lack of soft skills among engineers and engineering graduates have come to the forefront over the last decade. Recognizing the needs of the rapidly evolving and globally dispersed work contexts, IBM (International Business Machines Corporation) recommended that technical education in the 21st century should focus on preparing "T" shaped individuals who are not only steeped in field specific technical knowledge but also are able to demonstrate knowledge across disciplines and the ability to work with others [9]. More recently, in its exploration of the future direction of science, technology, engineering, and mathematics (STEM) education, the STEM connector's Innovation Task Force (SITF) emphasized that the next stage of STEM education should enable students to master the context, which demands the ability to function in teams, to demonstrate business acumen and leadership skills, and to be able to "navigate across global organizations" [10] (p. 13). However, of concern to engineering educators, Busteed [11] reported that employers expressed deep concerns about the preparation of college graduates and revealed a great disconnect between what employers expect and the level higher education considered as prepared for work. Another study reported that 58% of managers responding believed

that the productivity of their company was limited because of the lack of soft skills among their potential employees, especially among high growth industries and start-up enterprises [12]. Additionally, 59% of these managers specified that employees who demonstrated competence with soft skills were harder to find than those with technical skills [12]. Heckman and Kautz [13] argued that, at an individual level, soft skills such as conscientiousness predicted success in life, academic attainment, health, and higher labor market outcomes as much as cognitive ability. What is more, in a 21st century workplace, lack of soft skills can undermine the technical ability of individuals and can cost them their job and/or potential career growth [14]. Consequently, there is a noteworthy shift in the importance given to soft skills within technical fields. Accrediting bodies, such as ABET, have reiterated the need for engineering education programs to provide students opportunities to acquire a broader set of skills to improve their ability to collaborate, work in teams, and thrive in a globalized work environment [1]. Soft skills that were considered 'nice to have' within technical fields in the last century are moving to the 'need to have' category in the current century [15,16,17].

1.1. Purpose and Problem Statement

Soft skills, however, are not a finite set of skills or abilities. They constitute a wide range and disparate set of social and people skills, personal attributes, and self-management skills [18]. Soft skills required by engineers may vary at different levels of their careers [19]. Fundamentally, the set of soft skills required in entry-level occupations are not the same as those necessary for senior management level positions [20]. Recent studies have been conducted to analyze future skills needed and to identify which soft skills employers consider important for new or entry-level engineers [21,22,23,24,25,26].

The purpose of this study, therefore, was to provide documentation for university engineering programs related to expected soft skills by determining what soft skills employers perceive as being important for entry-level engineers to possess and demonstrate and by assessing the perception of proficiency of recent new hires in engineering. The study also sought to further understand the difference in employers' perceptions about importance and proficiency of soft skills for entry-level engineers within to their performance. A qualitative evaluation of open-ended responses answered the question of what employers look for in applicants and new hires. Snowball unstructured interviews reinforced the outcomes of the quantitative analysis of the survey data and the qualitative evaluation of open-ended responses. The objective was to inform engineering educators about the need to focus on non-technical skills within the curriculum [1,27] and help to prioritize which soft skills are reported as most important for entry-level engineering roles.

1.2. Research Questions

This study addressed the following research questions:

- What soft skills do employers expect entry-level engineers to demonstrate, which soft skills are most important?
- What is the perception of employers regarding the general level of soft skills proficiency of entry-level engineers?
- What is the difference between expectations of employers and their perceptions of proficiency demonstrated by entry-level engineers across the measured set of soft skills?
- What are the qualities that employers look for in applicants and new hires as entry-level engineers?

1.3. Conceptual Framework

ABET expects engineering programs to reflect current and future aspects of the technical fields and prepare students for a career in the discipline. Engineering programs are required to watch the trends in technical fields and the changes in knowledge and skill requirements these changes might augur. Environmental scanning is an established process used by organizations and higher educational institutions to gather information on the current and future trends in the macroenvironment in which they operate [28]. Aguilar (as cited in [28]) identified four methods of scanning the macroenvironment, including formal searching that refers to proactive seeking of information for specific purposes. The goal of environmental scanning is to alert decision makers to changes in the environment that lead to, or might lead to, changes in expectations [28]. In this study we use environmental scanning as the conceptual framework to assess the expectations of employers that recruit engineering graduates with the purpose of using the outcomes to inform engineering education programs. We specifically used an active, formal search approach to gather data on what soft skills employers expected engineering graduates to possess.

2. Review of Literature

2.1. What Are Soft Skills?

Skills generally refer to abilities people have acquired over time with effort or training and always involve an element of execution or performance [17,18]. Hard skills in an engineering context refer to technical skills or abilities that are required to perform work related tasks. Soft skills on the other hand are less tangible, hard to quantify, and rather challenging to define. In contrast to technical knowledge or abilities, the term 'soft skills' is used loosely in literature to denote a disparate set of personal attributes, traits, attitudes, and behaviors [4,17].

Research on soft skills exists across different fields such as labor economics [7]; employability, workforce development, and human resource development [6,8]; management and communication [4,29]; and in industry or subject specific literature such as information technology [20,30]; STEM [31]; education [15], or library and information science [18]. In addition, not for profit agencies and government funded or public sector projects also conduct country, region, or industry specific research on soft skills [32,33,34]. Private consulting agencies involved in studying the pulse of specific industries and evolving skill requirements within these industries investigate non-technical skills alongside technical skills requirements [11]. Given the multiplicity of fields in which research on soft skills is situated, it is not surprising that the taxonomy of soft skills is varied or that the definition of the term is rather fuzzy.

