Using agile methods to improve inclusion and team diversity

Utilização de métodos ágeis para melhorar a inclusão e a diversidade da equipe

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ABSTRACT
Agile Methodologies have brought insights into how to develop software by focusing on individuals and valuing diversity in the teams. Some studies show that diversity builds better teams and delivers better results. However, there is a known lack of representativeness when discussing diversity for people with disabilities. In this context, this paper aims at identifying the leading practices/techniques that allow an open concept of social inclusion and diversity in agile software development teams and propose any necessary adaptations to help wide diversity. We performed a literature review and raised a set of techniques that were presented to experts in two contexts: (i) within the software development industry and working under agile methodologies and (ii) with disabilities or people who coordinate teams with people with disabilities. The results show that some agile techniques can promote inclusion but is necessary for some adaptations. We verify that to encourage this diversity for people with disabilities, specific tools, knowledge of sign language and transformations in the environment is vital for supporting broad diversity.

Keywords: agile methods, software engineering, human aspects, people with disabilities, people with special needs.

RESUMO
As Metodologias Ágeis trouxeram conhecimentos sobre como desenvolver softwares, centrando-se nos indivíduos e valorizando a diversidade nas equipes. Alguns estudos mostram que a diversidade constrói melhores equipas e proporciona melhores resultados. Contudo, há uma conhecida falta de representatividade quando se discute a diversidade para as pessoas com deficiência. Neste contexto, este documento visa identificar as principais práticas/técnicas que
Permitem um conceito aberto de inclusão social e diversidade em equipas ágeis de desenvolvimento de software e propor as adaptações necessárias para ajudar a uma grande diversidade. Realizamos uma revisão literária e levantámos um conjunto de técnicas que foram apresentadas a especialistas em dois contextos: (i) dentro da indústria de desenvolvimento de software - tentar e trabalhar sob metodologias ágeis e (ii) com deficiências ou pessoas que coordenam equipas com pessoas com deficiências. Os resultados mostram que algumas técnicas ágeis podem promover a inclusão mas são necessárias para algumas adaptações. Verificamos que para encorajar esta diversidade para as pessoas com deficiência, ferramentas específicas, conhecimento da linguagem gestual e transformações no ambiente é vital para apoiar uma ampla diversidade.

**Palavras-chave:** métodos ágeis, engenharia de software, aspectos humanos, pessoas com deficiência, pessoas com necessidades especiais.

1 INTRODUCTION

Over the centuries, the development of industry and technology has enabled humanity to evolve of significant proportions at an economic and mainly social level. Even so, according to Aranha [4], a portion of the population was left out of this social process. Interactions and communication facilities for people with disabilities have evolved little, making it difficult to fit into the rigid criteria of modern society and be accepted by the job market, as is the case with companies and software development teams. The United Nations (UN) [36] points out that the World Health Organization, in 2011 data, 1 billion people live with a disability, that is, one in seven people in the world has a disability [36]. For Burgstahler and Ladner [8], it is necessary to ensure that all educational and employment opportunities that technology offers are accessible. So, everyone can contribute to creating an equity field, thus increasing people’s access with disabilities to post-secondary education and careers in high-paying jobs and ultimately strengthening the economy.

The role of the person with a disability within Software Engineering, as a developer, a leader or team member, cannot be defined by its limitations. Agile methods present a perception focused on individuals and can thus be used to dynamize and facilitate the change of this scenario presented in information technology.

In this context, clarify the following research question: *how to insert and integrate people with disabilities into agile teams?* A survey was carried out with Brazilian specialists from some country regions. This research made it possible to identify and understand the main challenges agile teams face to facilitate the inclusion and integration of professionals with disabilities (PWD). Thus, we have developed a catalogue of techniques that can be used to support a more efficient and inclusive software development process. In addition, we discussed the inclusion and integration of people with disabilities reflected in development processes, policies and organizational guides.
This paper following sections are organized as follows: Section 2 provides a brief theoretical foundation; Section 3 the research methodology; Section 4 displays the results of the literature review and the interviews; Section 5 covers agile practices identified as inclusive, expert recommendations in the form of a brief discussion; Finally, Section 6 presents final considerations, limitations, and suggestions for future work.

2 BACKGROUND

2.1 DIVERSITY AND AGILE METHODS

The Agile Manifesto conception marks the agile philosophy emergence [14], which comprises values and principles, seeking to re-signify the software development practices followed until then coming from an environment where only software was delivered, to a value delivery and focus, which generates a positive impact for stakeholders [31]. With the growing evolution of the agile development process in software teams, it is common to come across a people-oriented work model and evidenced by individuals and interactions more than processes and tools [14].

