Software Engineers Engagement and Job Satisfaction: A Survey with Practitioners Working Remotely in a Public Organization

Lidiany Cerqueira[1,2]📷[a], Lourene Lobato Nunes[3], Viviane Malheiros[3], Renan Guerra[3],
Beatriz Santana[1], Rodrigo Spínola[4], Manoel Mendonça[1] and José Amancio Macedo Santos[5]

[1]*Federal University of Bahia, Salvador, Bahia, Brazil*
[2]*Federal University of Sergipe, Lagarto, Sergipe, Brazil*
[3]*Data Processing Federal Service, Brazil*
[4]*Virginia Commonwealth University, Richmond, U.S.A.*
[5]*State University of Feira de Santana, Feira de Santana, Bahia, Brazil*

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Abstract: *Context:* Work engagement is related to a positive fulfilling work-related mental state. Job satisfaction refers to how professionals are satisfied with their work. Measuring work engagement and job satisfaction can help organizations to foster employee productivity, as they are related. *Objective:* This study aims to analyze the work engagement and job satisfaction of software practitioners working in remote environment in a public organization. *Method:* We assess the engagement and job satisfaction of software professionals at a large governmental software organization. We surveyed a group of 148 employees and performed a quantitative and qualitative analysis of the responses. *Results:* The respondents reported good level of engagement and job satisfaction, 63% of them would recommend their team to a friend. The survey also reveals that career development, psychological safety, team, management and rewards, benefits, meeting planning, and social interactions are the factors that most affect the satisfaction of software professionals. *Conclusion:* The results of this study can help software organizations in fostering workplace improvement and satisfaction of software development teams. For researchers, results provide a grounded view of work engagement and job satisfaction, guiding new research efforts aligned with the demands and current context as experienced by practitioners. For practitioners, the identified factors provide empirical reference for improving work environments. We summarized them in a cheat sheet frame.

1 INTRODUCTION

In the competitive software industry, tech companies face the challenge of increasing the quality while reducing production costs of their products. To achieve this objective, they often seek to increase their team's productivity, which is affected by human factors (Canedo and Santos, 2019) such as engagement and job satisfaction (França et al., 2018; Murphy-Hill et al., 2019; Panteli et al., 2018).

Tech companies have investigated these factors to understand how they affect their team's productivity. For instance, Google researchers found that the best teams were productive because they worked together well, regardless of who was on the team (Duhigg, 2016). They also point out that successful managers foster employee engagement and job sat-

isfaction (Harrel and Barbato, 2018). Microsoft researchers proposed a theory of software developer job satisfaction and perceived productivity (Storey et al., 2019) and identified work environment factors that affect the satisfaction and perceived productivity of software engineers (Johnson et al., 2019). Also, software communities such as GitHub and Stack Overflow are trying to understand what makes developers and teams perform better, be more productive, and have a great developer experience. Empirical studies conducted by França et al. (2018) identified a variety of factors that affect the motivation and satisfaction of software engineers, and proposed a theory of software engineers' motivation and job satisfaction. Overall, these studies indicate that measuring work engagement and job satisfaction can help organizations to understand and predict productivity (Forsgren et al., 2021; Murphy-Hill et al., 2019; Storey et al., 2019).

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[a] 📷 https://orcid.org/0000-0002-4989-0986

Several soft and technical factors may impact work engagement and job satisfaction (Storey et al., 2019; Wagner and Ruhe, 2018). Software companies often do not know how these factors affect their work environment (Canedo and Santos, 2019). Additionally, the accelerating adoption of remote work increases the challenges of managing virtual teams and the need to examine what impacts them (Panteli et al., 2018). Organizations need to understand the impact of employee engagement in a technology-mediated remote work environment as it can be an early predictor of burnout and can lead to poor job performance, low job satisfaction, absenteeism, and employee turnover (Maslach and Leiter, 2016; Panteli et al., 2018).

Our study investigates **the work engagement and job satisfaction of software practitioners working in a remote environment** of a large federal government technology company. To this end, it surveyed 148 software practitioners and analyzed their responses qualitatively and quantitatively. The survey participants work as managers, architects, designers, support, and programmers in a software development department. Results indicate that they have good level of work engagement and that 63% of the participants would recommend their team to a friend. During the analysis, we coded 28 soft factors and two technical factors, which, according to the participants' perception, can help the company improve satisfaction in the workplace.

Practitioners can use our results to foster workplace improvement and satisfaction of software development teams. For researchers, our results provide a grounded view of work engagement and job satisfaction in a software company, guiding new research efforts aligned with the demands and current context as experienced by practitioners. The results contribute to build knowledge on the topic by considering a specific context: governmental organization and remote work.

The paper is structured as follows. Section 2 presents the key concepts and related work on software engineering work engagement and job satisfaction. We present the survey design in Section 3, results in Section 4, and discussions in Section 5. Section 6 presents the threats to the study validity. Section 7 concludes the paper with our final considerations and future perspectives.

2 BACKGROUND AND RELATED WORK

This section explores key concepts on software engineering work engagement, job satisfaction, and pro-

ductivity.