There is no universally accepted classification of what constitutes a soft skill [17,18]. Researchers use terms such as non-cognitive, non-technical skills; people skills; transferable skills; employability skills; and interpersonal skills to refer to soft skills [17,18,27]. Most research equates soft skills with people skills or the ability to get along with or work effectively with others [4]. However, soft skills are more than people skills or interpersonal skills (such as effective communication, collaboration, and co-operation) required to

relate to other people [4,17,18]. The term soft skills also encompasses intrapersonal elements (abilities such as adaptability and self-regulation that reside within the individual), personality traits (example: agreeableness, conscientiousness), attributes (example: confidence, resilience); and straddles both the cognitive (examples: analytical ability, decision-making) and affective (example: active listening, empathy) domains [17,18]. Since soft skills are non-technical and not industry specific, these are highly transferable across contexts and are broadly applicable [35].

2.2. Research on Soft Skills

Research on soft skills generally tends to focus on: (a) examining the importance of soft skills in academic and work contexts; (b) compiling a list of soft skills that employers consider important in a specific field; (c) comparing perceptions of different stakeholders on the importance of a specific set of soft skills within a given field or industry; (d) assessing soft skills requirements for different levels of employment; and (e) developing tools to measure soft skills or assess their demonstration. For instance, Heckman and Kautz [36] demonstrated that personality traits such as conscientiousness, perseverance, sociability, and curiosity played a significant role in predicting and determining success in academic, social, and work lives. Exploring the importance of soft skills from the demand perspective, Deming [7] found that jobs requiring high social interactions experienced significant growth in the United States between 1980 and 2012. Several studies have also emphasized a demand for social and interpersonal skills in the labor market in the coming years [6,36,37,38,39].

There exists a robust portfolio of research on the soft skills required in specific industries. Robles [4] asked business executives to identify ten soft skills they considered most important for new employees to possess and collected a list of 517 soft skills. Robles [4] then identified the top ten most frequently listed soft skills and created a questionnaire asking the executives to rank these skills in order of importance. Adopting a quasi-ethnographic approach Windels, Mallia, and Broyles [40] explored specific soft skills that were most useful in the advertising industry. Research on skills requirements in the field of library and information science also explored soft skills essential to succeed in the evolving field [41,42].

Comparing perceptions of various stakeholders such as students (for example: [5]), faculty, and employers on soft skills requirements is another area of emphasis within soft skills research. Rainsbury, Hodges, Burchell, and Lay [43] studied the perceptions of students and graduates on workplace competencies. More recently, using a qualitative approach John and Chen [31] investigated the importance placed by students and industry practitioners on the skills (both technical and non-technical) necessary for success in STEM. In their study of knowledge and skill requirements (including interpersonal skills and personal traits) for entry-level information technology workers, Aasheim et al., [30] compared the perspectives of industry personnel and faculty.

Determining soft skills requirements for different categories of employees such as entry-level performers, middle management, and senior management or leadership is also gaining traction in different fields. For instance, Weber, Finley, Crawford, and Rivera [44] studied soft skills required for entry-level managers in the hospitality and tourism industry. Another study used the Delphi method to identify skills for success at various stages of careers within the information technology (IT) industry [19]. The study developed a list of skills including non-technical, interpersonal, and intrapersonal skills IT professionals considered most important for success at entry-level, mid-managerial level, and senior managerial level within their industry [20].

Assessment of these intangible skills is another challenge explored in soft skills research. Klein, DeRouin, and Salas [45] provided a taxonomy of interpersonal skills and suggested a variety of means to categorize and assess interpersonal skills. Loughry, Ohland, and Moore [46] focused specifically on individuals' ability to work in teams and demonstrated means to assess capacity for working effectively in teams. Some researchers have developed scales or tools to measure specific soft skills. For instance, Taggar and Brown [47] created scales to measure conflict resolution, communication, and group problem solving. Heckman and Kautz [13] not only argued that personality traits played a significant role in predicting and determining success in academic, social, and work lives beyond standardized achievement tests, but also demonstrated how personality traits can be measured.

2.3. What Soft Skills Are Important in the Employment Context?

In an attempt to understand the demand side of conditions, researchers and research groups often compile a list of soft skills based on employer expectations or requirements. They collect data from employers through surveys and interviews on soft skills they want their employees to possess or demonstrate.

Because the survey was distributed prior to the pandemic, the outcomes of the ratings of the between group differences by each of the profile variables were shared during summer and early fall 2021 with engineers, managers, and educators through a snowball technique to identify possible reviewers who would offer feedback on the results. These were unstructured interviews with a goal to capture reactions to the between group differences.

An engineer within an organization that primarily works with defense contracts commented, "Those differences where aerospace, defense, and manufacturing are rated higher than technology makes sense. We require all of our aerospace people and those working on the defense and manufacturing contracts to talk directly with the customer to find out what the customer needs and to report on the project. The tech team working on programming and coding pretty much keep to their team and the scrum master talks with the client" [Engineer 1]. This comment supported the outcomes presented in Table 7, the importance ratings for the soft skill, ability to deliver effective presentations.

An educator in a four-year higher education role and familiar with interactions of recruiters with students reviewed the results presented in Table 8. The educator commented, "The recruiters I have worked with over the years work diligently to review candidates for internships and positions. They interview faculty and have lunch and dinner meetings with the students to determine which students would fit their organization. Several have told me that they can teach the engineering, but a person must come with the ability to think strategically, work under pressure, be reliable, have good time management, and on. The personal skills and soft skills to be able to work with others are skills they need to

demonstrate the first day the start to work" {Educator 1]. The conversation with the educator reinforced that there would be an expectation that the recruiter would rate a newly hired engineer higher than others in the organization because the recruiter would have spent time getting to know the new hire during the recruiting phase.

An educator with past work experience with small business and with firms that have worked with plants and offices in other countries reviewed the results of the location analysis, which are presented . Although the effect sizes were noted to be small to medium, the educator's comments provided additional insight into the expectations. "Cultural awareness is so important that sometimes people forget. Some people want rewards and people to notice what they have completed and have their picture on the board as employee of the month. Others would consider that type of recognition as something very bad and think it could actually destroy the functionality of the team if one person is recognized. New hire engineers need to have global and cultural awareness as they take part in global teams and global team meetings" [Educator 2]. Global and cultural awareness were rated higher by respondents from organizations that have branches, offices, or plants outside of the United States. The experiences and comments made by Educator 2 supported the necessity of engineers preparing to work in an organization with a global reach should include additional study to learn more about the culture and traditions of other locations where the organization operates its business.