Each individual has unique experiences, different points of view about each reality, each context, concerning the environment around them. It is through this diversity that better software can be built, a better product, and a more effective team [49]. This can be seen in several agile methods, such as in XP (Extreming Programming), which among its values are communication and feedback [16].

2.2 HUMAN ASPECTS IN SOFTWARE ENGINEERING

Brooks [7] and Weinberg [53] recognized the human aspects of software development, formerly called “personal factors”, as an important influence on software development productivity. According to John, Maurer and Tessem [22] the most important human and social factors are the relationships between personality, skills and roles in a software team.

Al-Ani et al. [2] show that software engineers typically need different levels of information abstraction at distinct development stages, while performing various tasks. Hazzan and Tomayko [17] address that human factors can explain many flaws within the software world. For dos Santos Soares [?], the understanding is that agile methods emerged to focus on people, on human beings, within software engineering.

Viana et al. [52], and Robbins et al. [42] describe several human aspects, focused on concepts within organizational behaviour, these are: motivation, personality, emotions, perception, training, learning, leadership effectiveness, job satisfaction, individual decision making, performance assessment, attitude measurement, employee selection, job design, and work stress. Nijhuis et al. [33] also present the following human aspects, focused on software engineering: leadership, conflict resolution, risk management,
expectation management, negotiation, problem-solving, sustainability observation, analytical thinking, and conducting meetings.

Human and cooperative aspects affect the software building business on many levels and from different perspectives. These factors influence the activity and well-being of the team, the client, the organization and the community [11]. While the Software Engineering industry deals with the increasing complexity of its products, collaboration between different people who participate in the same project is essential. It is no wonder that software development companies and researchers seek to adapt processes in order to improve the individual’s well-being [10, 12, 15, 29, 43, 44, 51].

Accessibility is also analyzed in software engineering from the perspective of product quality, such as the ISO/IEC 25010 standard [19] and the systematic mapping by Silveira, Silva de Souza e Rocha [45] regarding attributes and software accessibility measures for people with visual impairments. Although equally relevant, the works focus on the product as a result being accessible and not on making the process of developing them more accessible.

2.3 BRAZILIAN GOVERNMENT INCENTIVE POLICIES FOR INCLUSION

According to Law number 8213/91 [38], the Brazilian government assigns to companies part of the responsibility to include people with disabilities in society. In other words, companies with more than 100 employees need to allocate vacancies for people with disabilities, ranging from 2% to 5%, depending on the employee’s number.

The UN (United Nations) in Brazil [35] has defined in its agenda for 2030, 17 Sustainable Development Goals (SDGs). In SDG number 8, which concerns with Decent Work and Economic Growth, one of its goals is: “By 2030, achieve full and productive employment and decent work for all women and men, including young people and people with disability, and equal pay for work of equal value” [35]. Furthermore, SDG number 9, which addresses the topic of Industry, Innovation and Infrastructure, states that “Ensuring equal access to technologies is crucial to promoting information and knowledge for all” [34]. These are points of global interest, where the UN itself states that it is energetically working to achieve these goals.

The world UN [50], points out that online access to public services, e-learning materials, text-to-speech devices, among others, are giving people with disabilities the ability to still engage in society. In addition, it also adds several governmental practices for countries to promote the inclusion of people with disabilities on different fronts of society.
The World Report on Disability [37], conceived by the government of the state of São Paulo in Brazil, points out government recommendations based on the guidelines proposed by the UN, such as:

- Instill in all people the conviction that people with disabilities can work, given adequate support.
- Make employment services available to people with disabilities equally in employment agencies.
- Develop services tailored to the community and individual needs, rather than “one size fits all” services.
- Monitor and evaluate labour market programs to facilitate and increase the employability of people with disabilities.

2.4 PEOPLE WITH DISABILITIES AND THE TECHNOLOGY MARKET

According to the UN [50], for most people, technology makes things easier. For people with disabilities, technology makes things possible. For the International Labor Office (ILO) [20], technology provides new and innovative means of adapting jobs and workplaces to facilitate the continued employment of older workers and those who have or develop disabilities throughout their lives. Figure 1 demonstrates that the difference between self-employed with and without disabilities is more remarkable in developing countries than in developed countries. In 13 of these countries, self-employment rates for people with disabilities are at least five percentage points higher than those without disabilities. The UN [50] also states that many of these people with disabilities work for their families.

