The Role of Non-Technical Skills in the Software Development Market

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ABSTRACT

Software development is an intrinsic collaborative profession, which demands a rich set of technical and non-technical skills. In particular, the recent changes that shifted the software development practice (from a collaborative in-person based activity to an intrinsic geographically distributed one) accelerated the need of non-technical skills. In this work, we aimed to draw the current landscape of non-technical skills in the software development area. To achieve this goal, we conducted a two-phase study. We started by inspecting 566 job post advertisement to assess how often these skills are requested. In the second phase, we interviewed 15 junior developers to find out which non-technical skills they think are required in their organizations, and to understand how they exercise these non-technical skills. Our results suggest that 98,9% of the job posts mentioned at least one non-technical skill, averaging 6.30 non-technical skills per job post. Our interviewees believe that non-technical skills help them to understand the organizational culture, the team dynamics, and their careers. In summary, we believe that our work contributes to pile additional evidence on the need that software professionals have in mastering these non-technical skills.

KEYWORDS

Non-technical skills, Software development, Social skills, Mixed-Method Research.

1 INTRODUCTION

Non-technical skills are skills that an individual possesses and that are very useful in every society in which the individual is involved. Its main difference from technical skills is that non-technical skills are understood in a more subjective way. They are personal and particular qualities, they are values and teachings that a citizen gathers throughout his life and that are not measured by certificates or academic degree.

"You don't hire for skills, you hire for attitude. You can always teach skills" [7]. This phase is attributed to Herb Kelleher, the co-founder, later CEO, of Southwest Airlines. Although it dates from the 80s, it is hardly questionable the importance of these attitudes —which we broadly call "non-technical skills"[1]—in today's competitive market jobs. non-technical skills have been largely discussed in fields such as administration [30], health [9] and psychology [4]. In particular, Wilkerson [31] surveyed 96 Management Information Systems (MIS) students about their perceived importance of non-technical skills, and noticed that skills in non-technical categories tend to be more important to MIS career success (than those in technical categories).

There is also recent research that investigates the role of non-technical skills in the IT professionals landscape. For instance, Powell [16] studied Emotional Intelligence in a Information Technology Course and noticed a strong positive correlation between this non-technical skill and communication; that is, the better one is handling her emotional intelligence, the better she tends to be as a communicator. In fact, Jones et al. [10] observed that non-technical skills can be more important than hard skills for entry-level positions.

Employers' concern about the lack of non-technical skills of their future workforce is far from something new [13], but it has grown

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[1]In literature there are mentions to "soft skills", "non-technical skills", "people skills", "transferable skills", "social skills" and "generic competencies" to refer to the same concept [14]. For consistency, here we will adhere to the term "non-technical skills".

in recent decades, becoming as important as the technical aspects. In the industry's perception, information technology (IT) professionals need to acquire an eclectic skill set, which encompasses both hard and soft skills [3]. The demand for non-technical skills, both in quantity and in terms of mastery, increases with the level of experience required by the position offered by companies. This also occurs if the role requires frequent interactions between the desired professional and stakeholders [18]. However, Lounsbury et al.[12] claim that IT professionals have low social needs and are more introverted than professionals in other disciplines. In this same research, they found that IT professionals had significantly higher levels of agreeableness and toughness, although a lower level of conscientiousness, emotional stability, extroversion, assertiveness, customer service orientation, optimism, and work motivation. Shih et al. [17] pilled additional evidence on the findings of Lounsbury et al. They found that IT professionals often have introverted personalities, which can be a barrier to understanding the customer position.

Narrowing down to the field of Software Engineering, the value of such non-technical skills is highlighted in many works [8, 11, 14], including IEEE's Software Engineering Competency Model [1]. The previously highlighted non-alignment between professional skills and their demanded abilities in IT industry has also been studied focused in the software engineering field but more than 5 years ago [2, 19]. A more recent study [15] focuses on job posts but without collecting developers opinions it could not contrast if there is such alignment or not.

In this work we aimed at understanding the current landscape of non-technical skills demanded in the software development market. To curate this understanding, we conducted a two-phase work. We started by mining 566 job posts posted in a well-known web portal. In this analysis, we sought to investigate which (and how frequently) non-technical skills are being demanded in software development jobs. In the second phase of this work, we turned our attention to novice developers that entered in the software development market recently (in the last five years).In this analysis, our goal was to understand their perceptions about the needs of non-technical skills (and how they become better at them).

Our study discovered a number of findings, some of which are surprising. First, we found a high number of non-technical skills demanded in the job posts analyzed (median: 6, average: 6.30, max: 21). The most recurring non-technical skill was Team work, which was present in 85,34% of the job posts analyzed. On the other hand, conflict management and negotiation were the least cited ones. Our interviewees concurred that non-technical skills compose an important set of skills that they should sought to master. In particular, Communication skills was the most recurring non-technical skill reported in our interviews.

2 BACKGROUND AND RELATED WORK

Software development is an activity that requires specialized technical skills. However, as it –still– is something that is mostly performed by humans to solve problems, and typically involves other people (e.g., teammates, stakeholders), the role of non-technical skills is very important for that matter. In a study about attributes of great software engineers, Li et al. [11] reinforced the notion of

Software Engineering having a strong sociotechnical side, it is not limited to a technical perspective. In their study they conducted over 50 interviews with software engineers and grouped internal attributes related to personal characteristics (e.g., passionate, open-minded) and decision making (e.g, knowledgeable about people and the organization, handles complexity), and external attributes that have impact on teammates (e.g., honest, mentoring) and the software product (e.g., elegant, creative). The ability to make effective decisions, or being able to learn new technical skills is often times more important than individual technical skills.

The Software Engineering Body of Knowledge (SWEBOK) [1] has a knowledge area (KA) dedicated to the Software Engineering professional practice, consisting of three topics: professionalism; group dynamics and psychology; and communication skills. These topics cover many non-technical skills that a software engineer must possess. While professionalism is focused in the adherence to codes of ethics and professional conduct, group dynamics and psychology include skills such as the dynamics of working in teams or groups; individual cognition; dealing with problem complexity; interaction with stakeholders; dealing with uncertainty and ambiguity; and with multicultural environments. Communication skills are split into four aspects: reading, understanding and summarizing; writing; team and group communication; and presentation skills.