During a meeting with a global talent acquisition director, the discussion moved from soft skills requirements for potential employees to the outcomes of the paired t-test results and the analysis to assess the between group differences identified in the analysis of variance of the calculated differences. The director commented, "My company has an expectation that employees will be able to communicate effectively with the members of their team, their clients within the organization and those outside of the organization" [Manager 1]. The director described situations where the soft skills that were rated the highest for importance were essential to the success of the employee's onboarding in the company. The comments included skills such as communication with diverse groups, reliability, time management, and ability to focus on a task. These were described as aspects of employees that were needed to be applied daily. With the pandemic, the team is now all remote and interacts with each other on teams throughout the day. The comments reinforced how necessary it is to further develop these skills after joining a company. Statements supported the finding that new employees do not know the routines and patterns for communication when they begin; however, as they learn about the work they are to do and how to contribute to the bottom line of the organization, the need to apply the soft skills to their work and their relationships in their teams.

These interviews reinforced that the soft skills identified prior to the pandemic were still relevant even though some work has shifted from offices to remote locations. The engineer, educators, and the manager interviewed have been working from their organization offices and with their teams in face-to-face settings.

2.4. Analysis of Participants' Open-Ended Comments at the End of the Survey

The survey also contained space for participants to articulate their thought on areas related to soft skills for entry level engineers in two sections of the survey. The purpose was to allow participants to elaborate on their thoughts about the importance of soft skills and to create an opportunity for them to specify reasons for their responses or draw attention to areas not covered in the survey [56]. The first space was provided at the end of the list of the 26 soft skills that participants were required to rate to capture soft skills that the survey did not assess but employers considered important. The second space was provided at the end of the survey to gather the general thoughts of employers about the importance of soft skills for entry-level engineers in their organizations or line of work. A total of 136 participants added their comments in the first section and 79 in the second. The number of responses (215) highlighted the intent and the seriousness of purpose of the participants and prompted us to consider and analyze their thoughts on the importance of soft skills for entry-level engineers [47]. In the next section, we present an analysis of the comments of the respondents with some actual quotes from participants (P).

2.4.1. Soft Skills Are Often the Final Deciding Factor

Most employers who responded to the open-ended questions emphasized the importance of soft skills for engineering graduates: "Interesting you are focusing on soft skills. When I look at a college hire, it is the soft skills that often are more important than technical knowledge" (P18). Most respondents mentioned that engineers with a willingness to learn can acquire the technical knowledge of skills on the job, while soft skills were the key discriminators during the hiring process: "General skills sets, GPA, and projects/extra-curricular activities that are related to the job weed out 90% of the candidates. The final choice is all about the attitude" (P29). Explaining why soft skills become the deciding factor, the employers argued that, if the engineering graduates were from reputed programs, their technical skills were most often satisfactory. Moreover, "hard skills are typically solid or buildable from entry level engineers/interns from decent programs" (P124), therefore, what differentiates the one graduate who is selected from the others who were not despite more or less equal technical skills were the candidates' soft skills. "Your resume gets you in the door and tells me you have the intellect to learn what I have to teach you … What I am looking to confirm in new hires is work ethic, commitment and flexibility" (P256). Employers found soft skills to be important for engineers to obtain a job or become hired, but they also found soft skills to be more important for them to grow in their careers: "It is the proficiency in soft skills that allow engineers to become successful technical, programmatic and functional leaders in organizations" (P76).

2.4.2. What Do Employers Look for Specifically during the Hiring Process?

The general consensus was when reviewing short-listed resumes, employers were not swayed by GPA or technical prowess, but instead, they:

... look for experience/activities outside degree requirements and primary disciplines, and employment concurrent with scholastics. This shows a well-rounded person able to work their brain in different ways and manage their own time and responsibilities (P94).

Moreover, employers admitted that "A successful new hire will not be the most technically proficient, instead it will be the one best able to learn and communicate" (P394). Others identified communication skills, critical thinking skills,

cultural fit (initiative, curiosity, interpersonal skills), enthusiasm/passion, and related extracurricular interests.

Even though some employers said they were happy with young engineering graduates from good programs, many complained that they generally lacked basic knowledge of workplace norms such as dress, hours of work, work ethics, and basic acceptable behaviors in a work environment: "The primary problem with co-ops and recent grads is their complete lack of understanding of basic norms and expected behaviors in the "real world" (P356). Others echoed similar observations: "they don't see why it is necessary to be at your desk working at the start of the day and are out the door like a shot at quitting time or even a little before that" (P404). Employers also said, they are forced to:

Spend a lot of time talking about simple things such as telling your supervisor/manager if you will be out or late, communicating when you are done with an assignment—or if you need help. Essentially, we have to teach entry level folks to talk and communicate in most aspects of simply holding a job (P148).

Clarifying that not all young engineers need to be schooled on basic work ethics, one participant specifically said:

This is not universally true of all millennials, but I can tell you nobody ever had to tell me not to do the following, all of which I've seen entry-level students do: 1. Show up to a job interview in a shirt and tie—with the shirt untucked! 2. In my second week on the job, ask for Friday off so I could go to a soccer tournament. 3. Fall asleep at my desk, even after being spoken to about it. 4. Spend 75% of my time looking straight down at my phone, even though my work is done on the monitors in front of me (P412).

Some of the same concerns about not being actively engaged at work were expressed by other participants who mentioned that engineering interns and graduates were "really … not mentally engaged when he came to work and there was a sense of entitlement with him" (P36).

The employers also identified soft skills they thought were important for entry-level engineers in addition to the 26 that were identified in the survey and also emphasized the soft skills they thought were critical in engineering workplaces in current times.