Work engagement refers to a positive dispositional state of mind, of pleasure and connection with the work activities, characterized by vigor, dedication, and concentration (Vazquez et al., 2015). It is related to high levels of energy and mental resilience at work, along with a sense of significance, inspiration, pride, challenge, and concentration (Vazquez et al., 2015).

Job satisfaction refers to how satisfied employees are with their work, team, tools, or culture (Forsgren et al., 2021). Researchers and companies do realize that productivity and job satisfaction are related to each other (Storey et al., 2019). Satisfaction is one of the most valued dimensions of productivity in software development (Forsgren et al., 2021).

Productivity is complex and nuanced, with important implications for software development teams (Forsgren et al., 2021). Most research in software engineering defines productivity in terms of the rate of output per unit of input, often time-based (Johnson et al., 2019). However, many factors influence software productivity and organizations generally do not know what these factors are (Canedo and Santos, 2019). There is no consensus on the "right" measurement of productivity. However, one weighty measure of productivity is personal perception (Forsgren et al., 2021).

2.1 Related Work

In this section, we explore relevant studies on engagement, satisfaction and productivity of software professionals.

Panteli et al. (2018) explored work engagement in virtual teams. The authors investigated work engagement in asynchronous mediated settings and found practices that foster its development. However, unlike our work, this study was not carried out in a software development company, but in a project management company in the engineering industry.

Wagner and Ruhe (2018) conducted a systematic review of productivity factors in software development. They presented a list of technical and soft factors that influence productivity. Soft factors are aspects related to human characteristics, such as management, feedback, communication, and appreciation for work, whereas technical factors relate to systems and process engineering, such as programming languages, tools, hardware, and processes (Canedo and Santos, 2019; Wagner and Ruhe, 2018).

Based on the list of factors distilled by Wagner and Ruhe (2018), Storey et al. (2019) performed a study to understand and measure productivity and job satisfaction. The authors investigated the most significant soft-technical factors and challenges faced by

Microsoft developers. As a result, they compiled a categorized list of soft and technical factors that can affect job satisfaction and productivity.

Our work used the categorization done by Wagner and Ruhe (2018) and Storey et al. (2019). We used their list of soft and technical factors as a starting point for our coding process, and followed a bottom-up process that eventually evolved their list to better classify our working data set.

Johnson et al. (2019) presented a study to understand which factors, related to the physical work environment, affect the satisfaction and perceived productivity of software engineers who work in company offices. The authors found that working privately without interruption plus team and leaders' communication were the most critical factors. Differently from (Johnson et al., 2019), our work is not focused only on factors related to the physical work environment.

França et al. (2018) carried out multiple case studies in four software organizations to present a theory of software engineers' motivation and job satisfaction. According to the authors, these aspects have been objects of study in many different fields for a long time, but there is still little concern with the proper use of theories applied to software engineering (França et al., 2018).

Google researchers performed case studies to identify the importance of managers in teams and also to characterize what makes effective teams on Google (Duhigg, 2016; Harrel and Barbato, 2018). They concluded that leaders play a decisive role in employee performance, satisfaction, and retention (Duhigg, 2016). They found five characteristics to define the best teams: psychological safety, reliability, structure and clarity, meaning and impact (Harrel and Barbato, 2018). Despite the results, the work of Google researchers can be considered Grey Literature (GL), as the company reports are not formally peer-reviewed nor formally published (Garousi et al., 2019). Our work takes into consideration the GL of Google reports to assess team related dimensions concerning psychological safety, performance effectiveness, allocation, and career development.

Engagement and job satisfaction are based on the subjective practitioners' perception, and may vary according to different contexts, professionals, work environment and organization. Thus our work seeks to identify additional factors and observe how they complement previous research. To this end, we present insights into the experience and opinion of software engineering professionals from a large governmental software organization. Although there are studies on motivation, satisfaction and engagement of software professionals, this specific context is still not widely studied and cultural differences can impact the results (França et al., 2018). Moreover, the participants of our study work remotely. Software companies are shifting to remote work, and researchers and companies are still trying to comprehend the challenges and factors that affect practitioners' engagement and satisfaction in such environments. Our results might be considered as input for comparing what factors affect remote and on-site work.

3 METHODOLOGY

This section presents the planning of the study considering its context, posed research questions, data collection and analysis procedures.

3.1 Context

Our study was carried out at the largest state-owned IT technology company in Latin America. The company has around 7,700 employees and is spread over several states of Brazil[1]. Thus, the survey and participants mother language is Portuguese. The study was carried out in the context of Project Sinergia, which is being carried out in the company's software development department, aiming to improve employees' soft skills. Within the scope of Sinergia, the company expects to identify improvement opportunities and analyze the evolution and return of the actions implemented. It also foresees a positive impact on the participants since the study allows them to know where they are, get a baseline of their competencies, and plan personal and team level improvement actions.