Similarly to SWEBOK, the IEEE's Software Engineering Competency Model (SWECOM) [6], which, according to the document itself, *"describes competencies for software engineers who participate in developing and modifying software-intensive systems"*, also defines set of non-technical skills. Besides technical skills, SWECOM's elements include cognitive skills and behavioral attributes and skills. Cognitive skills involve reasoning, analytical skills, problem solving and innovation, while behavioral attributes and skills encompass aptitude, initiative, enthusiasm, work ethic, willingness, trustworthiness, cultural sensitivity, communication skills, team participation skills, and technical leadership skills.

There are two important literature reviews exploring non-technical skills in Software Engineering [8, 14]. While Garousi et al. [8] covered 33 studies and focused on aligning software engineering education with industrial needs, the work of Matturro et al. [14] was broader, covering 44 studies and focused on what was considered relevant to the practice of software engineering in general. In the former study, the analysis conveyed to three main categories: teamwork and communication; leadership; and critical thinking. An additional general category encompassed less frequently mentioned terms and included other skills that we often seen in other classifications such as cultural fit, learning, and curiosity. The latter study looked for soft skills considered relevant to the practice of software engineering and resulted in a set of 30 skills (e.g., communication skills, analytical skills, problem-solving skills, decision-making).

By examining the different sources previously enumerated, there is a clear evidence of multitude of non-technical skills that are grouped under different classifications. This may pose a question on what skills would be actually demanded in software industry job advertisements. There are some significant studies concerning the industry perspective on what non-technical or soft skills are typically demanded [2, 15, 19].

For instance, Ahmed et al [2] analyzed 500 advertisements for IT positions and highlighted a lack of understanding of what role

soft skills play in an employee's professional ability and performance, citing skills such as analytical and problem-solving skills as highly demanded while innovative, fast learners who can adapt to change were in low demand, thus bringing a contrasting perspective. Two other studies were particularly focused on entry-level (i.e., junior level) developers. The first one, Stevens and Norman [19] combined job advertisements and interviews in New Zealand to find IT industry's desired software skills from software and found different categories (e.g., communication, interpersonal skills, teamwork, cultural fit). Meanwhile, the second study by Montandon and colleagues [15] collected job posts in Stack Overflow, and found that the most requested non-technical skills were related to communication, collaboration, and problem-solving, but the authors relied solely on job posts, without any opinions from the developers themselves.

3 RESEARCH QUESTIONS

In this work we pose two research questions.

RQ1. What are the most demanded non-technical skills in today's software development jobs?

Rationale. This first research question aims to draw the state-of-the-practice of non-technical skills demanded in today's software development market. This investigation is key to understand whether companies are noticing the usefulness of these non-technical skills (observed by their presence in job post advertisements), which in turn could help developers to better learn and practice the most pressing non-technical skills.

RQ2. Which non-technical skills are perceived by junior developers as important?

Rationale. In this second research question, we turn our attention to junior developers, that is, software development professionals who recently joined the job market. Our intuition to focus on this group is that since they have little professional experience, they may not be aware of the need of non-technical skills (or how mastering these non-technical skills could contribute to their careers). We are also interested in understanding the practices they use to improve some of these non-technical skills.

4 RESEARCH METHODOLOGY

Our study was conducted in two phases. The first phase aimed to categorize a corpus of 566 job advertisements posted on StackOverflow Jobs (Section 4.1). In the second phase, we interviewed 15 junior developers to explore their understanding about the expected non-technical skills that they are supposed to possess at work, or to get hired (Section 4.2).

4.1 Phase 1: Job advertisement analysis

In this section we present our approach to select and analyse job posts.

Job Posts Selection. In the first phase of this work, we aimed to investigate software engineering job posts shared in advertisement portals. There are several portals available for this purpose, including LinkedIn, Indeed, and Catho. Among them, arguably the most

popular one is the StackOverflow Jobs[2], a branch of the well-known Q&A website, dedicated to job announcements. Moreover, most of the job posts shared on StackOverflow Jobs are, indeed, related to software development. In the other portals we observed a great number of non-software development jobs. Since StackOverflow Jobs is focused on development roles, we searched for all job posts available. For our analysis, it was considered only posts that informed office location, experience level, company type and size, job role and modality. All job advertisements have a unique id, which is informed in URL or source code. The search process was based on web scraping[3]—. It was discovered that the search return around 20–25 new job posts per day. As new job openings appear, previously found job openings will soon become unavailable (they disappear after 30 days).

Therefore, to build a comprehensive corpus of jobs, we searched the StackOverflow Jobs portal from June 2021 to September 2021. After filtering jobs and eliminating duplicates, we got a total of 566 job openings collected.

To increase reproducibility, we save the PDF of each job opening found, which is part of our replication package. The jobs were created by companies based in 36 countries, spread across 4 continents.

Job Posts Analysis. Two researchers conducted the analysis of the job posts. Initially, the variables id, office location, level of experience, type and size of the company, function and type of work were extracted from each job advertisement for further classification and analysis of the results. As information technology (IT) positions can vary significantly from one company to another, we then use Doyle's proposal [5] to classify them. In this case, a list of the main IT positions is presented alongside a brief explanation about them, and mentions other positions that have different nomenclatures but that the activities are similar or exactly the same. After that, all phrases and words related to non-technical skills were considered as a unit of measurement. As it was not part of our initial intentions to carry out a study on the definition of each non-technical skill, we used the categories of skills proposed by Matturro and collaborators [14] to identify and classify them, as they cover a broader literature than the another literature review we found [8]. They identified the thirty most relevant non-technical non-technical skills in their systematic mapping. However, only twenty had a definition; the other definitions we got from the Indeed Careers Guide [20–29].

113 vacancies were submitted to the peer review process, this value corresponds to 20% of the total sample. In 352 cases the researchers agree and in 714 cases the researchers disagree regarding the existence of certain non-technical skills in the analyzed job posts. This somewhat high disagreement between the researchers is due to the fact that the technical explanation of the skills leaves room for free interpretation, generating different understandings about the same term, mainly on the part of the companies that prepare the advertisements, thus making the analysis of these vacancies become subjective on the part of researchers.