Engineers are no longer "just" engineers. They work in many cross-functional teams; are held accountable for project plans and schedules; communicating with diverse teams; leading teams; and being able to communicate effectively, both in writing and verbally (P65).

The soft skills the employers highlighted could be categorized as: (a) communication skills; (b) interpersonal skills; and (c) personality characteristics.

2.4.3. Communication Skills

Most participants identified that engineering graduates more often lacked the ability to communicate or have an interaction with human beings and that they chose to communicate virtually rather than in person, "which creates a challenge for them when they are engaged in an active (real-time) debate with another human being, especially a boomer or x-er" (P9). In addition to causing inter-generational conflicts, the choice of medium of communication was identified as a problem at other levels too:

Just because you 'drop an email' does not mean that the person you are exchanging information with is going to respond. And, for any real technical debate, it will be more than 140 characters. One of the comments I make more often than I would like to is, "go see him/her" (P182).

The participants also identified what aspects of communication were critical to entry-level engineers and why. One aspect mentioned by many participants was listening skills. Associated with listening, participants stressed the significance of listening with empathy, being able to take feedback, and following instructions:

I think the ability to listen to users, empathize with them and accept their criticism to create a better product is a very important skill to have (P294).

Too often I see SW [software] engineers dismiss valuable user feedback because they don't take the time to understand the user's reasoning, assume the user knows less than the engineer, or because they cannot accept criticism (P52).

It was not surprising that the participants expected new engineers to articulate clearly, and speak up when needed, ask for help, and ask the right questions. More importantly, the employers emphasized that:

The biggest challenge for young engineers is communicating effectively both orally and in writing to people (nontechnical and customers) that are not within their engineering team and/or do not have their level of technical savvy… whether they are explaining technology and capability and/or gathering requirements (P172).

In addition, choice of medium to communicate also came up in many responses. The employers felt that new engineers preferred to text rather than talk in person or communicate through "effective and polite emails" (P91).

2.4.4. Interpersonal Skills

Employers consider interpersonal skills very important for engineers. The employers' comments indicate that even though engineers consider themselves as working with machines, systems, and technology, ultimately, they are working with people and for people: "It's about solving problems for people; not about machines—you can have a perfect design but if you do not get peoples' buy in it will not work" (P107). Therefore, interpersonal skills such as respecting older people, being socially aware, and demonstrating emotional intelligence in their interactions are seen to be critical in engineering workplaces. Employers identify the ability to build and maintain professional relationships with colleagues, customers, and clients as being the key for survival and growth even in technical roles. However, there seems to be mixed reactions to the need for leadership skills. Some employers consider leadership skills not essential for entry-level engineers: "I think leadership is a meaningless red herring. Leadership requires many things that come with experience. In addition to teaching people to "lead", we need to teach them to be humble and follow" (P410).

2.4.5. Personality Characteristics

Among the list of soft skills that employers chose to write down, there were many personality characteristics. These included honesty, humility, commitment to tasks, persistence, confidence, not being stubborn, being an active learner, drive, and quality consciousness. In addition,

employers also underscored the need to demonstrate: "engagement and passion to do a good/complete job vs. checking the box as quick as possible" (P21), and creativity in resolving problems, ability to think through complex problems. They said they preferred even-tempered self-starters who show potential to "work without resources" (P3); "dealing with hostile coworkers" (P190); and are able to "pick up work where others left off and easily hand-off for others to pick up" (P312). Additionally, the employers expected new engineers to have the skill of "outcome thinking" or the ability to foresee the response or consequence of their actions. This was one of the main reasons, employers said they preferred slightly mature older graduates:

They need to be reliable, positive, and even keeled. We often prefer more 'mature' new hires who took 5–10 years off after college to pursue other interests. They are typically more even keeled than their freshly graduated counterparts (P244).

2.4.6. Summary of Participants' Comments

Employers clearly described soft skills as the determining factor in the hiring and promotion process. Even though most employers appeared satisfied with the technical skills of engineering graduates, most of them were concerned that they lacked basic knowledge of work ethics and work place norms. Ability to listen with empathy, speak with clarity and politeness, and write clearly and effectively seemed to be very important for employers. While a few employers believed that soft skills cannot be taught and one either has them or not, most others suggested that colleges create opportunities for engineering students to develop soft skills, to be involved in extra-curricular team activities, and to add a class that gave them a glimpse of the real world of work.

3. Discussion

The purpose for this study was to address the gap between what is stated in the literature as expected of more senior members of an organization and what soft skills employers perceive as being important for entry-level engineers to possess and demonstrate. The 26 soft skills rated for importance and proficiency provided a look into perceptions of engineering firms outcomes of recent graduate hires. The open-ended questions illuminated more brightly the need to provide opportunities in courses and within school activities to further develop communication skills, interpersonal skills, and personality characteristics.

The soft skills that employers expect entry level engineers to demonstrate included all 26 of the soft skills on the list; all had a score of 2.65 or higher, out of a scale of 0 to 4, indicating that they are important skills. Most important was Reliability, which was rated as 3.93 out of a possible 4.0 by the respondents to the survey. The open-ended comments reinforced this need for reinforcing reliability. Being considered reliable and having reliability are good social skills; social skills are necessary for successful social interactions [7]. Other top important soft skills to be maintained and improved in engineering education are team work, demonstration of responsibility, self-motivation, and a positive attitude. These can be included within engineering education through a variety of interactive activities such as group projects, independent projects, and activities that require personal accountability.

The perception of employers regarding the general level of proficiency of entry-level engineers when it comes to soft skills is that the entry level employees are moderately proficient on all of the skills. Only positive attitude was rated above 3.5 (3.55 out of 4.0). The others were rated between 2.35 and 3.38 on the level of proficiency. These moderate levels reinforce that engineering education programs are doing good work in that none of the average ratings were below two. More can be conducted to improve the proficiency of the students. Additional opportunities to practice leading others, making presentations, planning and thinking strategically, writing reports and other communications, and dealing with uncertainty would address those soft skills rated as the least levels of proficiency and in need of improvement.