3.2 Research Questions

Our survey focuses on understanding factors that affect work engagement and job satisfaction. Thus, our questionnaire address multiple questions related to these factors, considering the research background (Wagner and Ruhe, 2018; Storey et al., 2019), for instance, psychological safety, team effectiveness, performance, allocation, and career development. We defined the research questions based on the interest of organizing the understanding of these factors independently: we tried to capture how each factor relates to the organization's central interests for improvements in its software quality processes. Hence, our work has the following research questions:

- **RQ1.** *How is the work engagement in the solution development teams?* This question aims to assess employee's engagement at work. It is motivated by the fact that engagement is related to other key job factors at the organizational level. For

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[1]Data from the Transparency and Governance Portal

instance, there is a positive correlation between engagement and commitment to the job (Vazquez et al., 2015) and a negative correlation between engagement and the intention to leave an organization (Halbesleben and Wheeler, 2008). There are also possible correlations between engagement and absenteeism, satisfaction, and job performance (Salanova et al., 2005). Our work uses an adaptation of the Utrecht Work Engagement Scale (UWES) (Vazquez et al., 2015) to measure work engagement.

- **RQ2.** *How do solution development teams assess the dimensions of psychological safety, team effectiveness, performance, allocation, and career development?* Psychological safety is related to personal perceptions about the consequences of taking interpersonal risks in a context such as a workplace (Edmondson and Lei, 2014). Team effectiveness encompasses factors such as cohesion and collaboration, as well as proactive communication, clear goals, autonomy, and work impact (Beecham et al., 2008; Sharp et al., 2009; Storey et al., 2019; Wagner and Ruhe, 2018). The performance dimension intends to evaluate the teams perceived productivity. The allocation dimension intends to identify situations of overload or idleness within the team, and plays a critical role in the success of projects in software engineering (Costa et al., 2020). And, the career development dimension intends to assess the perception of factors such as feedback, career development, and recognition for work (Beecham et al., 2008; Sharp et al., 2009). By looking at these dimensions, this question aims to investigate how people work together within their teams and the organization itself.

- **RQ3.** *How satisfied are solution development team members with their teams?* This question aims to assess the satisfaction of the employees. Satisfaction refers to pleasurable emotions in reaction to work and influences attitudes towards the organization such as intention to stay and job attendance (França et al., 2018). One of the possible ways to measure satisfaction is to ask employees how much they would recommend their team to others (Forsgren et al., 2021).

- **RQ4.** *What factors can be improved in the work environment?* This question aims to identify points that can contribute to improving the work environment, productivity, satisfaction, and well-being of solution development team members. It works as a proxy to identify critical points of attention at the work environment.

3.3 Survey Instrument

We conduct a survey because productivity dimensions such as employee satisfaction and well-being are generally better evaluated with this type of research strategy (Forsgren et al., 2021). The survey encompasses 18 questions based on a Likert scale from 0 to 6 (0 - Never, 1 - Almost never, 2 - Occasionally, 3 - Regularly, 4 - Frequently, 5 - Almost allways, 6 - Always), and a question based on a Net Promoter Score (NPS) scale. NPS is a market research metric that uses a single survey question, asking customers to rate the likelihood that they would recommend a company, product, or a service to a friend or colleague (Bendle et al., 2019). In our survey, NPS helps to measure how satisfied employees are with the company. Finally, with a open-ended question, the survey totaled 20 questions. The questionnaire is available in our replication package (Cerqueira, 2024).

Questions 1 to 6 approach the employee satisfaction dimension. These questions aim to assess the level of work engagement, considering that there is a relationship between work engagement and professional performance (Vazquez et al., 2015). This set of questions is related to **RQ1**. Questions 7 to 18 focus on the dimensions psychological safety, performance effectiveness, allocation, and career development. This set of questions is related to **RQ2** and it is based on the technical reports of the Aristotle and Oxygen projects (Duhigg, 2016; Harrel and Barbato, 2018). It aims to assess the relationship among employees within the working team. Question 19 aims to answer **RQ3** and defines a team recommendation assessment to measure employee satisfaction within the team. It uses an NPS scale ranging from 0 to 10. Lastly, for answering **RQ4**, question 20 asks the participant what he(she) would do if he(she) had a magic wand to improve his(her) work environment. It aims to identify critical points of improvement at the work environment.

Before applying the survey at large, we piloted it in an organizational unit of 79 people. Our goal was to try the survey instrument with members of the target population of the study. We received 65 answers and got feedback about how much time it took to complete the task (the mean time was about 12 minutes), impressions about questions (e.g. clarity, ease of understanding, size), and improvement points. We did not include these responses in the final survey results. We used this information to refine the questionnaire by: (i) improving the survey questions for clarity and completeness, i.e., internal and construct validity; and, (ii) reducing the effort required to answer it.

3.4 Data Collection and Population

We conducted the survey between October 25th and November 08th of 2021 with employees who worked remotely in the development of software solutions. The respondents were from different geographical regions of the country and had working between 10 to 30 years in the organization. They work as managers, architects, designers, support, and programmers in a software development department.

The survey application was done synchronously in virtual meetings. In those meetings, those responsible for the survey explained the purpose of the questionnaire, and invited the attending employees to participate in it. The participation was voluntary, and those who decided to participate in the survey would be given 20 minutes to answer the questionnaire. We invited 225 practitioners to the survey and received answers from 148 (a 65% success rate). To ensure anonymity, we refer to survey participants by ID as $P_1, P_2, ...P_n$.