Figure 1 shows one example of a job post advertisement. In this figure, we highlighted 8 non-technical skills. They are: Listening

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[2]https://stackoverflow.com/jobs
[3]Web scraping is the process of analyzing the structure of HTML pages and systematically extracting data from it.
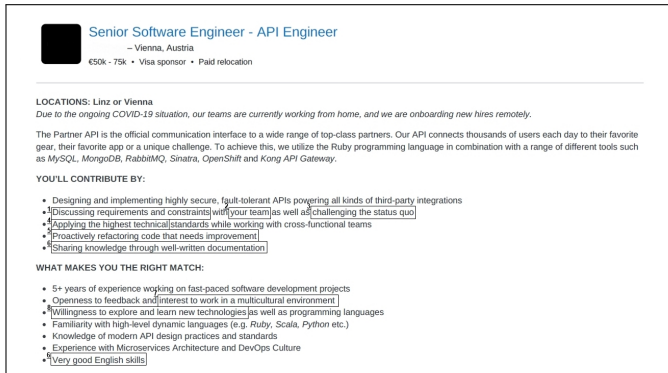
Figure 1: A job post; we highlighted the non-technical skills.

skills (1), Team Work (2), Change Management (3), Methodical (4), Initiative (5), Communication Skills (6), Interpersonal (7), and Willingness To Learn (8). On average, a job post mentions 6.30 non-technical skills (standard deviation: 2.30, median: 6, min: 0, max: 21).

4.2 Phase 2: Interviews with junior developers

In this section, we describe the methods used to select interview participants, how the interviews were conducted, and how we analyzed the data collected in the interviews.

Participants Selection. In this phase we sought to interview junior developers, that is, professionals who recently (no longer than five years) joined the software development job market. To find these junior developers, we started by using a convenience sampling approach. We started asking colleagues on our social networks whether they could introduce us to potential junior developers in the software development industry. During 6 weeks, we sent 23 invitations (approximately 4 invitations per week). We ended up confirming 15 junior developers interested in participating in our research. Before these 15 interviews, we conducted two pilot interviews to assess the quality and length of the interview guide. After these pilot interviews, we revised the interview guide: e.g., removed some questions as well as inserted and improved others. The two pilot-interviews were removed from our final set.

Demographics information about the 15 interviewed participants are depicted at Table 1. All interviewees were Brazilian, and their interviews were conducted in Portuguese. Among them 6 are undergrad students. Codes were later translated to English. We refer to the participants as P1–P15. They are between 21 to 27 years old, and have between 1 to 5 years of software development experience. Only 3 of the the participants were women.

Interview Process. We conducted semi-structured interviews through Google Meet. We recorded the interviews with the participants' consent. We conducted and analyzed the interviews from 1st June to 24th June, 2021. The 15 interviews lasted on average 61.31 minutes (min: 36 minutes; max: 106 minutes). The interview script was composed of four main parts:

(1) In the first part, we asked our interviewees demographics questions about their job role, experience, age, etc.

Table 1: Demographics of the Interviewees. "Exp." means year of experience, and "Duration" shows how long the interview took, in minutes.

#	Gender	Role	Age	Exp.	Duration
P1	M	Data Analyst	27y	3y	72m
P2	M	Developer	24y	1y	42m
P3	M	Developer	23y	1y	81m
P4	M	Developer	28y	3y	50m
P5	M	Developer	24y	0y	36m
P6	M	Developer	22y	4y	89m
P7	M	Software Architect	23y	5y	81m
P8	W	Data Scientist	22y	1y	55m
P9	M	Software Engineer	25y	4y	56m
P10	M	Developer	21y	1y	50m
P11	M	Developer	24y	1y	50m
P12	M	Developer	27y	4y	61m
P13	M	Software Engineer	23y	2y	68m
P14	W	Software Engineer	24y	3y	63m
P15	W	Developer	24y	3y	106m
		Average	24.06 y	2.06 y	61.31 m
		Standard deviation	1.98 y	1.57 y	20.56 m

(2) In the second part, interviewees were prompted to reflect about the importance of technical vs. non-technical skills;

(3) In the third part, we asked our informants about which non-technical skills they regarded as important in their (previous and current) jobs.

(4) Finally, we asked interviewees about the strategies they used to learn non-technical skills and whether and how their, previous and current, companies helped them to learn these skills.

Interview Analysis. All 15 interviews were transcribed. After that, we analyzed the transcripts using a four-steps process:

(1) In the first step, we read (and re-read) the interview transcriptions to get acquainted with the terms our interviewees employed that we were not yet familiar.

(2) In the next step, we added codes, that is, labels that could express the meaning of the excerpts of the interview that had appropriate actions or perceptions. These codes were created to answer our research questions. The initial codes were considered temporaries since they still needed refinement. The codes were identified and refined throughout all the analysis. At this point we had a total of 25 codes.

(3) Next, based on an initial list of codes, we then began to look for similar codes in the data and grouped the codes with similar characteristics in broader categories. Eventually, we also had to refine the categories we found.

(4) Finally, we reviewed the initial set of categories searching for additional evidence to support or refute our categories. We also renamed some categories to better describe the excerpts. The discussion about the categories are present throughout Section 6.

We conducted the interview analysis in pairs of authors followed by conflict resolution meetings. During these meetings, at least one more co-author was present to mediate the discussion.

5 WHAT ARE THE MOST DEMANDED NON-TECHNICAL SKILLS IN TODAY'S SOFTWARE DEVELOPMENT JOBS? (RQ1)

In this section, we report the non-technical skills mentioned in the 566 job posts studied. Overall we found 3571 statements mentioning non-technical skills. On average, each job post lists 6.30 non-technical skills. The majority of the job posts were collected from Eupore (430 job posts), being the countries with more vacancies the Germany (194 job posts), Netherlands (77 job posts), and United Kingdom (65 job posts).