![Figure 1: Percentage of employed persons with disabilities who are self-employment, by disability status (2002-2017)](image)

The reasons that point to exploring the work for people with disabilities are justified by the effects that work causes in these people’s lives. Once they leave the social isolation condition and dependence on others, to create their bonds in other spaces, with other people and performing other activities [28]. Offering opportunities for these people to get in the job market does not only represent the act of
preaching a more just and equity society but represents a fundamental transformation in the lives of these people, their families, the companies themselves and society as a whole.

2.5 RELATED WORKS

Burgstahler and Ladner [9] argue that efforts to increase the participation of people with disabilities in the high-tech sector benefit both society and computing area [9]. Moreover, Ladner and Com- den [26] relate the critical representation of people with disabilities (PWD), in the area of computer science and information, within universities and in graduate programs.

Bellman et al. [6] current practices so that people with disabilities can, through experimentation and professional experience, achieve inevitable success in their careers.

Leddy [27], demonstrates in his work the importance of advancing assistive technologies to make the job market more attractive. The author also highlights the interest of people with disabilities in pursuing science and technology.

A literature review carried out in this research identified the lack of research that relates people with disabilities to software development. The analyzed articles present a general discussion, demonstrating human and social aspects, labour market or academy, for people with disabilities in the area of technology. Thus, this work aims to promote the debate on this scenario and propose a set of improvements in agile practices to help people with disabilities carry out their activities within the software development sector.

3 RESEARCH METHOD

This research can be classified as exploratory research [25], with a qualitative approach. This section presents the planning research stages, consisting of a bibliographic survey, analysis of articles and structuring of practices found, interviews with specialists, and evaluation by specialists. Figure 2 illustrates the steps taken to carry out this research. Hereafter, a detail about each step is presented.
3.1 BIBLIOGRAPHIC SEARCH

The state-of-the-art investigation was restricted to the sources present in Table 1, to identify works that present techniques used by agile development teams and research related to social inclusion in software and computer engineering.

<table>
<thead>
<tr>
<th>Engine</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE Xplore Digital Library</td>
<td><a href="https://ieeexplore.ieee.org">https://ieeexplore.ieee.org</a></td>
</tr>
<tr>
<td>Springer Link</td>
<td><a href="https://link.springer.com">https://link.springer.com</a></td>
</tr>
<tr>
<td>Science Direct</td>
<td><a href="https://www.sciencedirect.com">https://www.sciencedirect.com</a></td>
</tr>
<tr>
<td>ACM Digital Library</td>
<td><a href="https://dl.acm.org">https://dl.acm.org</a></td>
</tr>
<tr>
<td>Google Scholar</td>
<td><a href="https://scholar.google.com">https://scholar.google.com</a></td>
</tr>
</tbody>
</table>

We restricted the search for papers between the years 2001 to 2018. We created two searches’ strings using the following terms: "people with disabilities and computing", "people with disabilities and software engineering" and "disabled people and software engineering". The string was used to identify works related to PCD in software development. However, we identified little and limited evidence of related work when applying the string. Regarding agile practices, we apply the search string: ((practices OR techniques OR methods) AND ((agile team OR agile project OR agile development) OR (XP OR SCRUM))). The union of the two strings did not return results, so the two searches were considered separately. Thus, first, it analyzed the practices and then the work related to the human aspects.

Initially, we checked the titles and abstracts of the selected articles. Then, the articles were read in full. Thus, a total of 99 articles were selected and analyzed.

Therefore, we grouped and analyzed the agile techniques or practices cited in the selected papers. A total of 261 agile techniques or practices were found. Thus, the repetitions were removed, and a grouping was performed considering the practices with more than ten citations. This resulting set was presented and evaluated by professionals who apply agile methods. Table 2 presents these groupings example, where #Cit. means the number of citations we found on the literature.
Table 2: Most cited agile practices and their synonyms.