3.5 Data Analysis Procedures

The survey instrument is composed of a mix of closed and open-ended questions. Thus, we need to rely on a variety of procedures for data analysis.

For the analysis of the answers to closed questions, we relied on descriptive statistics to get a better understanding of the data. We used the mode and median for the central tendency of the ordinal and interval data. For the nominal data, we calculated the distribution of participants choosing each option.

For the open-ended question, we applied qualitative data analysis techniques (Seaman, 1999). We coded responses to **Q20** based on the list of categories and important technical and soft factors proposed by Wagner and Ruhe (2018) and Storey et al. (2019) (see Section 2.1). For instance, we coded the participant P_{56}'s response *"I would improve communication. It is very difficult to get through to the team, they are always busy"* [2] as **Communication** in the **Team** category. In another example, we coded P_9's answer *"Get more feedback from my leaders"* as **Feedback** in the **Management** category. The list of categories initially adopted (Storey et al., 2019; Wagner and Ruhe, 2018) was eventually evolved as explained latter on in the paper.

The coding was performed individually by two researchers. Later, the researchers jointly reviewed their classifications to reach a consensus on the categorization of the data. The results were then discussed with

analysts from the Sinergia Project (organization stakeholders) to validate the final results.

4 RESULTS

The results of the study are presented in the following subsections.

4.1 RQ1 - How Is the Work Engagement in the Solution Development Teams?

Figure 1 presents how participants feel at work. Regarding Q1, Q2 and Q3, we can see that most respondents considered themselves full of energy, enthusiastic about their work, and feel like going to work. This points to a deep connection with the work activity, characterized by vigor, dedication, concentration and, therefore, less probability of absences and employee turnover (Vazquez et al., 2015). Concerning questions Q4, Q5 and Q6, most participants considered themselves proud and involved in their work, and also that the "time flies" when they were working. This denotes a sense of significance, inspiration, and pride in relation to their job (Vazquez et al., 2015). Lastly, none of the participants answered *Never* for questions 1 to 6. Therefore, overall, results indicate that the participants considered themselves engaged in their jobs.

> **Key Finding 1.** Overall, participants are highly engaged in their work.

4.2 RQ2 - How Do Solution Development Teams Assess the Dimensions of Psychological Safety, Team Effectiveness, Performance, Allocation, and Career Development?

The dimensions psychological safety, team effectiveness, performance, allocation, and career development are related to job satisfaction (Storey et al., 2019). Figure 1 presents the responses for each of those dimensions, from Q7 to Q18. Concerning team **effectiveness** (Q8 to Q13) and **performance** (Q14), we can see a similar assessment by the majority of participants. Participants are satisfied with the team's interaction regarding commitment, problem-solving, work complexity, impactful work, autonomy, and
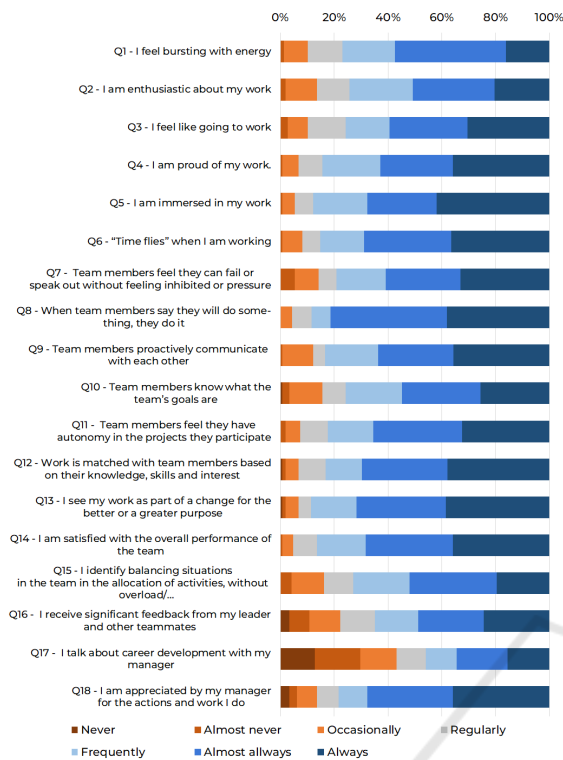
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[2]All answers quoted in this work were translated from Portuguese.

Figure 1: Survey responses.

collaboration. The respondents showed more concerns regarding communication (Q9) and team's goals (Q10), still less than 20% answered *Never*, *Almost Never* or *Occasionally* to those questions.

Psychological safety (Q7) and **allocation** (Q15) are also positively seen by participants. Google researchers found psychological safety to be the most significant factor for team's success, and establishing psychologically safe environments as essential to the organization (Duhigg, 2016). As software team building is an important project management activity, the right team size is critical to avoid allocation overhead issues (Costa et al., 2020).