Those soft skills with the greatest differences between expectations and perceptions of proficiency across the set of soft skills could be grouped into the same categories as the open-ended comments: communication skills, personality traits, and interpersonal skills. The ability to communicate effectively with diverse groups of people and the ability to communicate across age groups are necessary in the globalization of organizations and the age ranges of employees in departments and work teams. Engineering education programs would have the greatest effectiveness for closing the gap between importance and proficiency by focusing on these soft skills. Time management is something that many need to improve; however, new employees without an understanding of the expectations of the work environment would not have a good foundation for time management. It seems that good time management skills balancing work and study while in college might not be enough to develop this skill in the workplace. The open-ended responses alluded to a solution, better preparation in the engineering education preparation of what a work day and work expectations would be. Knowing how to dress and be on time are also part of the need for work expectation awareness.

Between group differences were assessed using analysis of variance and the profile characteristics of organizations and respondents to determine if there were differences by soft skill and its level of importance or the level of proficiency of the newly hired engineers in the organizations. Of the 26 soft skills included in the survey, 25 of the soft skills resulted in a statistically significant between group difference for at least one of the profile characteristics. Positive attitude had an average rating of importance of 3.82 out of 4 and an average proficiency rating of 3.55. In the ranking of proficiency, positive attitude was the highest ranked skill for the entry-level engineers whose proficiency was being considered in the study by the respondents.

This list describes the statistically significant between group comparisons found within the analysis of variance to determine the effects of the organization and respondent profile characteristics. Size, global location, public or private, primary business line, role within the organization, and supervisory requirements had differential effects for the soft skills. Engineering education programs can plan interventions within courses or offer opportunities to practice a soft skill in order to better prepare their graduates for work as an engineer. For example, knowing a large organization has a higher rated level of importance for being able to communicate across age groups, an engineering education program could have students present their senior design projects to a local community center where members of all ages from the community would be present to interact

with the students. Another example, engineering education programs can review recommendations for program activities for other engineering accrediting bodies such as the European Commission (ESCO), the European Centre for the Development of Vocational Training (Cedefop), or the Council of European Professional Informatics Societies (CEPIS). Evaluations of program content within these organizations has been reported in series of future program requirements [23,24,25,26] that could serve as checklists for programs or for students.

Descriptions of where the differences occurred in the comparisons are provided to help engineering educational program consider modifications or enhancements.

1. Ability to communicate effectively with diverse groups of people

A. The ratings by the recruiters for the level of importance and the level of proficiency of newly hired engineers were much closer to each other than were the ratings reported by respondents whose roles were coded as engineers, managers, or directors.

B. Although the effect sizes were small, respondents with direct supervision of newly hired engineers indicated greater differences between their ratings for importance and the level of proficiency exhibited by the newly hired engineer than those respondents without direct supervision.

2. Ability to communicate across age groups

A. Larger companies have a greater requirement for communication across age groups; >500 had higher ratings than 100–500 firms and differences indicated a small to medium effect size.

B. Organizations with branches, offices, or plants outside the United States report greater differences between importance and proficiency indicating a need for preparation prior to joining global firms.

3. Ability to deliver effective presentations

A. Larger companies have a greater expectation for presentation ability.

B. Organizations with branches, offices, or plants outside the United States report greater differences between importance and proficiency.

C. Although the effect sizes were small, respondents with direct supervision of newly hired engineers indicated greater differences between their ratings for importance and the level of proficiency exhibited by the newly hired engineer than those respondents without direct supervision.

D. Public sector organizations report higher importance and higher proficiency ratings than private sector organizations. The effect size for the differences between public sector organizations and private sector organizations is a small to medium effect. This could indicate more opportunity to practice in public sector firms or more opportunity to be observed in private sector firms.

E. Organizations with facilities outside the United States reported more importance for newly hired engineers to effectively present than in organizations with operations only within the United States.

F. The type of firm differs in requirements. The level of importance is rated higher for aerospace, defense, manufacturing, and medical compared to technology primary line of business.

4. Ability to write effectively

A. Medium to large effect size for differences between industry recode of the primary line of business. Respondents who identified as healthcare had reported the newly hired engineers' proficiency exceeded the respondents' ratings for the level of importance for writing effectively. Respondents from organizations whose primary line of business was defense, energy, engineering, medical, or research and development (R&D) coded the level of importance higher than the proficiency of the newly hired engineers such that the between group comparison of each of these lines of business were determined to have statistically significant differences from those respondents in healthcare.

B. Although the effect size is small, those with direct supervision of newly hired engineers responded with greater differences between their ratings for importance than the level of proficiency exhibited by the newly hired engineer.

5. Ability to work in teams

A. Importance of ability to work in teams, organizations with more than 500 employees were rated higher than organizations with less than 100 employees.

6. Ability to deal with uncertainty in relating to people and situations

A. Importance rating higher for engineering compared to manufacturing primary line of business.

7. Ability to work under pressure

A. Importance ratings were higher for aerospace, civil engineering, consumer products, manufacturing, and semiconductors compared to R&D primary line of business.

8. Ability to plan and think strategically

A. The public sector ranked the importance higher than the private sector.

9. Ability to understand, articulate, and solve complex problems and make sensible decisions based on available information

A. Although the effect size is small, those with direct supervision of newly hired engineers responded with greater differences between their ratings for importance than the level of proficiency exhibited by the newly hired engineer.

10. Critical thinking (ability to identify, construct, and evaluate arguments; detect inconsistencies and errors in reasoning; solve problems systematically; reflect on underlying values and beliefs)

A. The ratings by the recruiters for the level of importance and the level of proficiency of newly hired engineers were much closer to each other than were the ratings reported by respondents whose roles were coded as engineers, managers, or directors.

B. Although the effect size is small, those with direct supervision of newly hired engineers responded with greater differences between their ratings for importance than the level of proficiency exhibited by the newly hired engineer.

