How COVID-19 Pandemic affects Software Developers' Wellbeing, and the New Trends in Soft Skills in Working from Home

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Abstract. The coronavirus COVID-19 swept the world in early 2020, working from home was a necessity. In the software industry, thousands of software developers began working from home, many did so on short notice, under difficult and stressful conditions. The emotions of developers can be affected by this situation. On the other hand, some well-known soft skills have been emphasized as required for working remotely. Software engineering research lacks theory and methodologies for addressing human aspects in software development. In this paper, we present an exploratory study focused on the developers' wellbeing during pandemic, expressed as emotions, and the perceptions of the level in which soft skills are practiced/required in the working from home mode. The results show that high percent expressed to experience positive emotions, however, a portion of respondents expressed to feel negative emotions. In the case of soft skills, some of them are revealed as practiced in high level in working from home, but still there is not consensus.

Влияние пандемии COVID-19 на психофизическое состояние разработчиков программного обеспечения и новые тенденции в области гибких навыков при работе из дома

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Аннотация. В начале 2020 года коронавирус COVID-19 распространился по всему миру, и работа на дому стала необходимостью. В индустрии программного обеспечения тысячи разработчиков программного обеспечения начали работать из дома, многие сделали это в короткие сроки, в сложных и напряженных условиях. Эта ситуация могла воздействовать на эмоции разработчиков. С другой стороны, стало понятно, что для удаленной работы необходимы некоторые хорошо известные навыки межличностного общения. Исследованиям в области программной инженерии не хватает теории и методологий для рассмотрения человеческих аспектов в разработке программного обеспечения. В этой статье мы представляем предварительное исследование, посвященное психофизическому состоянию разработчиков во время пандемии, выраженному в испытываемых эмоциях и понимании того уровня, на котором используются/требуются гибкие навыки при работе из дома. Результаты показывают, что эмоции большей части разработчиков были положительными, однако часть респондентов выразила отрицательные эмоции. Что касается гибких навыков, некоторые из них оказываются очень востребованными при работе из дома, но единого мнения нет.

Ключевые слова: COVID-19; удаленная работа; разработка программного обеспечения; психофизическое состояние разработчиков; гибкие навыки

1. Introduction

According to a World Economic Forum (WEF) forecast of employment trends [1], remote work is the future; it is one of the biggest drivers of transformation in workplaces around the world, with around 40% of full-time employees already used to some form of remote work/telecommuting in the USA and Europe. Also, the WEF stated that [1]: "On average, by 2020, more than a third of the desired core skill sets of most occupations will be comprised of skills that are not yet considered crucial to the job today, according to our respondents." Gartner [2] stated that as digitalization moves from an innovative trend to a core competency, enterprises need to deliver products, attract, and retain talent.

According to specialized forums on Internet [3-6], recently, there are multiple options for hiring software developers in the marketplace; hiring remote dedicated develop is one of them. A company needs to hire remote dedicated developers when it feels and notices the following signs [7], among others: a) Struggle for desired skills in their teams; and b) Need of faster delivery of the project.

The recent situation of COVID-19 spread represents a starting of disruption in skills for remote work, as it suggested in Internet forums [8-10]. In this time, employees need to adopt or develop habits for working, which represent abilities and skills to possess. Professional software developers and practitioners are now working from home (WFH), and they should possess those skills.

Some studies present evidence of the "dilemma" about if software developers like to work from home in formal jobs [11-17], its benefits and challenges; this is also well expressed in popular forums on Internet [5, 18-20]. The ability to work remotely has been long touted as a prime perk by recruiters and hiring managers, especially in industrialized countries, contracting outsourcing services; furthermore, even when some developers like to work remotely, many others do not. However, data from a Survey [5] of the well-known blog called Stack Overflow Developer suggests that before pandemic a slight majority of developers (57.90 %) want to work in the office as opposed to home (33.20 %), while a mere 8.80% want to work out of another place such as a coworking space or café.

Working remotely has advantages and disadvantages, as expressed in Internet forums [21, 22], some of them are cited here:

Advantages: Reduced cost of software development; increased productivity; full flexibility of work; easy to scaleup the software development teams; faster to decrease/increase the manpower; faster delivery of projects; effective use of diverse time-zones; and access to a large pool of talent across the globe.

Disadvantages: Reduced control over the remote team; communication-related problems; reduced human connection; cross-culture gap; issues related to the quality of work; and increased risk of project failure due to reliability matters.

Traditionally, the productivity and performance of software developers and other jobs [23] is assessed and measured, as indicators of company capacities to produce software, but software developers are not machines, they are human beings; this fact stablishes a connection between cognitive and psychological aspects [24]. There are several studies that describe the connection between developers' wellbeing and their performance and productivity as it is cited in [25-27]. However, in the software industry there is a lack of attention addressing the human aspects in software development [28, 29]. Software systems are designed and used by humans; and the human being is characterized, among other things, by emotions. Given this fact, the process of designing and developing software systems is, like any other facet in our lives, driven by emotions [24].

By today, during the COVID-19 pandemic, in the software industry, thousands of software developers began working from home, many did so on short notice, under difficult and stressful conditions. Companies that fire for remote software developer jobs are [30]: *Amazon*, *Facebook*, *CrowdStrike*, *GitHub*, *Oracle*, *Slack*, *Twilio*, *Twitter*, *Spotify*, *SAP*, *VMware*, *Salesforce*. Several studies have concluded that remote developers are happier, more productive, and focused when working from home as is stated in [31, 32]. So, employees can harness flexible hours to optimize their schedule and work when they feel the most productive if they deliver work on time.