Career development (Q16 to Q18) caused the most concern within the teams. The responses *Never*, *Almost Never* or *Occasionally* are around 40% of the total answers for Q17. Previous studies have pointed to the importance of the manager showing appreciation and giving good feedback about the work, as well as to the need for good communication within the team (Storey et al., 2019; Beecham et al., 2008; Duhigg, 2016; Wagner and Ruhe, 2018).

> **Key Finding 2.** Clear career development practices are a central concern when evaluating job satisfaction.

4.3 RQ3 - How Satisfied Are Solution Development Team Members with Their Teams?

Figure 2 shows the participants' evaluation for Q19 (*How highly would you recommend your team (your division) to a friend to work in it?*): 63% answered yes, 26% were neutral, and 11% would not recommend. Later on, when collecting feedback on the survey, we found out that one important contributing factor to the neutral and non-recommending responses was the type of work. Many participants answered "*do not recommend*" or "*neutral*" not because of their team or their manager, but because of work-related issues such as working with old technologies and legacy systems, and using bureaucratic workflows.
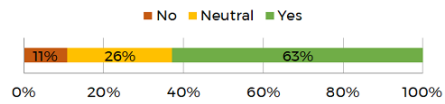

Figure 2: Participants' recommendation of the solution development teams.

> **Key Finding 3.** Overall, participants are satisfied with their teams. However, technical factors (e.g., use of old technologies, work on legacy systems, and using bureaucratic workflows) can play an important role in not recommend their team to a friend to work in it.

4.4 RQ4 - What Factors Can Be Improved in the Work Environment?

Among the 148 participants, 61 did not answer the open-ended question and six of them reported being satisfied with the work environment and did not see any need of improvement (e.g., P_{12} answered "*Anything. Perfect. Best team I worked*"). Thus, we coded the answers from 81 participants. We found 28 soft and two technical factors.

4.4.1 Soft Factors

These are factors related to human aspects. Table 1 shows the coded categories and soft factors. Team (29), Management (22), and Rewards, Benefits, and Career (15) are among the most cited categories. The value in parentheses is relative to the frequency of each category and coded factor.

Key finding 4. Soft skills related to *Team*, *Management*, and *Rewards, Benefits and Career* look determinant to improve work environment.

Team. Responses in this category are linked to team improvements. Communication (13) and social interactions (5) stand out as the most mentioned. Participants also mentioned psychological safety (3), collaboration (3), skilled co-workers (2), team culture (2) and innovation support (1) as factors that need improvement.

Communication (13) concerns the degree and efficiency with which information flows in the team (Wagner and Ruhe, 2018; Forsgren et al., 2021). For instance, P_{14} reported that *"less aggressive and more empathetic communication"*. The organization must intensify the adoption of good practices to maintain a communication flow between team members as this factor can be correlated to the success of a project and have a positive impact on productivity (Wagner and Ruhe, 2018). Ensuring access to tools, infrastructure, and organizational resources, besides, keeping communication channels open, sharing essential work information, and a space for informal talks are fundamental communication strategies for companies (Johnson et al., 2019; Juárez-Ramírez et al., 2021; Miller et al., 2021).

The social interactions (5) factor concerns interactions, events and social connections between team members (Miller et al., 2021). For instance, P_{77} reported that *"I would promote get-togethers in order to celebrate the team's results and foster the team's proximity"*. Three participants mentioned the factor psychological safety, which we questioned in Q7. As we can see in Figure 1, some respondents (approximately 21%) think that *almost never*, *occasionally* or *regularly* team members feel they can fail or speak out without feeling inhibited or pressured.

Management. In this category, factors refer to the team manager roles. It includes factors such as meeting planning (5), feedback (5), clear priorities (4), appreciation shown for work (3), autonomy (3), and well-defined goals (2), as reported by P_{116}: *"I would seek more equity in the tasks valuation"*.

As for the meeting planning (5) factor, responses mentioned problems in the proper planning of meetings. This factor had not been previously listed as an important factor for productivity by (Storey et al., 2019; Wagner and Ruhe, 2018), however the participants of our survey mentioned the need for better planning and organization of meetings to better use their time. Too many meetings or poorly conducted meetings can become a waste of time and a challenge for developer productivity (Beecham et al.,

2008; Juárez-Ramírez et al., 2021).

Managers can be essential for making clear decisions and facilitating collaboration between teams, being decisive for the performance and efficiency of employees (Harrel and Barbato, 2018). They must understand and be able to provide feedback to benefit their engineers (Storey et al., 2019).

The feedback (5) factor relates to giving information about performance effectiveness. Software engineers suffer from a low level of feedback, while direct and immediate evaluation contributes to understanding work results and building a self-perception of their actual performance (Beecham et al., 2008; França et al., 2018). This is aligned with answers of some participants for questions Q16 and Q18, in which they indicated *never*, *almost never* or *occasionally* for receiving feedback and for recognition for their work (see Figure 1). For example, P_{25} reported that he(she) wanted to *"Get more feedback from my leaders"*.

Rewards, Benefits, Career. In this category, we have factors such as lateral move opportunities (6) and benefits (4). For instance, P_{28} responded that *"An acknowledgment or award individually linked to a result / delivery of value, and not linked to a specific deadline"*. In general, the participants consider that there should be more opportunities to change projects or teams.