11. Creativity: coming up with 'out-of-the-box' ideas and solutions

A. Ratings are lower by those who supervise than by those who do not supervise entry level engineers.

12. Social responsibility
A. The public sector rated the importance higher than the private sector.
B. Statistical difference for importance not evident in pairwise comparison when consider primary line of business.

13. Global and cultural awareness
A. Small effect size for differences for where have branches, offices, or plants outside United States, no outside branches had greater difference between importance and proficiency than the differences in ratings for those with branches, offices, or plants outside of the United States.
B. Small to medium effect for the rating of importance for organizations with branches, offices, or plants outside of the United States.
C. The public sector rated the importance higher than the private sector.

14. Leadership
A. Organizations with more than 500 employees were rated importance and proficiency higher than organizations with less than 100 employees.
B. Statistical difference for importance not evident in pairwise comparison when consider primary line of business.

15. Focused: the ability to stay focused on a task
A. Ratings are lower by those who supervise than by those who do not supervise entry level engineers.

16. Self-efficacy: belief in one's capabilities to achieve a goal or outcome
A. Although the effect size is small, those with direct supervision of newly hired engineers responded with greater differences between their ratings for importance than the level of proficiency exhibited by the newly hired engineer.

17. Staying/ being organized
A. Although the effect size is small, those with direct supervision of newly hired engineers responded with greater differences between their ratings for importance than the level of proficiency exhibited by the newly hired engineer.

18. Time-management
A. The ratings by the recruiters for the level of importance and the level of proficiency of newly hired engineers were much closer to each other than were the ratings reported by respondents whose roles were coded as engineers, managers, or directors.
B. Although the effect size is small, those with direct supervision of newly hired engineers responded with greater differences between their ratings for importance than the level of proficiency exhibited by the newly hired engineer.

19. Reliability
A. Statistical difference for importance not evident in pairwise comparison when consider primary line of business.

20. Flexibility and adaptability
A. Ratings are lower by those who supervise than by those who do not supervise entry level engineers.

21. Self-motivation
A. The ratings by the recruiters for the level of importance and the level of proficiency of newly hired engineers were much closer to each other than were the ratings reported by respondents whose roles were coded as engineers, managers, or directors.
B. Although the effect size is small, those with direct supervision of newly hired engineers responded with greater differences between their ratings for importance than the level of proficiency exhibited by the newly hired engineer.

22. Responsibility
A. Although the effect size is small, those with direct supervision of newly hired engineers responded with greater differences between their ratings for importance than the level of proficiency exhibited by the newly hired engineer.

23. Curiosity
A. Ratings are lower by those who supervise than by those who do not supervise entry level engineers.

24. Willingness to take initiative
A. Organizations that identified as other types reported ratings for importance and proficiency that were about the same meaning the newly hired engineers were performing at a level that fulfilled the requirements of the organization. The differences in ratings of the other type organizations compared to public sector organizations were identified as a small to medium effect size.

25. Ability to handle multiple priorities
A. Although the effect size is small, those with direct supervision of newly hired engineers responded with greater differences between their ratings for importance than the level of proficiency exhibited by the newly hired engineer.

Supporting the findings of the importance of these soft skills, in 2020, chief human resources and strategy officers from leading global employers identified the top ten skills for employment, skills, and recruitment. Applied across industries and geographies, these included complex problem solving, critical thinking, creativity, people management, coordinating with others, emotional intelligence, judgment and decision making, service orientation, negotiation, and cognitive flexibility. Members of this group and others released a report in 2021 aimed to build common language and skills at work [57]. Within this report, attitudes for development were delineated as learned behaviors, emotional intelligence traits, and beliefs individuals allow to influence their ideas, interactions with others, and responses to situations [57]. Elements of the attitude category of the World Economic Forum taxonomy include working with people, self-intelligence, and global citizenship and civic responsibility [57]. These three subcategories of attitudes reflect similar topics to those identified as ones newly hired engineers were in need of developing such as active listening, communication, information exchange, following instructions, assisting coworkers, time management, self-control, and meeting commitments.

Even though interactions and communication with others were at the top of the lists for importance and need for

improvement, social responsibility and global and cultural awareness had statistically equal ratings for importance and proficiency. It was determined that highlighted focus over the past decade must have resulted in sufficient efforts to have adequate proficiency within these two soft skills yet there is still a need to address communication with diverse groups and effective writing.

3.1. Implications for Engineering Education

By targeting the soft skills identified as most important by employers of entry-level engineers, we hope our research can inform engineering educators where to focus their efforts in developing well-rounded, successful graduates. Curriculum developers could leverage this research to enhance student outcomes by emphasizing the skills employers have identified as most important. Understanding what soft skills employers consider important will enable engineering educators to prioritize those skills within higher education. Prioritizing industry relevant soft skills in turn will enhance the employability of engineering graduates and prepare them better for a professional career.

From a student perspective, knowledge of non-technical skills that are critical for them to enter and grow in their professional careers is crucial to enhancing their employability. Being aware of employer expectations would help students to prepare better for the recruitment process. Intentional focus on soft skills will encourage engineering graduates to attend to acquiring and mastering of soft skills in addition to technical skills taught in their curriculum.

Additionally, we encourage engineering educators to administer soft skills surveys to those employers who hire their graduates. While we have aggregated a large data set, specific employers may value certain soft skills more than others and some institutions may find value in customizing soft skill development to cater to local employer needs. We are relatively early in our research of soft skills for entry-level engineers and see opportunity for additional research to augment our current findings. Two areas we have identified for continued education research include learning soft skills in context and developing structured assessment plans for soft skill acquisition. We believe both of these areas hold promise in refining and enhancing learning outcomes in engineering education. Finally, as this area of research develops, we anticipate that ABET may develop more fine-grained expectations for Engineering Accreditation Commission (EAC) and Engineering Technology Accreditation Commission (ETAC) graduates.