As we mentioned early, there are advantages and disadvantages of working from home. The elapsed period of pandemic has shown that some precise advantages are flexible schedule, increasing productivity, and work-life balance. However, working from home has some challenges, such as the following requirements: self-management and discipline, effective communication, and teamwork synchronization. So, it is time to analyze the wellbeing of developers expressed in a set of emotions working in the pandemic lockdown and the new normality. Furthermore, it is important to revisit the set of soft skills that commonly are demanded in software development, and especially in the working from home mode because it is a new fashion derived from COVID-19 pandemic.

In a previous version on this paper ("How COVID-19 Pandemic affects Software Developers' Wellbeing: An Exploratory Study in the West Border Area of Mexico-USA" [33]), we presented the first part of this exploratory study with a survey applied to practitioners in the west border area of Mexico-USA, emphasizing the conditions of working from home, the support from the companies, and the set of emotions they have experienced. In this extended version, we add a descriptive analysis about the most common skills of software developers, emphasizing those soft skills that participants considered more required/practiced in working from home mode. Also, we include the corresponding background.

The rest of the paper is organized as follows. Section 2 contains a background describing what emotions are, and the new trends in soft skills requirements. Section 3 describes some related work. Section 4 describes the methodology used. Section 5 contains the results in a descriptive way. Section 6 contains the discussion. Finally, section 7 has the conclusions and future work.

2. Background

2.1 The stereotype of software developers and emotions

There are many stereotypes about software developers. A common trope is the idea that they are emotionless, completely rational robots.

Software engineering research lacks theory and methodologies for addressing human aspects in software development [28, 29, 34]. Software development tasks are undertaken through cognitive processing activities. Affects (emotions, moods, feelings) have a linkage to cognitive processing activities and the productivity of individuals. Software engineering research needs to incorporate affect measurements to valorize human factors and to enhance management styles.

In [35], a theoretical framework for supporting emotions in the context of workplace was presented, which is the Affective Events Theory (AET). In AET, the work environment settings (e.g., the workplace, the salary, promotion opportunities, etc.) mediate work events that cause affective reactions, which are interpreted according to the individuals' disposition. Affective reactions then influence work-related behaviors, including emotions.

Emotions have been defined as the states of mind that are raised by external stimuli and are directed toward the stimulus in the environment by which they are raised [36]. However, several definitions have been produced for this term [37], and no consensus within the literature has been reached. For practical aspects, this term has been taken for granted and is often defined with references to a list, e.g. anger, fear, joy, surprise [38].

Other related terms are moods and feelings. Moods have been defined as emotional states in which the individual feels good or bad, and either likes or dislikes what is happening around him or her [39]. Feelings have been defined as the conscious subjective experience of emotions [40]. One of the most related terms is happiness, which has been defined as the emotional evaluation of life measured as the sum of the frequency of emotions in a timespan [41-43].

In our study, we are focused on a set of emotions, and we are going to introduce the way they are considered in the software development context. Software companies nowadays often aim for flourishing happiness among developers. There are several ways to make software developers happy, for instance [44]: Perks, playground rooms, free breakfast, remote office options, sports facilities near the companies, etc. Graziotin et al. present several studies [44-49], which relate developers' happiness with productivity, solving problems in a better way, better performance, and so on.

In [29], a set of emotions experienced by programmers are presented: a) Positive: Happy, Enthusiastic, Pleased, Optimistic, Enjoying, Content; b) Negative: Depressed, Frustrated, Angry, Disgusted, Unhappy, Disappointed. These emotions could occur during programming and affect productivity.

2.2 The new trends in soft skills

In a software developers' working career, they consider whether their level of hard and soft skills is appropriate. Employers know that professional and technical skills alone cannot help to achieve organizational goals and maintain company competitiveness. The qualities preferred for software developers include technical knowledge within the field or the position as well as soft skills [50]. Currently, employers consider that to achieve the company's goals, the employees must master the technical and professional knowledge and superstructure of soft skills. This means that soft skills are becoming critical to the success of a company.

A hard skill is the ability to conduct a particular type of task or activity using technical knowledge and experience, while a soft skill relates to a person's relationships with others and can be applied widely [50]. Hard skills involve technical knowledge of programming languages, compilers, base software systems [51-56], and other specific technical knowledge such as effort estimation, and so on [57]. Hard skills are acquired in formal courses and training.

In the case of soft skills, many definitions can be found in the literature. In general terms, soft skills are personal quality attributes divided in interpersonal, intrapersonal, and high-order thinking (cognitive) skills [55, 58], which are characterized as self-identity, self-control, social skills, communication, and mindset [58-60]. Soft skills characterize certain career attributes that individuals may possess like the ability to work in a team, communication skills, leadership skills, customer service, emotional intelligence, and problem-solving skills [61]. Soft skills are personal qualities, attributes, or the level of commitment of a person setting him or her apart from other individuals who may have similar skills and experience [62]. They are the intangible, non-technical, personality-specific skills that characterize a person as a leader, facilitator, mediator, and negotiator [50].

Much formal and informal literature cite the importance of the programmer role [63], and the skills or attributes that programmers and software developers should have [64]. Next, we summarize some proposals for soft skills, which are appropriate for software developers: creativity [65-68], critical thinking (problem solving, analysis) [67, 68], self-learning, reading and comprehension, interpretation, inference, explanation, open-mindeness, self-regulation [67], effective communication, effective cooperation [65, 69], engagement, commitment, teamwork [61, 68], leadership skills, customer service, emotional intelligence [61], motivation [70], tasks identification, planning and scheduling, conflict resolution [68].