Participants also mentioned the need of improvements related to salary (3) and career promotions (2). This shows that some participants also want more equity in the distribution of promotions and salary progression. When considering these challenges, managers can propose alternative incentive strategies, such as useful knowledge as a reward (França et al., 2018).

Individual Skills and Experiences. In this category, we coded two responses as a personality (2) factor. They mentioned conflicts between different temperaments in the team. P_{16}, for example, reported that *"I would make with a colleague of mine that, if he did not have 'personal nitpicking', that person would be my friend..."*. The combination of different temperaments and personalities can affect the performance and satisfaction of team members, being important for good coexistence, communication, collaboration and psychological safety of the team Wagner and Ruhe (2018).

Organization. We coded responses that mention the vision (3) factor in this category. This relates to the organizational vision and culture (Wagner and Ruhe, 2018). Employees must understand the culture and organizational vision (Storey et al., 2019). P_{32}, for example, mentioned *"Have a broader view of the department's performance in the global context of the organization"*.

Personal Productivity. In this category, we coded two responses as ability to achieve goals (1) and perceived productivity (1), which are related to achieving goals and considering themselves productive within the company (Sharp et al., 2009).

Project. We coded the six responses, all related to the team size factor, in this category. For instance, P_{74} mentioned *"To increase team size"*. These answers suggest the need to re-evaluate the number of people in the team, possibly reallocating people, increasing teams, or evaluating their workload (Costa et al., 2020; Wagner and Ruhe, 2018).

Training. In this category, we coded responses related to the training factor (6). Participants mentioned that they would like more training. For instance, P_{42} said *"I would seek training for myself and the team in skills and competencies that today are seen as gaps"*). It is critical that software engineers can broaden their skills, specialize in the domain of tools and technologies, and also widen their soft skills (Storey et al., 2019).

Work Life/Work Experience. In this category, we found the factor time to complete tasks (7), as exemplified by P_{33} in *"I would assign tasks with deadlines suited to the capacity of the team"*. It is important that software engineers have enough time to complete their tasks and to learn how to carry out their activities (Storey et al., 2019).

Work Type/Impact. Some job complexity factors can affect job performance and well-being, as it can increase satisfaction by challenging software engineers (Storey et al., 2019). However, the company must balance the complexity and the time available to complete the tasks. We coded three responses as work complexity because they mentioned the need for more variety, significance and complexity. For instance, P_{123} mentioned that *"Find challenging activities for the team"*.

> **Key Finding 5.** We identified two new factors that can contribute to improving the work environment: *(appropriate) meeting planning* and *(promote) social interactions*.

Working Environment. Regarding this category, we coded the factors proximity to team (5), physical environment (2), and e-factor (1). We classified as proximity to team answers that mention the distance and lack of contact with team members due to the social isolation caused by the pandemic. For instance, P_{33} reported *"Currently, just putting an end to the pandemic to go back to the office..."*. Johnson et al. (2019) noticed that for some software engineers, team proximity is significant, as perceived productivity and satisfaction can increase when the people they work with

are in close proximity. Due to the collaborative nature of software development, the ability to informally sense if someone is available to initiate a discussion can facilitate many tasks (Johnson et al., 2019).

> **Key Finding 6.** The soft factors *communication*, *(appropriate) time to complete tasks*, *lateral moving opportunities*, *training*, *team size*, *(culture of providing) feedback*, *(appropriate) meeting planning*, *(promote) social interactions*, and *proximity to team* are frequently seen as factors that can contribute to improving the work environment, productivity, satisfaction, and well-being of software practitioners.

E-factor is related to work interruptions. Software engineers may feel less satisfied or less productive with their work depending on how many interruptions and context changes they face (Wagner and Ruhe, 2018). Interruptions can occur in shared physical work environments (colleagues talking, telephone, office noise) as well as in remote work (family, children, pets, ambient noise), and can delay the work progress (Beecham et al., 2008; Johnson et al., 2019). Working in privacy without interruption is a major factor in satisfaction with the work environment (Johnson et al., 2019). Therefore, some software engineers prefer to work in private spaces (Storey et al., 2019). However, the ability to communicate and work collaboratively is also valued. Hence managers and leaders must balance the need for individual privacy with the need for team communication.

4.4.2 Technical Factors

The close-ended questions did not initially foresee the answers in this category. However, some participants pointed out the need for improvements in technical factors too. We coded four responses in the processes and systems category, as hardware (3) and tools (1) factors. Some participants were concerned with access to better and more up-to-date equipment and tools. As an example, P_{133} mentioned that *"I would always have the most up-to-date equipment, accessories and all possible tools."*. These resources also can impact job satisfaction and productivity (Canedo and Santos, 2019; Storey et al., 2019).

4.5 Follow up Meetings with Company Analysts

We held some meetings with company analysts of the Sinergia Project who planned the questionnaire. We

use their feedback to validate the results of the qualitative analysis. We presented the coded factors and discussed our interpretation with them.