Figure 2 presents the number of non-technical skills found in job posts. It is interesting to note that some non-technical skills are barely mentioned in the job posts. For instance, *Conflict Management* was mentioned only **once**. Similarly, *Negotiation* skills were mentioned only seven times. A possible explanation is that these two skills were represented in the overarching *Team work* skills.

Another interesting result is the fact that *Change Management* skills are not mentioned often given the fast-paced environment in which most software teams are embedded in. This becomes even more relevant when we remember that *"Responding to change over following a plan"* is one of the values present in the Agile Manifesto. Perhaps this particular skill has been demanded in the context of another skill that is mentioned more often, in this case, *Flexibility*, the 7th most mentioned skill. However, we can not say for sure.

While there is a possible explanation for the low demand of specific non-technical skills in the job posts analyzed, there are other skills that were *not* often mentioned in job posts that are harder to explain like *Ethics, Stress Management,* etc. We argue that further research should explore why these non-technical skills are not present in job posts.

6 WHICH NON-TECHNICAL SKILLS ARE PERCEIVED BY JUNIOR DEVELOPERS AS IMPORTANT? (RQ2)

In the second phase of our study, we aimed to understand whether, and which, non-technical skills are regarded as important by junior software developers.

6.1 On the importance of non-technical skills

In fact, most interviewees see non-technical skills as more important than technical skills. For instance, P7 argues the following:

"(...) I'd rather work with a technically average person, but who is easy to get along, who has "soft skills" than the opposite: a person who is really good technically, but who is socially inept."

Analysis of the interviews indicates that participants see non-technical skills as important for four different reasons. First of all, non-technical skills help in the *organizational culture* because (i) most companies are adopting agile methods and (ii) developers often need to engage with customers. P04, for instance, mentioned:

[non-technical skills] sure are important, like networking, teamwork, and communication. ... [in his/her previous job] there was a demand system which I managed the internal customers. So, our customers were other employees. (...) they opened a ticket, and sometimes, someone from our team had to talk to the customers. So, a meeting was held to understand what the issue was, how it came to be, and how to solve it".

According to five of our interviewees, non-technical skill might even influence the team performance. For instance, P09 argues the following:

"I've worked with different types of developers, ranging from the most shy to the talkers, and there is clear different that impacts both the team and project performance. That developer who questions everything and who asks questions when s/he is unsure helps the flow of the project, in addition to making the work environment more pleasant. Meanwhile, the ones very shy, it is necessary for me to clearly engage to understand."

Our interviewees think that non-technical skills are important even for *health* reasons. P06 argued:

"The professional [developer] needs to take care of himself, because, in my view, he is the product. Then, I need to be fine both physically and psychologically. (...) We are overloaded with technical aspects and just a bit of the non-technical ones."

Last, our results suggest that non-technical skills might positively impact their *careers*. For instance, when reflecting asked about these skills, P02 said they might influence whether you get, or not, a job:

"In several [job] interviews I participated, it is asked about social skills like 'how easily do you communicate with others?' or 'how do you handle difficulties and frustrations?'."

P10 extends this reasoning and argues that non-technical skills might influence in career progression and goes on describing a person in his/her organization who has *not* become a team leader even though (s)he "has a lot of [technical]knowledge" because (s)he "keeps creating problems to other people" by blaming other them because of issues in the project.

In the following paragraphs, we will describe which specific non-technical skills our interviewees regarded as important.

6.2 On the need for non-technical skills

Through the opinions of the interviewees, we can identify three main contexts where junior software development professionals need to use the non-technical skills: Attending Clients, Workday in the office, and Mindset. The first context refers to the interactions between customers and developers, which usually take place in meetings to align the project. In this context, interviewee P09 reports the importance of non-technical skills communication, customer Orientation, decision Making, listening, negotiation, and organizational/planning during requirements gathering.

"In my current job, being a software factory, the company takes several software projects from several companies... My workflow consists of gathering and documenting the project requirements, aligning them with the developers, designers
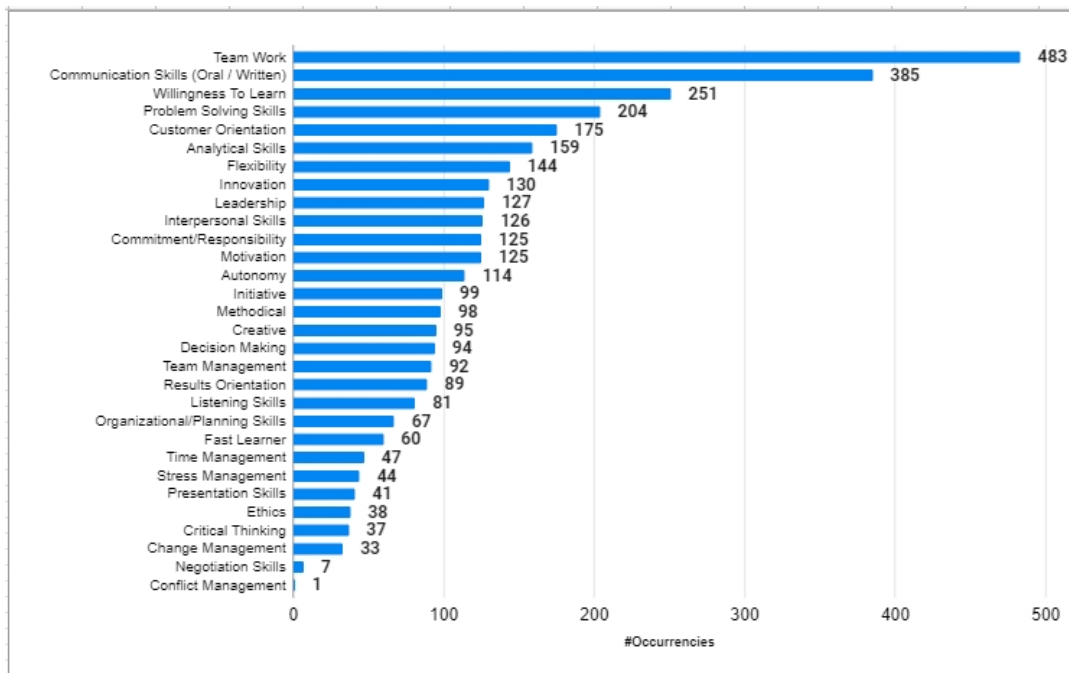
Figure 2: Overall view of the non-technical skills found in job posts.

responsible for the prototypes high and low loyalty and customers. First, I raise requirements with customers, trying to understand them and also managing their expectations. Then I try to pass the requirements on to the developers as best I can... Practically every day there are meetings with clients; when it doesn't, it must have something strange. In a meeting, it is necessary to understand what the customer wants, how to make the orders into something tangible, taking into account the limitations and available resources. This includes knowing both the project and our environment and the client's financial limits. So, communication with the client involves interpretation and curiosity. Thus, it is possible to understand if what the customer is talking about is what he really needs."