<table>
<thead>
<tr>
<th>Practice</th>
<th>Literature Synonym</th>
<th># Cit.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Meeting</td>
<td>Daily Scrum Meeting / Sprint meeting</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>/ Frequent meetings / Stand Up Meeting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>/ Status meeting</td>
<td></td>
</tr>
<tr>
<td>Pair Programming</td>
<td>Pair programming</td>
<td>41</td>
</tr>
<tr>
<td>Planning meeting</td>
<td>Planning meeting / Sprint planning /</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>iteration planning</td>
<td></td>
</tr>
<tr>
<td>Continuous Integration</td>
<td>Continuous Integration</td>
<td>38</td>
</tr>
<tr>
<td>Sprint Review</td>
<td>Sprint review / iterations review /</td>
<td>36</td>
</tr>
<tr>
<td>Backlog</td>
<td>backlog / product backlog / sprint</td>
<td>34</td>
</tr>
<tr>
<td>Retrospective</td>
<td>Retrospective</td>
<td>23</td>
</tr>
<tr>
<td>Refactory</td>
<td>Refactory / database refactoring</td>
<td>11</td>
</tr>
<tr>
<td>TDD</td>
<td>TDD</td>
<td>26</td>
</tr>
<tr>
<td>On-Site Customer</td>
<td>On-Site Customer</td>
<td>25</td>
</tr>
<tr>
<td>Customer Simple Design</td>
<td>Simple design / Simplicity in design</td>
<td>21</td>
</tr>
<tr>
<td>Collective Ownership</td>
<td>Collective Ownership</td>
<td>21</td>
</tr>
<tr>
<td>Planning game</td>
<td>Planning game</td>
<td>20</td>
</tr>
<tr>
<td>Progress Monitoring</td>
<td>Burn-down chart / Monitoring of a progress</td>
<td>19</td>
</tr>
<tr>
<td>Relative Estimation</td>
<td>Relative estimation / planning poker /</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>effort estimation / measure flow / story</td>
<td></td>
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<tr>
<td></td>
<td>points</td>
<td></td>
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<tr>
<td>Test</td>
<td>Test / database testing</td>
<td>19</td>
</tr>
<tr>
<td>Code standards</td>
<td>Code standards</td>
<td>18</td>
</tr>
<tr>
<td>Metaphor</td>
<td>Metaphor</td>
<td>17</td>
</tr>
<tr>
<td>User Story</td>
<td>User Story / Story Cards</td>
<td>15</td>
</tr>
<tr>
<td>40 Hour Week</td>
<td>40 hour week</td>
<td>14</td>
</tr>
<tr>
<td>Customer Feedback</td>
<td>Customer Feedback</td>
<td>13</td>
</tr>
<tr>
<td>Acceptance Test</td>
<td>Acceptance Test</td>
<td>12</td>
</tr>
<tr>
<td>Test</td>
<td>Small release</td>
<td>12</td>
</tr>
<tr>
<td>Small Release</td>
<td>Small release</td>
<td></td>
</tr>
<tr>
<td>Kanban Board</td>
<td>kanban game / tasks kanban / kan-</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>ban board</td>
<td></td>
</tr>
</tbody>
</table>

3.2 EXPERTS INTERVIEWS

For the interviews, professionals working with any agile method for at least one year were selected. Professional interviews were conducted from different country regions (Recife, Florianopolis, Rio de Janeiro and Curitiba). The interviews allowed the construction of knowledge about the perspective of inclusion, its challenges, and the human aspects involved in each practice.

To support the interviews, we elaborated two semi-structured interview protocols, the first to address PWD who work in the software development sector, presenting five specific areas: (a) Personal and
company-related issues, (b) Questions about Inclusion in Agile Teams, (c) Questions related to challenges faced by agile teams due to lack of Inclusion, (d) Questions about Inclusion techniques and strategies, and (e) Extra questions. The second protocol was built to address managers who have had the experience of coordinating at least one PWD in a project. This protocol presents three specific areas: (f) Demographic Issues, (g) Targeting Issues and (h) Issues related to Practices Agile. Both protocols can be consulted online. In addition, we created a contact form in order to engage the interviews online. This form was sent to a PCD group working in the IT sector, which contains more than 200 professionals from all over the country. However, many PWD professionals were contacted, among the various groups of disabilities currently recognized, only the visually impaired accepted to participate in the research.

All interviews were audio-recorded so that the authors could revisit the information collected in order to align the work with the interviewees’ considerations.

3.3 TECHNIQUES ADAPTATION PROPOSAL

This step aimed to analyze and adapt the practices found in the literature based on the results of the interviews. It allowed to introduce or highlight the theme of Inclusion to do practices that facilitate the Inclusion and integration of PWDs within the teams. After this adaptation, a catalogue of inclusive agile techniques was generated, containing suggestions and difficulties pointed out about applying the practices presented during the interviews.

3.4 EXPERTS EVALUATION

Practices were presented, discussed, evaluated, and adjustments were made based on expert feedback. The following were raised: the aspects on which it can be said that the practice in question facilitates inclusion; the tips and recommendations for the application of the practice aiming at such inclusion; understanding of the common challenges presented for each practice and suggestions for improving the work. Only three agilists took part in the assessments, with one PCD and two managers (No PCD).

Finally, the data collected in the phases of article analysis, inter-views and evaluation were analyzed together, allowing the structuring of a catalogue of techniques to support inclusion initiatives within agile teams.
4 RESULTS

4.1 AGILE PRACTICES ACCORDING TO THE LITERATURE

After analyzing the 99 selected articles, initially, it was possible to identify 261 agile practices present in the literature. Most agile practices found in the literature are connected to Project Management (GPR). Although, among the practices with at least ten citations, there are those that offer support for both Product Design and Construction (PCP), Product Integration (ITP), the review and tests contemplated by Verification (VER), as is the case of Pair Pro-gramming with 41 citations and Test-Driven Development (TDD) with 26 References.