When evaluating the results, the experience of the analysts was crucial for an accurate interpretation. For instance, they observed that participants would not recommend their team to a friend (see **RQ3** on Section 4.3) because of issues related to the type of work such as obsolete technology, legacy system, and bureaucratic workflow. In another example, regarding the interpretation of the communication issues mentioned by participants, at first, we assumed it could be related to the proximity to team. However, according to the analysts' experience, it was not the case. In fact, the reported problems could also affect onsite work teams as well. Results presented in subsection 4.4 already consider the results of follow up meetings.

Table 1: Soft factors that can be improved, according to survey participants.

Category	Factor	N
Individual skills and experiences(2)	Personality	2
Management (22)	Well-defined goals	2
	Appreciation shown for work	3
	Autonomy	3
	Clear priorities	4
	Feedback	5
	Meeting planning	5
Organization (3)	Vision	3
Personal productivity (2)	Ability to achieve goals	1
	Perceived productivity	1
Project (6)	Team size	6
Rewards, benefits, and career (15)	Promotion	2
	Salary	3
	Benefits	4
	Lateral move opportunities	6
Team(29)	Team culture	2
	Collaborative team	3
	Social interactions	5
	Communication	13
	Psychological safety	3
	Support for innovation	1
	Skilled co-workers	2
Training (6)		6
Work life/work experience (7)	Time to complete tasks	7
Work type/impact (3)	Work complexity (3)	3
Work environment (8)	Proximity to team	5
	Physical working environment	2
	e-factor	1

5 DISCUSSION

In this study, we present the assessment of work engagement and job satisfaction by software professionals working remotely in a large governmental software organization. Considering the practitioners perspective, we highlight **career development, psychological safety, team management and rewards, benefits, meeting planning, and social interaction** as important factors requiring more attention from similar organizations aiming at job satisfaction (Section 5.1). Considering the researchers perspective, we highlight the need to explore: i) **meeting planning** and **social interactions** as new factors building on the factors originally listed by Storey et al. (2019) and Wagner and Ruhe (2018) (Section 5.3), ii) the importance of considering different approaches to investigate work engagement and job satisfaction (Section 5.2), iii) different organizational and cultural contexts to build a broader base of empirical knowledge on work motivation and job satisfaction (Section 5.4), and iv) the strengthening of partnerships between the industry and academia to study the subject (Section 5.4).

5.1 Revisiting the Research Questions

Concerning work engagement (**RQ1**), the survey participants showed a deep connection with work activity and also a sense of significance and pride in relation to their job. Regarding job satisfaction (**RQ2**), the participants assigned most negative scores to the following dimensions: **career development** (feedback, career development and appreciation for work), **allocation**, and **psychological safety**. In the open-ended questions, most of the respondents mentioned the categories **team**, **management** and **rewards, benefits and career** as points that should be improved. Hence we understand that the participants are more concerned with these categories and dimensions, requiring more significant attention from the organization to improve them.

Even so, when asked if they would recommend their team to a friend to work on it, 63% of the respondents would recommend it (**RQ3**).

5.2 Relating the Open-Ended and Closed Questions

Despite the high level of engagement and satisfaction observed in the self-reported questionnaire, we found significant factors reported as impacting employee satisfaction after coding the open-ended responses to **RQ4** (see Section 4.4). We compared the open-ended responses with the closed-ended re-

sponses of each participant. For instance, communication was the most mentioned factor in open-ended responses as a point to be improved. However, Figure 1 shows that 88% of the participants considered that team members frequently, almost always, or always, communicate with each other. We observed that even after positively evaluating the dimensions in the closed questionnaire, the respondents reinforced the need for improvements, pointing out the factors categorized in subsection 4.4. For responses coded as communication factor, we analyzed how the participants rated **Q9. When problems or delays occur, team members proactively communicate with each other and commit to the solution**. We found that, among these respondents, all of them rated Q9 positively. The same happened with participants who mentioned the factors psychological safety and well-defined goals in comparison to **Q7. I notice that team members feel they can fail or speak out without feeling inhibited or pressured** and **Q10. I notice that team members know what the team's goals are**.

Thus, we considered that the open-ended question, asking the participants what they would do with a magic wand (Q20), encouraged the creativity and critical thinking of the respondents. This allowed a deeper understanding of the aspects evaluated in the survey and the surfacing of ideas that were not initially foreseen in the closed questions.

5.3 Additional Factors Considered by the Participants

We consider the classifications of Storey et al. (2019) and Wagner and Ruhe (2018) as an extensive list of factors impacting satisfaction and productivity. However, we found two additional factors that were not considered by Storey et al. (2019) and Wagner and Ruhe (2018) as important to job satisfaction. We added the **meeting planning** factor in the management category and **social interactions** in the team category. Five participants of our survey mentioned the need for better planning and organization of meetings. Social interactions was the second most mentioned factor in the team category, also pointed by five respondents. They wanted more interactions, events and social connections between team members.