In the last six years, the WEF [1] is leading in the looked at current employment, skills, and workforce strategies to identify the top ten skills everyone will need in the fourth industrial revolution. The report compares the shift in the soft skills needed to succeed in maintaining a job. In Table 1 we can see how the top ten skills have shifted between 2015 and 2020 [1, 50].

As we can see, *complex problem* solving continue in the top by 2020. *Critical thinking* moved forward two places, going to the second place. *Creativity* moved from the tenth place in 2015 to the third in 2020. *Emotional intelligence* appears as a new skill, at sixth place in 2020. *Active listening* disappears in the list of 2020.

Table 1. The shift in the top ten soft skills in 2015 and 2020

Top 10 Soft-skills in 2015	Top 10 Soft-skills in 2020
1. Complex Problem Solving	1. Complex Problem Solving
2. Coordinating with Others	2. Critical Thinking
3. People Management	3. Creativity
4. Critical Thinking	4. People Management
5. Negotiation	5. Coordinating with Others
6. Quality Control	6. Emotional Intelligence
7. Service Orientation	7. Judgment and Decision Making
8. Judgment and Decision Making	8. Service Orientation

9. Active Listing	9. Negotiation
10. Creativity	10. Cognitive Flexibility

3. Related work

In [71], a study is presented, which investigates the effects of the COVID-19 pandemic on developers' wellbeing and productivity. These authors used a questionnaire survey created mainly from existing, validated scales and translated into 12 languages. This work oriented the wellbeing to emotional status. The authors stated that individuals' wellbeing while working remotely is influenced by their emotional stability (that is, a person's ability to their control emotions when stressed). This proposal is supported by the suggestion of [72]. The main results presented in [71] are: (1) the pandemic has had a negative effect on developers' wellbeing and productivity; (2) productivity and wellbeing are closely related; (3) disaster preparedness, fear related to the pandemic and home office ergonomics all affect wellbeing or productivity. In general terms, this study reports that the COVID-19 pandemic has not been good for emotional stability, as it also supported by [73].

In [74], the Construx Software company presented a study, where surveyed software professionals to determine the effect that working from home during the COVID-19 pandemic is having on software development. The survey explored changes in communication and the impact on individuals, on teamwork, on leaders' ability to lead, and on specific technical practices. The study presents long-term recommendations for WFH based on survey findings. Next, we highlight some of them: (1) recommendations for individuals, oriented to orchestrate a tech infrastructure at home, workday time scheduling, and disposing time space for personal and family issues; (2) recommendations for teams, oriented to organize synchronized teams' work, stablishing clear expectations and communicate them to the team, and enabling efficient communication channels and practices; and (3) recommendations for leaders, oriented to develop remote-leadership skillset, maintain support to remote teams, and consider human aspects such as emotional needs of team members and try to give support on it.

In [75], the authors presented a study to analyze and understand how a typical working day looks like when working from home during the pandemic and how individual activities affect software developers' wellbeing and productivity. Results suggested that the time software engineers spent doing specific activities from home was similar when working in the office. However, they also found some significant differences. An interesting finding was that the amount of time developers spent on each activity was unrelated to their well-being and perceived productivity. So, the authors concluded that working remotely is not per se a challenge for organizations or developers.

In [76], the authors presented a study, emphasizing on that COVID-19 pandemic has provoked an overnight exodus of developers that normally worked in an office setting to working from home. To find out how developers and their productivity were affected, the authors distributed two surveys to understand the presence and prevalence of the benefits, challenges, and opportunities to improve this special circumstance of remote work. One of the main findings is that there is a dichotomy of developer experiences influenced by many different factors, which for some are a benefit, while for others a challenge. For example, a benefit for some was being close to family members, but for others having family members share their working space and interrupting their focus, it was a challenge.

4. Methodology

4.1 The survey

The objective of the survey is to identify the level of positive and negative emotions that software developers experienced working from home during the COVID-19 pandemic. Furthermore, we are going to identify the perception of participants about which soft skills are practiced in the working

from home mode. We designed the survey organized in the following sections: a) demographic, b) job position aspects, c) conditions of working from home (equipment, etc.), d) the impact of COVID-19 in working life, e) effectiveness of working from home strategies (including emotions), and f) programmer/developer attributes. The survey was presented in Google forms and applied by April 2021.

The set of emotions. Developing software systems is driven by emotions, as is stated in [24]. Programmers go through positive and negative emotions [29] in software development activities. Based on this, we considered a set of emotions, both positive and negative, supported by proposals extracted from [44, 45, 46, 47, 48, 49].

The set of soft skills. As we mentioned early, the WEF suggested a set of skills needed for the fourth industrial revolution [1, 50], as it is shown in Table 1. We adapted such proposal to the software development context considering intra and interpersonal attributes. We integrated a set of soft skills considering those suggested in [64-66, 68, 69] and our experience in real software projects with industry.

The survey has three important parts for this study: (1) the main difficulties faced in working from home during pandemic, 14 items (one per each difficulty) in a 5-point Likert scale; (2) emotions lived in full working from home mode during pandemic, 17 items (one per each emotion) in a 6-point Likert scale; (3) soft skills or attributes practiced in working from home during pandemic, 23 items (one per each soft skill) in a 4-point Likert scale. The consistency of the items was evaluated with Cronbach's alpha test, having the following results for the three sets: items of difficulties 0.794, acceptable; items of emotions 0.775, acceptable; items of soft skills 0.990, excellent.