Figure 3 presents the practices with more than ten citations grouped by MR-MPS-SW:2020 design process [47] (GPR, PCP, ITP, VER, Validation - VAL, Management of Configuration - GCO and Requirements Engineering - REQ) and a Process Management organizational process (GPC).

To facilitate the interviews, only the practices that were mentioned in 20 or more different articles were prioritized, generating a set of 13 agile practices, as shown in Figure 4. As most of the practices are related to project management, project managers who have PWD in their teams were also considered in the interviews.
Thus, during the interviews, the second author sought to discuss with the interviewees how to identify the perspective of inclusion using agile practices. With this, points were raised related to: (i) because the practice facilitates inclusion; (ii) what tips and recommendations do you suggest for applying the practice?; (iii) what challenge is associated with applying the practice?

In this way, the participants were asked about using agile practices with team members with a disability, if they saw difficulties if their team decided to start using such a technique or even possible improvements to make them inclusive.

4.2 RESPONDENTS PROFILE

We conducted five interviews from October 10th to November 10th, 2019. Participants in the interviews represented a total of 4 different companies.

Table 3 presents the profile of each of the 5 interviewees (E), if they work or worked in projects that used some agile method (AM), if they have already worked with PWD in any project (WorkPWD), highlighting the position held in the project (Position), whether the interviewee in question is a PWD or even, what disability he has or has worked with, if not (WhatPWD). Among the positions, respondents were Project Manager (GP), Software Engineer (ES), Agile Coach (AC) and Chapter Leader (CD).

<table>
<thead>
<tr>
<th>E</th>
<th>MA</th>
<th>WorkPWD</th>
<th>Position</th>
<th>PWD</th>
<th>WhatPWD</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Yes</td>
<td>Yes</td>
<td>CL</td>
<td>Yes</td>
<td>Visual</td>
</tr>
<tr>
<td>E2</td>
<td>No</td>
<td>No</td>
<td>ES</td>
<td>Yes</td>
<td>Visual</td>
</tr>
<tr>
<td>E3</td>
<td>Yes</td>
<td>Yes</td>
<td>AC</td>
<td>Yes</td>
<td>Visual</td>
</tr>
<tr>
<td>E4</td>
<td>Yes</td>
<td>Yes</td>
<td>GP</td>
<td>No</td>
<td>Hearing impaired</td>
</tr>
<tr>
<td>E5</td>
<td>Yes</td>
<td>Yes</td>
<td>GP</td>
<td>No</td>
<td>Hearing impaired</td>
</tr>
</tbody>
</table>
Table 4 presents information from each of the 4 companies regarding the approximate number of employees (Num), regarding the existence of PWD in development teams (nPWD), type of organization (Type) and location (City) and the respective interviewees who represented them in this research.

<table>
<thead>
<tr>
<th></th>
<th>Num</th>
<th>nPWD</th>
<th>Type</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>200</td>
<td>1</td>
<td>Multinacional</td>
<td>Florianópolis</td>
</tr>
<tr>
<td>E2</td>
<td>300</td>
<td>3</td>
<td>State-owned</td>
<td>Rio de Janeiro</td>
</tr>
<tr>
<td>E3</td>
<td>Não identificado</td>
<td>3</td>
<td>Multinacional</td>
<td>Rio de Janeiro</td>
</tr>
<tr>
<td>E4</td>
<td>640</td>
<td>5</td>
<td>Institute</td>
<td>Recife</td>
</tr>
<tr>
<td>E5</td>
<td>640</td>
<td>5</td>
<td>Institute</td>
<td>Recife</td>
</tr>
</tbody>
</table>

4.3 INTERVIEW RESULTS

For the execution of the interviews, we used two protocols \(^3\) were used as a guide for the execution. The first guided the semi-structured interviews and was used in interviews E1 and E2. The second presents a protocol for a dynamic with participants E3, E4 and E5.

The dynamics consisted of separating a group of 20 agile practices, arranged on pieces of paper, into three different containers, representing (i) whether the practice facilitates inclusion, (ii) whether it is neutral, or (iii) whether it does not facilitate inclusion. The practices that the participant did not know, were presented by the second author so that the interviewee could choose them. The performance of the dynamics with E3 took place orally, with the items defined in the papers being verbally described and asking which would in what group.