3.2. Implications for Engineering during Industry 4.0

Similar to the outcomes for the explanatory sequential design used in this study to complete confirmatory interviews of the findings, interviews with members of the manufacturing industry in South Africa revealed "soft skills alongside technical skills are even more important than technical skills alone in Industry 4.0" [26] (p. 5). Thinking skills, social skills, and personal skills were identified as essential skills for engineers to meet the requirements of Industry 4.0. Required skills identified in South African firms include soft skills evaluated within this study, that is critical thinking, creativity and innovation, decision making, accountability, application of knowledge, cross-cultural communication and collaboration.

During the last decade, potential new hire engineers of a traditional age (18–24-year-olds) in college have experienced two global crises, the economic downturn and the pandemic. A labor polarization has taken place with an increase in automation to replace routine jobs that formerly were completed by human labor and a change in the interactions expected within the world of work and global labor market [58]. Prior to the pandemic were considerations of the fifth social revolution, a time for the development of new social systems for the continual growth, renewal, and development of the workforce driven by technological and economic forces [59]. Industry 4.0 includes a changing digital culture that relies on collaboration, innovation, data-driven insights, and customer-centricity [60]. Each of these four pillars draws upon professional skills such as intergenerational feedback, inclusive language and interactions, corporate citizenship, open discussions, communication with customers, deepened customer relationships, support for creative solutions and innovation, and development of knowledge hubs to encourage sharing of ideas and enabling other people to participate. The attention on the development of behaviors, mindsets, and practices is a shift in focus from products and outputs to changes in personal actions that are driven by mindsets. While organizations will still rely on key performance indicators and structural performance in the organization through Industry 4.0 and on, the development of people to create safe environments for people to try new things relies of an integration and reinforcement of professional skills. Organizational initiatives are underway to develop digital culture target actions where leaders acknowledge they are human, offer a sense of empowerment to their employees, support new mindsets through reverse mentoring and exchange circles, and establish approaches and levels of vulnerability [60]. The compounded challenges faced during the pandemic and the uncertainty to the future fuels the imperative that people working together and understanding the lives of other people is necessary to equip leaders with the insights and foresight necessary to make decisions in business and education [61].

In order to inform students of technical criteria for success, the ABET criteria has communicated the requirements. The success of engineering students in non-technical areas has been outlined yet lacks specificity. This study's purpose was to provide empirical evidence for the establishment of non-technical skills for engineering education. The data within this study were compiled for all industries. The between group comparisons explore differences in the expectations for soft skills by industry. The snowball interviews confirmed the findings of the survey implemented prior to the start of the pandemic were still relevant. Future research is proposed to conduct additional interviews with engineers, managers, and educators to further the explanatory sequential research design and gain greater understanding of the needs within industry and by engineering discipline.

The coverage for this study was quite broad; however, even though nearly 500 respondents participated in the study, not all responded to all of the soft skills questions. Missing data resulted in the removal of the record for the paired differences analysis. This is a potential limitation in that it reduces the number of full data elements to 337. The comparison of the difference in the mean values of the soft skills to the paired differences means were not statistically significant; thus, the deletion of the elements from the paired mean differences did not statistically impact the overall outcome of the need for improvement for 24 of the 26 soft skills studied.

9. Introduction

Needless to say, that to be successful in any industry, apart from being equipped with the relevant tech skill set, requires a person to be proficient in respective soft skills also. Even engineers who are always stereotypically expected to be proficient in technical skills, need the soft skills to sustain the environment of the workplace. Soft skills help a person perform, and coordinate well at their respective workplace. For instance, as a software engineer, you're required to have better communication skills to effectively communicate with your team members, clients, etc.

What are Soft Skills? – 'Soft Skills' are the skills that all working professionals are expected to acquire; these are non-technical skills that are the deciding factor about your workplace personality on how you work and interact with your colleagues. Notably, these skills are not taught at institutions but rather acquired through learning and adaptation capacities over time.

Essential Soft Skills Every Software Engineer Must Have:

While technical skills and knowledge work well for work, on the other hand, soft skills help them in better coordination. Despite continuous advancement in technology with the evolution of Artificial Intelligence (AI), it is a fact that soft skills will need to be employed for a better practice of workplace culture. Acquiring and sticking to the soft skills does seem like a little bit of a challenge. However, it is not tough to master them. So, the following are the top soft skills that every software engineer should have:

1. Proficient in Communication

Communication is a key skill that you have to have irrespective of the industry you work with. As a software engineer, it becomes more important for you to be proficient in communication skills in order to communicate your ideas in a better manner. It helps in the better management of work in a team while you are working on collaborative tasks/projects. Your clear and to-the-point mark of communicating all the aspects of the project will also help others understand things in a bit more efficient and easy manner.

2. Be a Problem-solver

You can't solve a problem if you are not open to interpretations. As a software engineer, you be burdened with a lot of tasks, and problems that arise in the middle of work can be really frustrating. However, this is the time to deploy your critical thinking and look at the problem from all sides and spares while being open-minded. Trust, you'll not fail to solve if you do so. Just like an algorithm that is employed to solve a specific problem by analyzing an issue, you have to go along with all the possibilities of a solution.

3. Know Time Management and Organization

No matter, which industry you opt for, time management is an important soft skill to have and so, is organization. Being a software engineer, your work is not just limited to your boundaries, it has other people waiting for it to be completed in order to move further with their own respective tasks. So, if you have forgotten to manage your time and all your work is with clients, project managers, business managers, and other stakeholders, leaving them to wait will create a wrong impact. Better you be cautious and organized and as a developer, finish yours within the delaines.

4. Always be Open to Learning and Adaptation

No matter how expert you are at your work and you may be known as the best professional as a software engineer. But, there are always some things that are left in this era of technological advancements such as Artificial Intelligence (AI) and Augmented Reality (AR). There must be some things that your juniors may know better than you. In that scenario, it is important that you stay humble and open to learning as a software engineer in order to improve and update yourself. This was about advancements, now there must be some things that you might want to do in a traditional manner but your team members are willing that to happen in a new way with the updated technology. In this case, you should be open to the adaptation of new technologies and ways of handling work.