4.2 The sample

This research involves a social study, so we considered graduates of the Computer Engineering undergraduate program from the Universidad Autónoma de Baja California, Tijuana campus. Due to the limitations to contact complete graduated classes, it was not feasible to do random sampling, so we used a non-probabilistic sample, that is, a convenience sample, considering a list of graduates with possibilities for contacting them. We did an invitation to 65 graduates who are working in companies in the Tijuana-USA border, including Silicon Valley and Seattle, WA. We included big companies worldwide known, considering that such level of companies could provide media needed to work from home. The invitation was sent to graduates through email or chat contact, encouraging them to answer in a period of 15 days. One kindly reminder was sent to 30% of the invited graduates before the deadline. Finally, 45 answers were collected.

The sample was 45 developers from companies of the west side of the Mexico-USA border: Baja California (Mexico) and California (USA). 62.2% of respondents work and live in Tijuana, 11.1% live in other cities close the border, while 26.6% developer work and live in the USA side. The gender, 98% male and 2% female; this proportion is common in software development practitioners. 53.0% of respondents live at family home, while 47.0% do not. About 60.0% are single.

About the work experience in industry, the distribution is as follows: Less than 1 year: 2.2%; 1 year: 13.3%; 2 to 3 years: 17.8%; 4 to 5 years: 22.2%; 6 to 7 years: 17.8%; 8 to 9 years: 11.1%; 10 or more years: 15.6%. A significant percent expressed to have 4 or more years (66.7%).

The respondents reported to perform a mix of activities related with software development. They emphasized to do software design. The percentages for activity are expressed as follows: Software design: 82.2%; Programming: 57.8%; Maintenance: 66.7%; System/requirements analysis: 28.9%; Code review: 28.9%; Project management: 17.8%; Manager 66.7%; Team Leader: 66.7%; Other: 11.1%; Administrator: 0%.

5. Results

The results are expressed in the followings terms: 1) equipment and infrastructure for working from home; 2) the satisfaction with the company' support; 3) worries about conditions derived from working from home; 4) difficulties faced; 5) experienced emotions; 6) preference for the working from home mode; 7) level of satisfaction with working from home, and 8) the soft skills practiced.

5.1 Equipment and infrastructure

The conditions of equipment and workspace available for working from home is shown in Fig. 1.
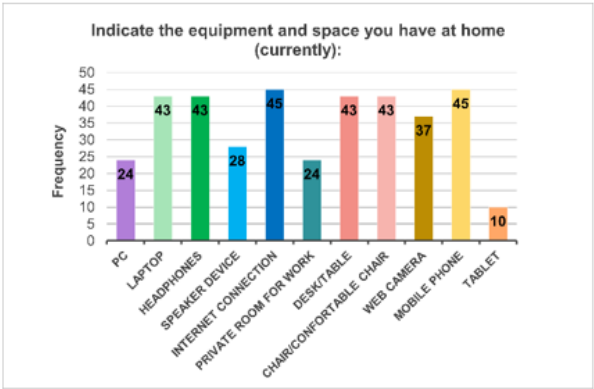
Fig. 1. Equipment in home office

The most basic equipment is possessed by almost all the respondents (laptop, headphones, Internet service, desk/table, comfortable chair, and mobile phone). However, important items required for working from home are not possessed by all the respondents, for instance, only 62.2% have speaker device, and only 53.3% have a private room for working. Speaker device is required for conversations and meetings. A private room for office is very recommendable for comfort.

5.2 Satisfaction with the company' support

The satisfaction with the company is expressed as follows (see Fig. 2, 3):

- "The general support you are getting from your Company to help you transition to taking your work from home": 77.7%.
- "The support you are getting from your Company to provide you equipment and tech for taking your work from home": 77.7%.
- "The communication they are getting from the Company about its ongoing responses to COVID-19, e.g. how long time to stay working from home, when to return back to office": 80.0%.
- "The communication you are getting from your Company about its ongoing responses to COVID-19, e.g. how long time to stay working from home, when to return back to office": 75.5%.
- "Encouragement to teamwork": 75.5%.
- "Promotion of using methodologies for working better": 68.8%. "Recognition of people, team, individual, effort/performance": 77.7%.
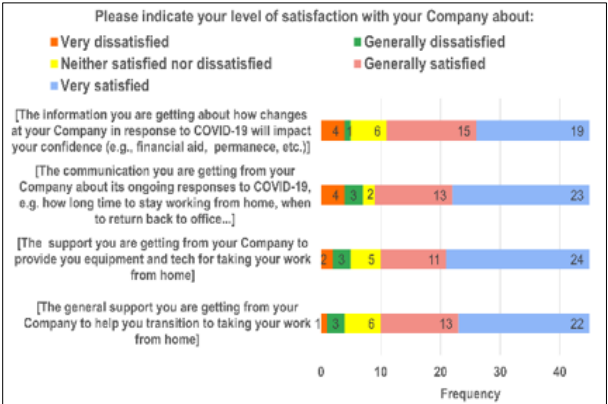- "Informing protocols to visit office if it necessary": 71.1%.