All interviewees stated that keeping communication aligned is an obstacle that the team must overcome together. In addition, they highlighted the understanding pains and needs of teammates and helped them in the continuous evolution that generates a trusting relationship.

For E3, E4 and E5, promoting workshops or classes with all team members so that they learn to communicate in sign languages if that is the need is essential. The respondents agreed that using written models and targeted eye contact, as well as the use of representative objects, facilitates the day to day within the team.

According to E1, E2 and E3, promoting an accessible work environment is an arduous task, especially if the team and PWD are inexperienced. In addition, for the interviewees, the dissemination of knowledge in an adequate way as a challenging factor, among the reasons communication is pointed out as a limiting factor since the interaction between PWD and other team members still fails in most scenarios.

In addition, E4 and E5 mention that conflicts can also be generated by the agile practices themselves, indicating low performance or individual-to-individual engagement. In these cases, the man-
ager must protect such data and focus on information directed to the team, as he understands that the teams’ success implies each member’s success.

E3 emphasizes that some practices repetition, such as the retrospective, sometimes becomes monotonous and uninteresting to perform. This happens due to the difficulty in finding a varied number of dynamics that can be correctly adapted to the context of the PWD individual, whether with visual impairment, hearing impairment or even with motor limitation.

Therefore, given the challenges, with the data presented by the interviewees, we present the suggestions in Section 5.

4.4 ADAPTATIONS AND EVALUATIONS

Based on the results of the interviews, practices were adapted and re-prioritized. Some of them were removed due to the interviewee’s observations, who pointed out that such practices were not correlated to the process of interaction, integration and continuous inclusion of people with disabilities in the project.

Practices removed from the catalog were: Yesple Design, Code Collective Ownership, Continuous Integration, Refactory, TDD (Test Driven Development) and Backlog (Product/Project Activity List). Although both the interviewees and the authors of this article recognize the importance of software development practices, as they directly facilitate the inclusion of people with disabilities in the project, they were excluded from the catalogue.

In addition, the practices Workshop and Coding Dojo (Coding Challenges) emerged in the interviews as necessary aligned for the engagement of people with disabilities. With the practices catalogue adapted, following the experts’ recommendations, a new evaluation of the adapted practices was carried out, the final result is presented in Section 5.

The evaluations showed that agile practices help to renew team’s energies and engagement. It was evident that with the use of agile practices it is possible to have a greater focus on people with disabilities. For the participants, the practices adaptation for team involvement directly influences how the team develops its activities. Any error or misinterpretation can directly impact the team members, and consequently, the project success. Finally, the practices that were scored as not facilitating the inclusion process were re-introduced to the respondents, where they were asked how it would be possible to adapt or improve them to make them more inclusive.

For this research, the 3 feedback reviews, in the period from 4th to 22nd November 2019, were also included in the results presented in Section 5.
5 AGILE PRACTICES AS INCLUSION TOOL

The following sections condense the agile practices selected for this work after the interviews and assessments were performed.

5.1 DAILY MEETING

Daily meetings favour several human aspects within software engineering, jointly and in a single moment. For E1, E3 and E4, they directly contribute to the team’s interaction through communication, assist in the conflict resolution process, risk identification and management, and expectations of activities, all of these aspects being supported by the communication pillar.

E4 pointed out that the daily meeting is an opportunity to integrate people with disabilities and team members, generating trust, which is one of the crucial factors for the project success. Thus, we have identified some actions to facilitate communication in teams that have people with hearing impairments, such as:

- Provide a sign language interpreter to accompany meetings (when available);
- Provide a signal guide for each team member - starting at team training and admission;
- Look directly at the individual and speak slowly, so that he can lip-read, given the individual’s disability;
- Use conference tools, with headphones, so that people with hearing loss can understand what is being discussed;
- If there is a physical disability among the team members, run the meeting with all the members seated in a group, forming a circle.

Moreover, if there is a visually impaired team member, it is recommended that the information passed by each team member be more affluent in detail so that there is a greater understanding by the individual and everyone who makes up the team.

At last, when the meetings are remote, make sure that only one person speaks at the time and all imagens, models, diagram must be explained not only presented. Besides, software for transcription or translation into sign languages was suggested.

5.1.1 References: [1, 32, 46], E1, E3 and E4.
5.2 PAIR PROGRAMMING

According to E1 and E5, pair programming can be used to bridge interaction with the team. Also, it is as the individual interacts with another individual daily to complete their activities. Several human aspects can be worked through this practice, such as problem solving, analytical thinking and also communication, thus generating motivation and individual engagement with the project and with the team, as pointed out by E1, E3 and E5.