Improper meeting planning can be a waste of time and a challenge for developers (Beecham et al., 2008; Juárez-Ramírez et al., 2021), potentially impacting in productivity. Missing social interactions can affect connection and interpersonal communication with team members, impacting developers productivity (Miller et al., 2021). We recommend that these two factors should be considered by future

works that address job satisfaction of software practitioners. The company analysts also considered these findings as a relevant contribution to their organization, since they had not perceived them before.

5.4 Implications for Researchers

França et al. (2018) consider that there are few studies on work motivation and job satisfaction in software engineering and they are still concentrate on developed countries. Thus, aspects such as the cultural difference concerning the reality of different cultures are also not widely understood. We consider that the results presented in this work are little explored and there is still a gap for further investigation. Considering the factors that affect job satisfaction and productivity proposed by Storey et al. (2019) and Wagner and Ruhe (2018), our survey appointed two new factors (**meeting planning** and **social interactions**). This result represents a contribution for researchers.

In our work, we used NPS to measure how satisfied are team members with their teams (see section 3.3). Bendle et al. (2019) emphasize the value of academic partnership with practitioners to achieve relevant and robust research regarding the use of NPS. Our survey shows how it can be used to assess practitioners' satisfaction with their teams.

Another important aspect of our study is the partnership between software industry and academia, since field research addressing human factors in the software industry is still rising, specially in developing countries (Cerqueira et al., 2022).

There are relationships between the identified factors that lends itself for further research. For instance, feedback and psychological safety are related to communication, as well as personality and social interactions (DeFranco and Laplante, 2017; Miller et al., 2021). Communication was the most mentioned factor by the participants, who pointed out the need for better communication, empathy development, reducing aggressive behaviors and improving socialization among team members. There is a broad need for software engineering research focused on team communication (DeFranco and Laplante, 2017). But in particular, we highlight the need to deepen the research to understand and measure how skills and behaviors related to communication affect teamwork, satisfaction and engagement of software practitioners. Future work can use our results to compare how remote and onsite work affect job satisfaction.
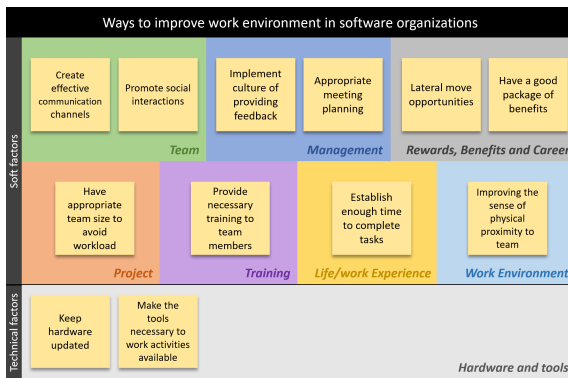
Figure 3: Work improvement frame.

6 THREATS TO VALIDITY

There are some threats to validity in this work, as with any other empirical study. Below, we discuss the most relevant threats to our study.

Conclusion Validity. A threat arises from the qualitative analysis because it is subjective and subject to inconsistencies. We used this analysis to answer RQ4. To mitigate this threat, two researchers individually analyzed and coded all open-ended questions. Later, they compared and refined their results until reaching consensus. Finally, results of the qualitative analysis were presented and discussed with the professionals for validation.

Construct Validity. Overall, participants may, based on the fact that they are part of a study, act differently than they do otherwise. To help prevent hypothesis guessing and evaluation apprehension, in the invitation e-mail, we clearly explain the purpose of the study and ask the participants to answer questions based on their own experience. The questionnaire is anonymous and that the collected data is analyzed without taking into consideration the participants' identities.

Internal Validity. As the survey questions were answered remotely, the participants could misunderstand these questions, arising an internal threat affect our study. To mitigate it, the survey passed through internal reviews conducted by experienced researchers. Afterwards, we piloted the survey with 79 employees to assess the survey questions, structure, and duration. We decided to shorten the questionnaire after validation of the pilot study.

External Validity. The company we studied employs around 7,700 people, working on software products for the government. Our results likely generalize more to the context of large public software companies than to small, private or open-source organizations. Hence, we do not claim that our results are generalizable for general contexts. However, an argument can be made that the ecological validity Andrade

(2018) of the work, i.e., the extent to which these findings approximate other real-world scenarios, is likely to hold in other settings.

7 CONCLUSION

This work investigates the work engagement and job satisfaction of software practitioners working in a remote environment. The study is based on a survey carried out at a large governmental software organization. In total, 148 software professionals answered the survey.

Results reveal that **career development, psychological safety, team, management and rewards, benefits, meeting planning and social interactions** are factors that organizations need to pay more attention, because they affect the satisfaction of software professionals. These factors can change depending on the context, organization, characteristics of the teams and work environment (Canedo and Santos, 2019). We also found that **meeting planning** and **social interactions** are factors that should be considered by studies addressing job satisfaction. These factors were not previously identified by the studies of Storey et al. (2019); Wagner and Ruhe (2018).

The results of this work can directly benefit practitioners, since the leveraged skills provide empirical reference for improving work environments. We summarized the most commonly mentioned of these skills in a cheat sheet presented in Figure 3. The proposition of interventions and improvements for the factors identified in our analysis is subject to future work.

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