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Fig. 2. Satisfaction with the company - Part I

Fig. 3. Satisfaction with the company - Part 2

5.3 Worries

Considering the answers "sometimes" to "very often", the percentages of worries are as follows (see Figs. 4, 5): Doing well in the Company now that many or all your work is from home: 51.1%; losing friendships and social connections now that work is from home: 46.6%; accessing and successfully using the technology needed for your work, from home: 42.5%; and having access to health care: 46.6%.
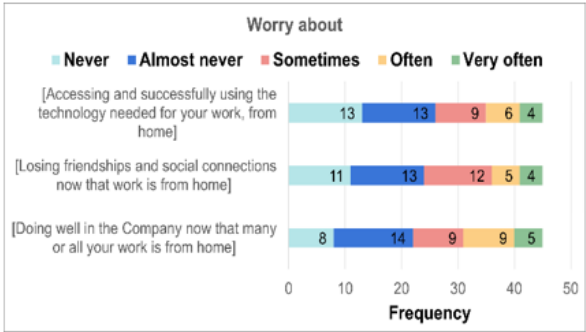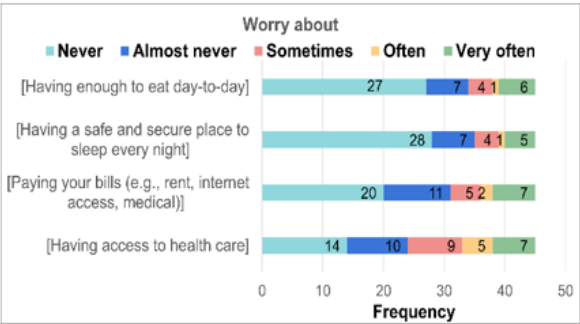

Fig. 4. Worries -Part 1

Fig. 5. Worries -Part 2

In general terms, respondents are more concerned with social interaction with work colleagues, and lack of social experience with other work colleagues, expressed as 55.5% (extracted from Figs. 7, 8) in both cases. Also, significant difficulties are to have access to team leader and team for face-to-face conversations (37.7%, 42.2%, respectively, extracted from Fig. 7). Another significant percent is the difficulty in keeping a regular work schedule (40.0% extracted from Fig. 6). Finally, a clear concern is anxiety with respect to COVID-19 risks (44.4%).
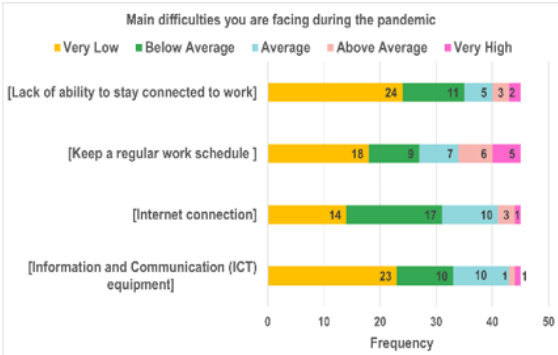

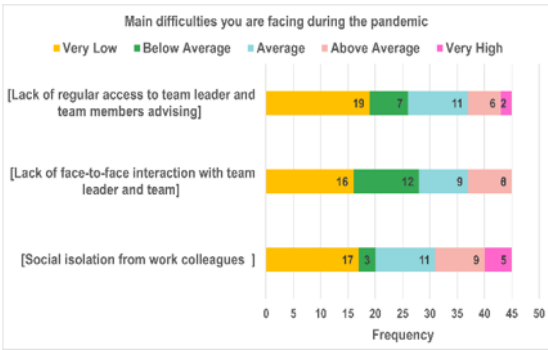*Fig. 6. Difficulties -Part I*

Fig. 7. Difficulties - Part 2

In general terms, respondents are more concerned with social interaction with work colleagues, and lack of social experience with other work colleagues, expressed as 55.5% (extracted from Figs. 7, 8) in both cases. Also, significant difficulties are to have access to team leader and team for face-to-face conversations (37.7%, 42.2%, respectively, extracted from Fig. 7). Another significant percent is the difficulty in keeping a regular work schedule (40.0% extracted from Fig. 6). Finally, a clear concern is anxiety with respect to COVID-19 risks (44.4%).

5.4 Faced difficulties

Seven difficulties are shown in Figs. 6, 7. 26.6% expressed to have difficulties with information and communication equipment. 31.1% expressed to have difficulties with Internet connection. 40.0% expressed to have difficulties in keeping a regular work schedule. 22.2% expressed to have difficulties to stay connected to work. 55.5% expressed to have difficulties with social isolation from work colleagues. 37.7% expressed to have lack of face to face-to-face interaction with team leader and team. 42.2% expressed to have lack of regular access to team leader and team members advising.

The second set of seven difficulties are shown in Figs. 8, 9. 35.5% expressed to lack of opportunities to request better performance of team leader or team. 55.5% expressed to have lack of social experience with other work colleagues. 24.4% expressed to have more difficulties to complete work. 24.4% expressed working from home experience not engaging. 44.4% expressed to have general anxiety with respect to COVID-19 risks. 22.2% expressed to have anxiety about working from home. 22.2% expressed to have economic concerns.
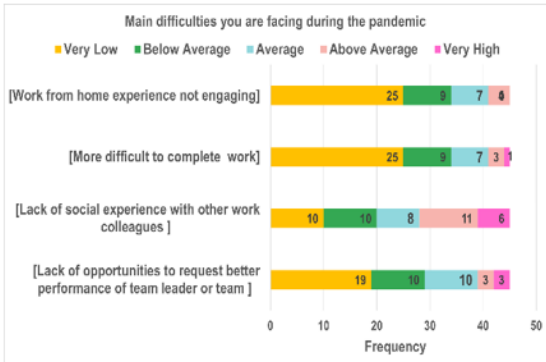