For the interviewees, if the PWD is visually impaired, it is vital to reinforce the importance of always maintaining direct communication with the pair and narrating in great detail. For hearing impaired members, in order to maintain fluid communication, it is necessary that both adopt the same language, use more written models or eye contact, use sign languages, and practice the act of speaking slowly so that the member with a hearing aid can read lip movements.

5.2.1 References: [1, 13, 46], E1, E3 and E5.

5.3 PLANNING

As presented by E2, in the planning meeting, each individual has their voice, ensuring that everyone hears their opinion. E1 and E2 also address that the planning meeting is a time to expose ideas and demonstrate the ability and understanding of what is being posed as a challenge, mainly addressing human aspects such as negotiation, analytical thinking and risk and expectations management.

To overcome the challenges, a “Token” was suggested. This technique consists of using an object that symbolizes that the individual who it, has the turn to speak, and the other participants in the meeting must listen.

The needs of the PWD member must also be evaluated when estimating/prioritizing the functionalities, using visual objects as a representation of cards, for example, when it is a hearing impaired person or, each one verbally presenting their estimate, when it comes to a visually impaired person. It is also a valid recommendation if accessibility tools are not used.

It is also possible to consider the presence of a sign language interpreter (given the availability within the organization) to participate in the meeting to facilitate communication to the PWD member of the team.

5.3.1 References: [1, 5, 46, 54], E1 and E2.
5.4 REVIEW

E1 comments that the evaluation meeting (the review) allows individuals to interact and understand the expectations of the customer and the users about what they have developed based on the project requirements—addressing in this issue the sustainability aspect of the activities and the project, considering the environmental and long-term effects. This perspective is critical to increase confidence in the work developed and in the team itself and make the client understand the needs and how the team develops its activities and delivers its results, as discussed by E1 and E3.

This practice challenges the awareness creation among the meeting participants, who are not directly members of the team, especially the client, that care is necessary, such as the occasional use of a microphone, improving sound perception and avoiding speech overlap. A second challenge is also to make the team understand and empathise when, in turn, the client is an individual with a disability.

5.4.1 References: [1, 18, 39, 54], E1 and E3.

5.5 RETROSPECTIVE

E1 and E3 express that as the retrospective is a moment that promotes pure integration between all those present and that several human aspects are linked to this practice. Both also pointed out that analytical thinking about the process is necessary, as well as being able to identifying risks and negotiating among the team ways to solve identified problems, all this on the pillar of communication.

E3 also addresses that empowering the team on how it can adapt and seek self-improvement and high performance makes this practice a great ally in the process of inclusion within the team.

Thus, finding a varied number of dynamics that adapt to the need or that can be correctly adapted to the context of the PWD individual is the most challenging factor for this practice since the repetition of techniques makes this practice monotonous and uninteresting.

5.5.1 References: [33, 39, 40, 54], E1 and E3.
5.6 EFFORT ESTIMATION

E1 points out that working with the team’s history is essential to evolve the team’s maturity; knowing each one’s speed facilitates predictability for the estimates. E1 and E3 consider that the human aspect of negotiation is highly present in this practice, as everyone must come to a joint agreement on the estimate given to activity. This estimation process involves team members discussing the challenges they will face in the following work cycle, and these moments of interaction between members are crucial for the alignment of communication between the team, as presented by E4 and E5.

Making use of the appropriate tool and ensuring that the individual with a disability feels inserted within the process and within the team is the challenge in question. In the initial moments, when not finding a suitable tool or method to carry out the estimation, sign language interpreter can be included in the team, if necessary (given the availability of the organization), or follow the estimation process only by dictating it orally, team member by team member, one at a time.

5.6.1 References: [1, 21], E1, E3, E4 and E5.

5.7 WORKSHOP

E1, E2 and E3 comment that this practice helps in a collaborative construction, which each member has space to give an opinion on what is being presented. Each team member who is presented with the theme has the need to mediate and lead the meeting, also developing leadership skills in addition to communication. Thus, it is necessary to always consider preparing suitable material and format, so that those who have any special needs feel comfortable and are able to properly understand its purpose.

5.7.1 References: [48], E1, E2 and E3.

5.8 CODING DOJO

E1 and E2 point out that this practice also helps the team’s technical evolution through programming challenges and teamwork. Aspects such as analytical thinking, problem solving and leadership are worked through this practice, seeking to improve the team’s level of engagement and collaboration with the challenges faced in the activities. In addition, E1 and E4 also mention that it is necessary to value communication between the team to solve such a challenge in the defined time. Thus, this practice helps both in the development of the integration of people in the team and in their technical evolution.