In addition, three interviewees emphasize that this context requires autonomy (*"people usually conduct meetings with clients alone"*, P08), knowing how to deal with stress due to sudden changes in the project (*"... arrives at the end of a sprint and the customer says, 'I changed my mind. That's not what I want'. So the person has to have emotional intelligence to deal with the fact of not being able to finish something the client wanted and then they will have to start all over again from scratch. Therefore, it is necessary to always have that resilience to lose and win without being affected by your result."*, P02) and communicate the requirements to the development team (*"Even if I know what needs to be done, it is necessary to detail for developers step-by-step."*).

In Workday in the office, the context is linked to the team's internal workflow, how it is organized and, therefore, requires the practice of non-technical skills. Interviewee P13 summarizes the work routine in a self-contained and multidisciplinary team that

demands a lot of communication to align tasks according to the expectations and requirements of the product/client — implying a lot of negotiation and group work — and autonomy in the performance of individual activities.

"Throughout my career, I have always worked with teams following the Spotify squads, which are teams that have several people with different abilities, self-contained teams that aim to be able to carry out their tasks without the need for third parties or at least without direct need. from third parties. In the day-to-day work, we have a lot of internal communication between the team... we have to have a good dialogue and negotiation of scope and expectations in relation to the product and in relation to what is being delivered and alignment around of the features themselves..."

This context can be divided into two moments: team meetings and team dynamics. Team meetings serve to define and align the project according to the scope and difficulties of the members, as mentioned by interviewee P03:

"In my first job... there was the daily (meet) to talk about the points of the project, what each one was doing and what obstacles were found... In my current company... On Monday, the weekly planning daily takes place with approximately 1 hour long. On the other days, we have 30-minute alignment dailys. There is also group interaction to deal with some problems and quick meetings to also solve something quickly."

In addition to communication, listening, problem solving skill and team work, some interviewees highlight that the professional at the beginning of his career needs to develop non-technical skill critical thinking so as not to accept anything within the project,

which could compromise the final result of the product, such as mentioned by P07:

> "...imagine the situation of a junior architect faced with an architectural decision that could change the course of the project. Suppose an experienced person says something at the meeting that you know is wrong, because you happened to read something credible about the issue the day before, and it could hurt the project. In this case, courage consists in refuting the person who is wrong, even if he is much more experienced."

This also serves to establish a culture of feedback among team members, whether to point out improvements (*"I would also say that it is important to know how to criticize the work of others, whether positively or negatively. criticism. As the software engineer's job involves evaluating the code of his peers, it is important to acquire this skill. You cannot criticize aggressively, even if the work done is bad"*, P13) as to recognize the merit of colleagues (*"Communication also involves knowing how to give and receive feedback, such as constructive criticism and praise. It is essential to recognize the talents of employees and learn from mistakes."*, P09)

In team dynamics, communication continues to be the main factor for the team's good performance: *"Let's say you know what to do, but you don't know how to explain it to me, it's really not doing it, because you're not working alone."*, said P07.

If communication is compromised, rework situations may occur or compromise the execution of tasks, as stated by P09 : *"If a developer does not communicate well, he may interpret the task in one way, when it is in another, thus forcing you to have to redo the service... There are certain work processes that end up generating this, but it is important to make communication as clean as possible, eliminating noise."*. Allied to this, it is important to have non-technical skills stress management to maintain good communication and remain motivated.

Another important point for team dynamics is commitment. Participant P08 talks about the need to take responsibility for the tasks and be ethical about their progress: *"I know how to work as a team, but I had a little problem, because some teammates didn't do their part and I had what to solve... you need to warn that you won't be able to do something and avoid leaving something implied; you need to make it clear what is working and what is not so that everyone has a good understanding of what is going on"*. She also emphasizes the importance of flexibility, as it is common for the team to be distributed in different locations with different time zones. In addition, P11 emphasizes the importance of being available to help co-workers:

> "having the availability to help a team member, the ability to know when to ask for help from another person and knowing how to present your point of view on the development of a certain task... how to proceed for each feature. In the internship, I was constantly communicating to the team what I was developing and the difficulties that appeared, there were also some situations where I helped someone who was having difficulty"

6.3 On preparing the mindset for non-technical skills

Finally, the mindset context is the psychological disposition that junior professionals must have to face challenges and tasks. In this category we have identified three topics that require a set of non-technical skills: *result orientation*, *Ask for help* and *mental health*.

The first theme is focused on the dispositions that the professional must have in order not only to deliver good results, but also to know how to disseminate them. The willingness to learn skills, communication skills, analytical skills, customer orientation and problem solving skills are important to achieve the result. An important thing to keep in mind is to learn alone and keep up to date, seeking to acquire autonomy at work. According to P13, *"...is a mix of technique and soft skill, which is to learn alone. It's generic, because I think everyone in IT knows that... However, what you don't know when you enter the market it's how much this is expected of professionals. He is expected to solve things himself or at least try himself"*; and, P14 completes, *"it's very important to keep up to date... you have to enjoy learning. You can't get into this area and be like '[...] Ah ok, nowadays I know react' . It may be that in 3 years the market needs will change and such and such something else will emerge and be better."*.