Fig. 8. Difficulties - Part 3

In general terms, respondents are more concerned with social interaction with work colleagues, and lack of social experience with other work colleagues, expressed as 55.5% (extracted from Figs. 7, 8) in both cases. Also, significant difficulties are to have access to team leader and team for face-to-face conversations (37.7%, 42.2%, respectively, extracted from Fig. 7). Another significant percent is the difficulty in keeping a regular work schedule (40.0% extracted from Fig. 6). Finally, a clear concern is anxiety with respect to COVID-19 risks (44.4%), Fig. 9.
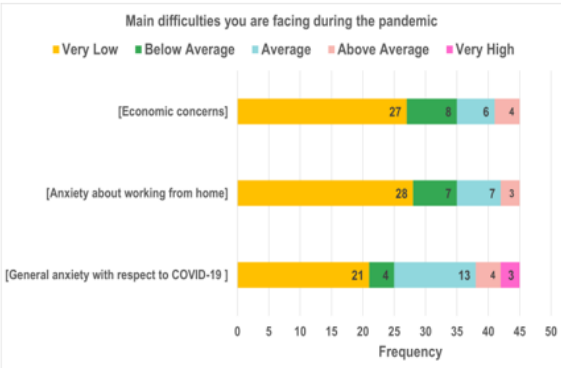

Fig. 9. Difficulties - Part 4

5.5 Emotions

A set of positive emotions are shown in Fig. 10. Considering answers from average and more, 88.8% of respondents are optimistic from average to very high, and 64.4% are optimistic above average

and more. 86.6% have serenity from average to very high, and 55.5% have serenity above average and more. 95.5% are happy from average to very high, and 64.4% are happy above average and more. 97.% have acceptance from average to very high, and 84.4% have acceptance above average and more. 93.3% have trust from average to very high, and 75.5% have trust above average and more. As we can see, the respondents present high levels of positive emotions.
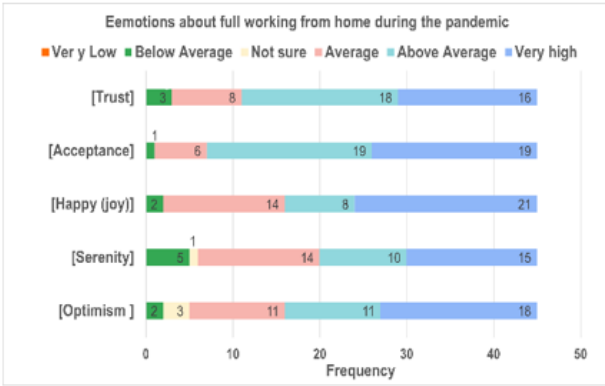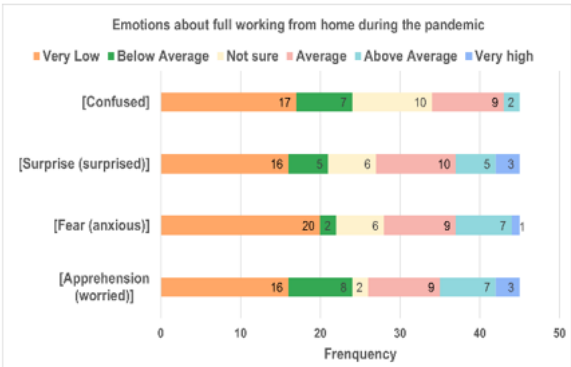

Fig. 10. Emotions –Part 1
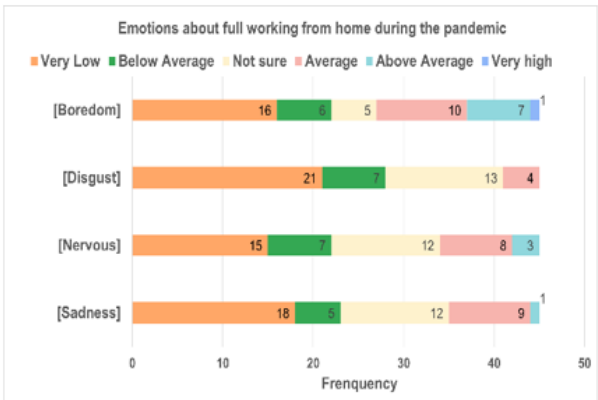

Fig. 11. Emotions –Part 2

Fig. 12. Emotions –Part 3

In Figs. 11, 12 the responses about negative emotions are presented. Let see the results for negative emotions. 53.3% of respondents expressed not to have apprehension, while 42.2% expressed to have it in average and more, 4.4% said not to be sure. In the case of fear, 48.8% expressed not be afraid,

while 37.7% expressed to be afraid in average and more, and 13.3% said not be sure. About to be confused, 53.3% expressed they are not, while 24.4% expressed to be and 22.2% were not sure.