5. Be Empathetic

Reflecting on your behavior, the amount of empathy inside you is a key that decides the amount of respect that people will have for you. This is the fact that being a software engineer, a person spends most of his/her time writing codes for machines. Although this monotonous situation makes anyone frustrated, it is important for you to show empathy towards other people including your colleagues and friends. You need to imagine yourself in the shoes of other people to understand their perspectives. It will help you get better ideas from others.

6. Have Patience

Frustration is a by-product of being overburdened. But, remember that others may be going through a similar situation. From the beginning of a project to the time of summing it up, takes a lot of time and so, it requires a lot of hard work as well as patience. Not, everything can fall right into place and when you are not able, to sum up, the work and deadlines are near, so, as a software engineer, all you need to do is relax and then make a proper action plan for the project.

7. Master the Interpersonal Skills

You might be amazing at your professional skills and probably you must be a champ in terms of doing your tasks as a software engineer. Well, what about the people around you? Are they able to catch up with your level and are they feeling free to come to you to get their issues solved? This is the time when you should introspect and analyze your personality and actions. To be good at interpersonal skills, it is important to be humble and watch out for your tone and body language while you talk to your team members. As a software engineer and a team member, you are supposed to ensure that team members are communicating well with each other to get their respective queries solved.

Being a software engineer is good, but being a software engineer possessing all the relevant soft skills is best. If you are good at your technical and professional skills, you are a good software engineer or developer but if you are good at technical and soft skills you can be a great software engineer. Your personality plays a major role and is deciding factor about what you are going to bring to the table. So, better while acquiring professional skills, you work on your personality with open-mindedness.

BIBLIOGRAPHY

[1] Claxton, G., Costa, A. & Kallick, B. (2010). Hard thinking about soft skills. Educational Leadership, 73, 60-64.

[2] Donaldson, W. (2017). In praise of the "ologies": A discussion of and framework for using soft skills to sense and influence emergent behaviors in sociotechnical systems. Systems Engineering, 20(5), 467-478.

[3] Downey, G. (2005). Are engineers losing control of technology?: From 'problem solving' to 'problem definition and solution' in engineering education, Chemical Engineering Research and Design, 83(6), 583–595.

[4] Fry, J.P. (1972, December). Procedures for Implementing Soft-Skill Training in CONARC schools, Paper presented at the CONARC Soft Skills Conference, Texas, 12-13 December.

[5] Gadol, J. K. (1973). Universal man. In P. F, Wiener (Ed.), Dictionary of the history of ideas: Studies of pivotal ideas. Vol. 4, 437-443.

[6] Garicano, L. & Wu, Y. (2012). Knowledge, communication, and organizational capabilities, Organization Science, 23(5), 1382-1397.

[7] Graham, R., & Porterfield, T. (2018, June), Preparing today's engineering graduate: An empirical study of professional skills required by employers. Proceedings of the 2018 ASEE Annual Conference & Exposition, Salt Lake City, Utah. 10.18260/1-2—30887

[8] Gray, L. (2013). The depth metaphor and international human resource development: From theory to practice. Human Resource Development International, 16(4), 426-440.

[9] Guest, D. (1991, September 17). Managers in focus as the skills gap closes: The hunt is on for the Renaissance Man of computing. The Independent (London).

[10] Heckman, J.J. &Kautz, T. (2012). Hard evidence on soft skills. Labour Economics,19. 451-464.

[11] Humphreys, A. & Wang, R.J. (2018, April). Automated text analysis for consumer research. Journal of Consumer Research, 44(6), 1274-1306.

[12] Hurrell, S.A. (2016). Rethinking the soft skills deficit blame game: Employers, skills withdrawal and the report of soft skills gaps. Human Relations, 69(3), 605-628.

[13] Kimmel, M. J. & Balzer, R. H. (1984). Military Leadership Job and Skill Requirements: An Annotated Bibliography. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

[14] Neeley, K.A. (2016). Leadership, Entrepreneurship, Management, Policy: Intersections or Separate Domains? Proceedings of the 2016 ASEE Annual Conference & Exposition, New Orleans, Louisiana.

[15] Oxford University Press, & Chicago Public Library (2000). Soft skills. Oxford English Dictionary. Oxford, UK: Oxford University Press. Oxford University Press, & Chicago Public Library (2000).

[16] Parlamis, J. & Monnot, M.J. (2018). Getting to the CORE: Putting an End to the Term "Soft Skills." Journal of Management Inquiry, 28(2), 225-227.

[17] Rao, M.S. (2018). Soft skills: Toward a sanctimonious discipline. On the Horizon, 26(3), 215-224.

[18] Russell, J. (2018, July 18). What are soft skills and why are they important? Dave's Charm School (blog) Available: https://davescharmschool.com/2018/07/18/importance-of-soft-skills/. 11

[19] Somerville, M.H., Goldberg, D. E., Kerns, S. E. & Korte, R. (2010, October). A war of words: Using sticky language to effect change in engineering education. 2010 Frontiers in Education Conference (FIE). IEEE: T3B-1-T38-2.

[20] Turley, J. (1981, August). Mobilization manpower: A credible force or an empty promise? Military Review, 2012.

[21] U.S. Continental Army Command. (1973, April 5). CONARC soft skills training conference. Proceedings of a conference conducted at the Air Defense School, 12-13 December 1972.

[22] Wang, X., Bendle, N.T., Mai, F. & Cotte, J. (2015). The Journal of Consumer Research at 40: A Historical Analysis. Journal of Consumer Research, 42(1), 5-18.

[23] Whitmore, P.C. (1972, December). What are soft skills? Paper presented at the CONARC Soft Skills Conference, Texas, 12-13 December.

[24] Whitmore, P.C. & Fry, J.P. (1974). Soft Skills: Definition, behavioral model analysis, training procedures. (Professional Paper No. 3-74). Alexandria, VA: Human Resources Research Organization