However, some interviewees point out that the professional needs to go beyond the technical knowledge necessary for their function. According to P10, it is necessary to know how to decompose a problem: *"my team collaborators, even though they have knowledge of the language and the problem they are solving, sometimes they get stuck on how to solve the problem; they get flustered and, consequently, I think having this thought, like, how he is going to deal with that problem, step by step, how to break that problem into parts for her to solve little by little, is very important"*. Another point brought up is being interested in the whole of the product and the business: *" You cannot be the guy who sits down, receives, does tasks and solves bugs. In my view, you have to analyze the product, propose improvements by seeing what the user does. It has to go beyond its function... So, you have to have this criticality of analyzing the product beyond its own function. This is important both in terms of product and of generating value for the company"*, said P03. P07 calls this the global view of the project (*"so, even though you don't have an explicit planning of all the features, it's nice that you understand the business there so that you can put into perspective how the whole will be , even though you don't have every definition of the whole yet"*). At this point, P10 emphasizes the importance of creativity: *"An example here, citing the company, we have a Kanban there that almost no one used because it was not good. So ... we took this kanban and managed to link it Discord, a little API. But then, no one had ever thought of it that it was something so simple at first. So, no one had come up with this idea, now everyone uses discord and I use our system's Kanban."*

Another theme brought up by junior professionals is the ability to know how to ask for help, which involves communication, interpersonal skills, willingness to learn and initiative. According to P14, one reason to seek help is to improve productivity:

> "Even though I'm experienced, there will be things I don't know that are basic for someone else. If you know that someone can help you, there's no reason to be ashamed to ask for help."

P14 agrees that seeking help improves productivity, but also states that it contributes positively to learning and, consequently, to professional development: *"... I like to work in a team, but before I was very afraid to ask for help, so within the company I learned a lot about that and today I see how my work flows better."*

In the process of asking for help, interview P15 points out that it is necessary *"... to know who to ask and not be ashamed to ask..."*, because *"... When you enter a company there are many new things..."*. One way to identify this person is by talking and interacting with colleagues, as pointed out by P10: *"I think a developer needs to be communicative, needs to know how to look for the problem, and not just sit there searching on Google... Sometimes , you find a solution with your colleague next door or with someone who has been through it too..., just talk to the person and you solve your problem."*. However, before asking for help, P03 suggests prior preparation:

> *"I learned that the good junior is one who, when encountering a difficulty, searches for a solution for a certain time and gathers information about the problem; it is not advisable to find an error and ask for help immediately. Having this information in hand, one can seek help from someone. This way, you evolve better, as you learn from the mistakes found, allowing you to seek help more efficiently."*

In the topic of mental health, stress management, time management and organizational/planning skills play an important role. Respondents call attention to excessive work, lack of patience and taking on several activities in parallel as something harmful to mental health. According to P14, the area estimates certain sacrifices to the detriment of mental health:

> *"... in this IT area I think there are a lot of things that are glamorized like working nights, so there are many things that I consider wrong but that in this area are treated as if it were common or as if for you to be successful you need to do these things things… I personally think it's a challenge in this area for you to stay aware of that and not let yourself sort of overwork you know to the detriment of your mental health."*

Within this context, professionals sometimes overload themselves by taking on several activities and projects simultaneously, as stated by interviewee P08: *"I… was doing PIBIC and starting my TCC while I was joining the CJR. I ended up not being able to handle everything. .. In addition to the development demand, some [colleagues] had to reconcile with the internship and others with the heavy tasks of the nucleus..."*. To deal with this type of situation, she points out the need to recognize your limits and a good organization: *"Another thing I see in my day-to-day is that you know when you won't be able to handle it... it's important that you knowing what you are capable of delivering and knowing your limitations... A good organization is necessary to have time to do the tasks and have time for yourself"*.

Regarding patience, participant P15 points out some situations that test it. Among them one point that tests the patience of the interviewee P15 is having to deal with a more inexperienced professional than she is: *"In my current job, I'm working with a more junior person and it's been the most challenging situation so far, because I need to explain very simple things and we're in a very busy."*. She also mentions not being heard in meetings. As a solution, the

interviewee seeks to be inspired by the professionals she admires: *"... the people I admire are extremely patient with me. Seeing that they have patience in abundance and I am that way, I realized that I needed to improve"*.

7 DISCUSSION

According to the results obtained, we were able to draw four discussions that we believe are of interest to this research:

7.1 The large number of non-technical skills identified in the job posts

As the job post analysis process took place, we noticed the large number of non-technical skills that were located, demonstrating that there is indeed a real interest from companies in such non-technical skills. We can also analyze that the most recurrent non-technical skill concerns knowing how to work in a group, since it is of great interest to companies that there is a good flow of work and a good environment for their employees. We also emphasize that communication skills are fundamental, as they are necessary so that any and all ideas or thoughts are well disseminated and are clear to everyone. An intriguing point was the fact that only one vacancy mentioned "Conflict Management", this vacancy for the position of "Senior Software Engineer", as this non-technical skill works as a complement to the ones mentioned above, since it is fundamental to maintain a good environment of work. The vacancy in question also mentions the following non-technical skills: Communication skills, Team work, Interpersonal skills, Innovation, in addition to mentioning "Mentoring" which is the non-technical skills that concerns the sharing of knowledge and experience through a mentor, non-technical skill this that the work of Matturro and colleagues [14] is not present.

7.2 The lack of a definitive taxonomy on non-technical skills

In addition to the thirty non-technical skills present in the work of Matturro and colleagues [14], there are still several others that his work does not include and that are either present in other literature or have not even been recognized as non-technical skills. In this work we identified and cataloged eight other non-technical skills that are not present in the literature, namely: Attention to Detail (06), Coaching (39), Diversity Skills (07), Empathy (63), Mentoring (24), Multitask (35), Open-Minded (05) and Workplace Feedback (35). These non-technical skills come from mining jobs posts. Considering the small sample window studied, added to the fact that we only work with a vacancy portal, it was possible to find eight new non-technical skills. This fact opens future research opportunities for an eventual definitive taxonomy on such non-technical skills. This definitive taxonomy could, in turn, help researchers since even among researchers there are disagreements about the best terminology to use to identify certain non-technical skills.