The next set of negative and positive emotions are shown in Fig. 13. In the case of anger, 57.7% expressed not having anger, while 8.8% expressed being angry, and 33.3% said they were not sure. 51.1% expressed not being annoyed, while 20% expressed having annoyance, and 28.8% said not be sure.
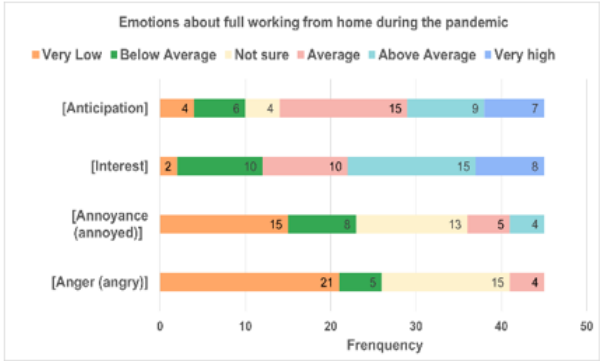
Fig. 13. Emotions –Part 4

5.6 Preference of working mode

The preference in shown in Fig. 14. 44.4% have high preference for working from home, while 35.5% have medium preference, and 20.0% have low preference. On the other side, 24.4% have high preference for working in the presence face-to-face mode, and 15.5% have medium preference, and 60.0% have low preference.

Fig. 14. Preference for working mode

5.7 Satisfaction with working from home

As we can see in Fig. 15, 91.0% shown satisfaction of working from home, considering responses satisfied and very satisfied. There is a significant percent of people which are satisfied of working from home, even when some of them have experienced negative emotions and have some difficulties as it is expressed in previous sections.

Fig. 15. Satisfaction of working from home during pandemic.

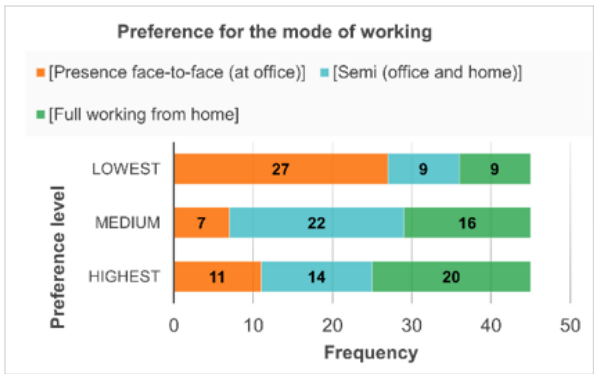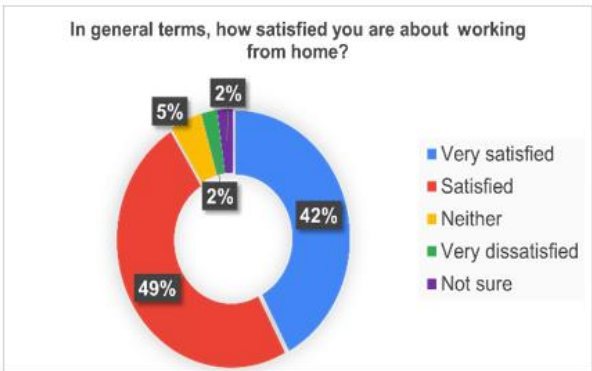## 5.8 Attributes/soft skills of software developers practiced

We collected responses about the three modes: Presence face-to-face, semi-online mode, and working from home; however, in this section we only present the results of the participants opinion on how soft skills are practiced in the working from home mode. We present the results for a sample of skills, organized in terms of the level of practice in the working from home mode, so firstly we present the more practiced in this mode, and later the less practiced.

Table 2 shows the frequencies for each soft skill. We present the results in terms of the 4-point Likert scale: Nome (N), Low (L), Moderate (M), High (H). As we can see, most of the soft skills have significant frequencies from moderate to high, except those "negative" attributes or attitudes such as impatience, laziness, and hubris.

The skills more practiced in high level are self-learning (66.6%), reading & comprehension (64.4%), adaptability (64.4%), and good team player (64.4%), curiosity (60.0%), attention to details (57.7%), task & time management (57.7%), quick learning (55.5%), and quick learning outside programming (55.5%).

Table 2. Soft skills: Working from home (Frequency)

Soft Skills	N	L	M	H
Self learning	0	5	10	30
Reading & comprehension	0	4	12	29
Adaptability	1	4	11	29
Good team player	0	5	11	29
Curiosity	0	2	16	27
Attention to details	0	3	16	26
Task & time management	0	5	14	26
Quick learning	0	3	17	25
Quick learning outside prog.	0	4	16	25
Pair support	0	8	13	24
High end-user focus	0	3	19	23
Communication	0	3	19	23
Confidence	0	6	16	23
Supreme analysis	0	1	23	21
Deep & broad tech. capacity	1	4	21	19
Clear thinking	0	4	23	18
Impatience	3	7	18	17
Laziness	3	10	15	17
Hubris	5	13	12	15

As we can see, fortunately, impatience, laziness, and hubris were experienced in a lower level in the scales moderate and high, however, these kinds of attitudes were lived.

6. Discussion

6.1 Emotions and feelings

In the case of emotions, there is a mix of perceptions. High percent of respondents expressed to experience positive emotions in good level, such as optimism, serenity, happiness, acceptance, trust, interest, and anticipation. This is nearing the conclusion made by [75], which stated that "working remotely is not per se a challenge for organizations or developers." In this case, especially developers shown good level of wellbeing in terms of positive emotions.

On the other hand, significant percent expressed not having negative emotions in considerable level, such as apprehension, fear, confused, anger, and annoyance. However, part of the respondents expressed to experience some negative emotions in a significant level in average and more, such as sadness (22.2%), nervous (24.4%), and boredom (40.0%).

6.2 Skills/attributes practiced

The bigger consensus is 66.6% of *self-learning* for working from home compared to 44.4% for presence face-to-face mode. *Adaptability* is the second one with 64.4% for working from home compared to 53.3% for presence face-to-face mode, as the same as reading and comprehension with 64.4% for working from home compared to 40.0% for presence face-to-face mode. *Curiosity* is in the third place with 60.0% for working from home compared with 33.3% for presence face-to-face mode. *Time and task management* is in fourth place with 57.7% for working from home compared to 48.8% for presence face-to-face mode. These results allow us to suggest these four skills as the more practiced in the new fashion of working from home.

On the other hand, 57.7% respondents considered that *quick learning* is practiced in high level in presence face-to-face mode compared to 55.5% in working from home mode. In the case of *deep and broad technical capacity* 46.6% of respondents considered that this skill is practiced in high level in presence face-to-face mode, while 42.2% for working from home mode. The respondents considered that *clear thinking* is more practiced in high level in presence face-to-face mode (44.4%), compared to working from home (40.0%). These results suggest that respondents considered that they are more active and challenged in presence face-to-face mode.

The respondents considered that *good team player* and *pair support* are mode practiced in presence face-to-face mode than in working from home, which corresponds with the perceptions on worries and difficulties discussed in early sections. These skills correspond to the sixth ranked skill in [1, 50], "*Coordinating with Others*".

In the case of *high end-user focus*, the respondents considered it is practiced in high level in the working from home mode with 51.1%, as same as in the presence face-to-face mode. This skill corresponds to "Service Orientation" considered in the eighth place by [1, 50]. *Communication* is also considered as practiced in the same level in both modes, with 51.1%.

Analyzing the negative moods, *impatience*, *laziness*, and *hubris* are slightly more practiced in high level in working from home mode compared to presence face-to-face. From these results we can deduce that some negative moods are more lived in the virtuality. In the case of *confidence*, it is practiced in the same level for both modes; this is a positive result, which mean that virtuality does not reduce the confidence of software developers.

6.3 Comparing results with related work

In terms of emotions, [71] did not present a set of specific emotions, however, it covers well the topic of wellbeing in general terms; this is the same case for [73, 75]. Our study presents seventeen specific emotions, assessed in a 6-pint Likert scale, which means a real expression of how the respondents felt working from home during pandemic, having similarities with respect to the results presented in [29].

In the case of problems and difficulties faced by individuals and teams during pandemic, [74] reports implications in communication, teamwork and so on, however, this study does not present specific assessment of each difficulty. Furthermore, the consulted related work does not present specific assessment of soft skills or attributes practiced in working from home during pandemic. Our work presents the assessment of specific soft skills in a 4-point Likert scale, which represents a significant contribution on the acknowledgement that developers do about how human aspects are involved directly in software development activities.

7. Conclusions and future work

Working remotely have been announced some years ago by the WEF, for becoming to be a fashion by 2020. The preference of developers was divided as it is shown by some studies such as [5], but the COVID-19 pandemic forced to go home and working remotely. Infrastructure of ICT, office conditions, time management and some other aspects had to be considered. Also, the wellbeing of developers is important.

In this paper, firstly, we have presented a descriptive analysis of the wellbeing of software developers working from home during the COVID-19 pandemic. The study was focused on a set of emotions experienced by developers, under some conditions working from home.

With respect to the worries imposed by remotely working, the respondents expressed three main concerns: a) lack of social experience with other work colleagues; b) difficulties with social isolation from work colleagues; and c) social interaction with work colleagues, team leader and team. This is evidence of the importance of the social part in the software development process and during pandemic working from home.

On the other hand, the results shown that a significant percent of developers experienced positive emotions in high level, and not having negative emotions in significant levels. However, there is a part of respondents that experienced negative emotions.

Even when not the total of respondents prefers working from home, 91.0% expressed to be satisfied and very satisfied of working from home during the pandemic. This fact could introduce a new trend of acceptance of working remotely even after the pandemic.

In the case of software developers' skills/attributes practiced, in general terms, the results expressed in an early section allow us to conclude that most of the skills proposed in [1, 50] are evidenced as practiced by software developers in the working from home mode during the elapsed period of pandemic. However, it is important to continue investigating the progress of adequacy of software developers to the new normality, to assess how all the skills are practiced, because in some cases, the respondents expressed to practice some skills more in the presence face-to-face mode than in working from home mode.

Our study introduces the consideration of human aspects of developers, which is a topic not commonly addressed in the software engineering research, so we are adding more evidence that emotions and soft skills play a significant role in the software development context.

Continuing in this line, we have formulated as future work:

- Make a distinction between "working from home" and "working from home during pandemic", characterizing conditions, skills required, and wellbeing experienced.
- How to improve social experience with other work colleagues in remote working? Facing the

limitations imposed by distance and technology.

- Exploring the new position/opinion of developers and companies to WFH after pandemic. Before, 57.90 % of developers preferred working at office, as it is expressed in [5], however, our study revealed that 91.0% are satisfied of working from home.

- Looking for a consensus about which soft skills are more required/practiced in the new normality of working from home. It is important to reach for the perceptions of both employers and software developers.

Our work has a limitation in the size of sample, so it convenient to address new studies in this topic, trying for reaching lager samples, to gather more consensus.

The new trends in working from home have direct impact in the academic environment; the new software engineers will need to have the skills required to work from home. It is important to prepare students (as future software workforce) to acquire the digital skills as well as soft skills [56], which have important impact on the working from home productivity and wellbeing of software developers [77]. Some challenges will be faced to convince current students to accept the full online learning (from home) to acquire the most required skills for working remotely [77, 78]: *self-management and discipline, time management, effective communication skills*, and so on. It is important to increasing the quality and sustainability of education at universities regarding the requirements of employers in terms of soft skills [50].

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