7.3 The great importance given to non-technical skills by junior developers

Junior developers perceive non-technical skills as more important, as they meet people in their work environments who have failed

to grow professionally (even though they have a high technical knowledge) because they do not have a good command of some non-technical skills. The lack of these non-technical skills can even generate disagreements between team members, in addition to blaming other people for possible problems in the project that was their responsibility. These attitudes can contribute to a negative impact on the entire work environment. Still according to the interviewees, we can identify three main contexts where junior software development professionals need to make use of non-technical skills: 1) dialogues with customers and team members, 2) working in collaboration with the rest of the team, 3) working on their own mindset in order to know how to deal with adverse situations that may occur in the work environment. Finally, for the interviewees, the main non-technical skill to be worked on is "Communication Skills", as it will be widely used in different situations during their working hours. It is important to master it because through it the information will be passed on, the meetings will work properly and conversations with customers will be better used as there will be no doubts, since good communication solves this problem.

7.4 Analysis of the results of RQ1 and RQ2

We noticed that both in job advertisements and for junior developers non-technical skills are a really important favor. We also observed that both are in common agreement in defining which non-technical skills have the greatest degree of importance, as Teamwork, Communication skills, Willingness to learn, and Customer care are four of the five non-technical skills with the highest recurrence among job advertisements and also among respondents. Which demonstrates that they are of great importance in the work environment and that they can influence how a whole job will be done and how good the environment will be for everyone involved in the project, or even influencing the process of choosing a new employee.

8 LIMITATIONS

As any empirical study, this one also has many limitations and threats to validity.

First, our interviews focused on novice programmers. Therefore, our observations are limited to the perception of those entering in the software development market, and would hardly cover the perception of those more experienced groups. We decided to focus on novice programmers because although we conducted 15 in-depth interviews, we may have not reached saturation, that is, a theory that indicates that analyzing more data would not teach the researcher anything new. This gap could be mitigated in future work. Still regarding the interviews, many our our participants were found using convenience sampling. This approach might have limited the diversity of the participants.

Due to administrative decisions, the Stack Overflow portal chose to eliminate the "Jobs" section in March 2022. This decision will directly impact the continuity of this research using the portal. For a future study that seeks to investigate the same topic, it will be necessary to seek a new data source.

Another limitation is regarding our analysis of job posts. This analysis focused on job posts posted in 2021; it was not possible to compare with previous years and derive trends. This fact limited our

observations on the need of non-technical skills. In the future, we hope other could build on our study and paint a more longitudinal observation of this landscape.

Another limitation is linked to the replicability of the study and access to the data used, since the vacancies analyzed become unavailable after a certain period of time. This study can only be replicated if the researcher has access to the backup files that were created during this work, however, another point must be considered, with regard to one of the researchers not having full command of the English language, so if necessary that all vacancies are translated so that he could make his analysis, however, we know that there may be differences between the translation and the text in its original language, thus generating possible divergences or inconsistencies in the results obtained.

This work was carried out during the period of the COVID-19 pandemic, where the "home-office" work model was widely adopted, including in the vast majority of vacancies analyzed. Therefore, the result of this research may not represent the true scenario of this environment in a non-pandemic period, since there are great differences in the way of working and in the routine of those who work remotely for those who work in person, which directly impacts how many and which non-technical skills will actually be used by professionals.

Still, the research literature about non-technical skills is rather diverse and, as so, it differs in the naming of the skills. In this work, we tried our best to synthesize different views of non-technical skills, but the reader may still find differences between the naming conventions employed in this work and other in the literature. We believe that a more in-depth and comprehensive work is need in order to built a definite set of non-technical skills.

9 CONCLUSION

In this work, we present a study on non-technical skills, an increasing skill that software developers seek to understand and develop. We conducted a two-phase study, combining analysis of job openings from a popular job search portal and 15 developer interviews. Our analysis observed that, on average, each job advertisement expects the professional to present at least 6.30 non-technical skills, that is, non-technical skills are not only important but also indispensable for those professionals who are looking for new opportunities. Of these required skills, we can mention Team work skills, Communication skills and Willingness to learn skills as the most requested by companies. While our developer interview process observed that non-technical skills are considered more important than technical skills and still have a great influence on the hiring process of companies, given that these non-technical skills directly impact the work environment and in many situations developers too work in direct contact with customers and other stakeholders.

We also noted that this research presents some similar results to previous work in this topic. Specifically, Ahmed et al.[2], Montandon and colleagues [15] and Stevens and Norman [18] where the non-technical skills with the highest recurrence in their work were also found in large numbers in our results. We can cite as the three most recurrent non-technical skills in these works: Communication skills, Interpersonal skills, and Team work.

9.1 Future works

For future works, we plan to extend our interviews to cover higher positions. We also plan to diversify our pool of participants in the interview phase (all are Brazilian and only three are women). We also intend to hold a focus group with more experienced developers in order to confirm or refute some of the findings observed in this work. It is also on our agenda to interview HR professionals as they often assess the non-technical skills of new hires.

Another point to be studied in the future is to understand which non-technical skills each IT-oriented career requires, doing a study on the main positions in the area, how they differ and what skills are expected in each of them exactly.

For future works, we also plan to study and catalog the eight new non-technical skills (Attention to detail, Coaching, Diversity skills, Empathy, Mentoring, Multitask, Open-minded and Workplace feedback) that were found in our job vacancy analysis process, as well as seek other non-technical skills that are not present in the literature, in order to build a more comprehensive corpus for the creation of a definitive taxonomy.

Another point to be addressed in future research is the existence of ways or methods of studying to learn and/or improve non-technical skills. Research if there are courses and if so, then try to understand how they work, what methodologies they use and how they measure whether a particular student really has mastered the non-technical skill studied.

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REFERENCES

[1] Alain Abran, James W Moore, Pierre Bourque, Robert Dupuis, and L Tripp. 2004. Software engineering body of knowledge. *IEEE Computer Society, Angela Burgess* (2004).

[2] Faheem Ahmed, Luiz Fernando Capretz, and Piers Campbell. 2012. Evaluating the demand for soft skills in software development. *It Professional* 14, 1 (2012), 44–49.

[3] Janet L Bailey and Greg Stefaniak. 2001. Industry perceptions of the knowledge, skills, and abilities needed by computer programmers. In *Proceedings of the 2001 ACM SIGCPR conference on Computer personnel research*. 93–99.

[4] Jolanda A Botke, Paul GW Jansen, Svetlana N Khapova, and Maria Tims. 2018. Work factors influencing the transfer stages of soft skills training: A literature review. *Educational Research Review* 24 (2018), 130–147.

[5] Alison Doyle. 2021. IT Jobs: Career Options, Job Titles, and Descriptions. https://www.thebalancecareers.com/list-of-information-technology-it-job-titles-2061498. visited October 22, 2021.

[6] Richard E. Fairley. 2014. *A Software Engineering Competency Model (SWECOM)*. IEEE Computer Society.

[7] Kevin Freiberg and Jackie Freiberg. 1998. *Nuts!: Southwest airlines' crazy recipe for business and personal success*. Currency.

[8] Vahid Garousi, Gorkem Giray, Eray Tuzun, Cagatay Catal, and Michael Felderer. 2019. Closing the gap between software engineering education and industrial needs. *IEEE Software* 37, 2 (2019), 68–77.

[9] Morris Gordon, Daniel Darbyshire, and Paul Baker. 2012. Non-technical skills training to enhance patient safety: a systematic review. *Medical education* 46, 11 (2012), 1042–1054.

[10] Kiku Jones, Lori NK Leonard, and Guido Lang. 2018. Desired skills for entry level IS positions: Identification and assessment. *Journal of Computer Information Systems* 58, 3 (2018), 214–220.

[11] Paul Luo Li, Amy J Ko, and Jiamin Zhu. 2015. What makes a great software engineer?. In *2015 IEEE/ACM 37th IEEE International Conference on Software Engineering*, Vol. 1. IEEE, 700–710.

[12] John W Lounsbury, Eric Sundstrom, Jacob J Levy, and Lucy W Gibson. 2014. Distinctive personality traits of information technology professionals. *Computer and Information Science* 7, 3 (2014), 38.

[13] Charles Riborg Mann. 1918. *A study of engineering education: prepared for the Joint committee on engineering education of the national engineering societies*. Number 11. Merrymount Press.

[14] Gerardo Matturro, Florencia Raschetti, and Carina Fontán. 2019. A systematic mapping study on soft skills in software engineering. *JUCS-Journal of Universal Computer Science* 25 (2019), 16.

[15] João Eduardo Montandon, Cristiano Politowski, Luciana Lourdes Silva, Marco Tulio Valente, Fabio Petrillo, and Yann-Gaël Guéhéneuc. 2021. What skills do IT companies look for in new developers? a study with Stack Overflow Jobs. *Information and Software Technology* 129 (2021), 106429.

[16] Loreen Powell, Michalina Hendon, and Hayden Wimmer. 2017. The need for an emotional intelligence for information technology course: framework for educators and academic institutions. In *Proceedings of the EDSIG Conference ISSN*, Vol. 2473. 3857.

[17] Sheng-Pao Shih, Ting Lie, Gary Klein, and James J Jiang. 2014. Information technology customer aggression: The importance of an organizational climate of support. *Information & management* 51, 6 (2014), 670–678.

[18] Matt Stevens and Richard Norman. 2016. Industry expectations of soft skills in IT graduates: a regional survey. In *Proceedings of the Australasian Computer Science Week Multiconference*. 1–9.

[19] Matt Stevens and Richard Norman. 2016. Industry Expectations of Soft Skills in IT Graduates: A Regional Survey. In *Proceedings of the Australasian Computer Science Week Multiconference* (Canberra, Australia) *(ACSW '16)*. Association for Computing Machinery, New York, NY, USA, Article 13, 9 pages. https://doi.org/10.1145/2843043.2843068

[20] Indeed Editorial Team. 2021. 18 Presentation Skills for Business and How to Improve Them. https://www.indeed.com/career-advice/career-development/presentation-skills. visited September 20, 2021.

[21] Indeed Editorial Team. 2021. The Concept of Leadership Explained: Cultivating Effective Leadership. https://www.indeed.com/career-advice/career-development/concept-of-leadership. visited September 20, 2021.

[22] Indeed Editorial Team. 2021. How To Build Motivation (With Benefits and Steps). https://www.indeed.com/career-advice/career-development/how-to-build-motivation. visited September 20, 2021.

[23] Indeed Editorial Team. 2021. How To Demonstrate Your Willingness To Learn in the Workplace. https://www.indeed.com/career-advice/interviewing/willingness-to-learn. visited September 20, 2021.

[24] Indeed Editorial Team. 2021. The Importance of Creativity in Business. https://www.indeed.com/career-advice/career-development/importance-of-creativity-in-business. visited September 20, 2021.

[25] Indeed Editorial Team. 2021. Self-Management Skills: Definition and Examples. https://www.indeed.com/career-advice/career-development/self-management-skills. visited September 20, 2021.

[26] Indeed Editorial Team. 2021. Team Management Skill: Definition and Examples (Plus Useful Time Management Tips and Advice). https://www.indeed.com/career-advice/career-development/what-is-time-management. visited September 20, 2021.

[27] Indeed Editorial Team. 2021. Understanding the Process of Negotiation. https://www.indeed.com/career-advice/career-development/process-of-negotiation. visited September 20, 2021.

[28] Indeed Editorial Team. 2021. What Is Time Management? (Plus Useful Time Management Tips and Advice). https://www.indeed.com/career-advice/career-development/what-is-time-management. visited September 20, 2021.

[29] Indeed Editorial Team. 2021. Workplace Flexibility (Definition and Types). https://www.indeed.com/career-advice/career-development/workplace-flexibility. visited September 22, 2021.

[30] David Andrew Waldman. 1983. Structure and Importance of Technical Skills of Managers. (1983).

[31] Jerod W Wilkerson. 2012. An alumni assessment of MIS related job skill importance and skill gaps. *Journal of Information Systems Education* 23, 1 (2012), 188–197.