5.8.1 References: [30, 41], E1, E2 and E4.
5.9 DISCUSSION AND RECOMMENDATIONSS

Through interviews and information crossing, we could confirm that the agile practices align with human aspects development within software engineering for people with disabilities. This perspective is observed in the context in which the inclusion and integration of PWD is the central factor; that is, through the survey made, it can be observed that such practices not only promote certain aspects, but that these aspects are crucial for the effective search for inclusion and integration of PWD within agile teams.

It was also possible to observe that agile practices already help promote an environment of facilitation within a team when well used and following their primary objectives. However, this considers promoting diversity in terms of cultural and professional skills, leaving aside social inclusion. In turn, it is necessary, as well punctuated by the interviews, to adopt aggregating artifacts to the processes to help with the practices. Therefore, to understand the needs of individuals and thus provide a welcoming environment and processes for each and every professional. It was then discovered that looking directly at the human aspects and how individuals permeate these aspects within the daily work in their teams is a key so that inclusion and integration can be guaranteed within agile teams, projects, and the organization itself.

If there are people with hearing impairments on the team, some actions can be taken to facilitate communication and other human aspects:

- Look directly at the individual, and speak slowly so that he can lip-read (E1, E2, E3, E5);
- Using conference tools, with headphones, so that people with hearing loss can understand what is being discussed (E1, E2, E4);
- Make use of visual tools to represent actions or decisions to be taken together in moments of practice or meetings, which can be in a dynamic format, proposed by the project manager (E4, E5);
- Use microphones to improve sound quality during meetings, if the PWD has a level of hearing loss that still facilitates understanding through hearing aids (E3, E4);
- Remember the individual who has a hearing aid that they should have extra batteries for their device in the work environment (E4, E5);
- Provide a sign language interpreter to accompany the meetings, considering favourable conditions for the organization (All interviewees);
- Provide a sign language guide for each team member (E1, E2, E3, E4);
E1 and E2 explain that, if among the team members there is a person with a physical disability, as a recommendation, the meetings can be held with all the members sitting in a group, forming a circle, and using dynamics and actions that involve their primary abilities and leave their limitations in second perspective. It is necessary to remember that the work environment must be thought out and planned so that it values accessibility, favoring comfort for the physically disabled individual.

At last, if there is a visually impaired team member, some recommendations also pointed out by the interviewees that can facilitate the inclusion process:

- It is recommended that the information provided by each team member more affluent in detail, so that there is a greater understanding of those who makes up the team (E1-E5); Use dynamics that involve verbal use, dictating, for example, estimates or scores (E1-E5);
- The use of physical objects during practices or ceremonies, to represent either the order of speech or who can talk at that moment, within a proposed dynamic (E1, E2, E4);
- Use microphones to improve sound quality during meetings (E1, E2, E4);
- Respect each individual’s speech moment (E1-E5).

E3, E4 and E5 reinforced that providing PWDs with development tools that facilitate accessibility, as well as other online tools that are accessible, to carry out the project activities and the practices used in it are also necessary accessibility and inclusion requirements.

The competitive environment can be managed through certain agile practices, due to models that can be gamified and used in a positive way, for the evolution of each member, seeking avoid conflicts. E2 reinforce that the empowerment moment is worth it, it is necessary that each member of the team has the understanding that people with disabilities have full capacity to deliver results and teamwork. With adequate support, is fundamental for the team to overcome their challenges themselves.

E1, E3 and E5 show that when the practice includes a demonstration, it is necessary to carefully describe in maximum detail everything that is being done, so that, if a visually impaired person is present, he/she can have full understanding of what is being done.

E3 also points out that it is vital to have the awareness of the scenario, to identify how each individual reacts bodily to the dynamics. This can help to detect if the individual is feeling uncomfortable, nervous, irritated, uncomfortable, with the situation, with the method or even with team members.

The team size was considered a hindering agent in those practices involving meetings. Communication is very challenging for those with vision or hearing loss, as discussed in the interviews. E5 pointed out that cases in which PWD individuals can make use of their limitations as a
factor to continue being directed to low-complexity activities, even if they have evolved technically, are also not excluded. However, the preconceptions could drive the same low-complexity activities to the PWC.

6 FINAL CONSIDERATIONS

Currently, there are many works in the literature explaining and discussing agile practices in different types of software projects, such [3, 23, 24] among the 99 articles analyzed in this work. However, there are few works related to social inclusion within software engineering, among them [6, 9, 26, 27]. Diversity enriches society and is encouraged by companies that adopt agile methods to guarantee different views and experiences, thus helping to create innovative solutions [43]. This work sought to contribute within this perspective by answering the research question "how to insert and integrate people with disabilities into agile teams?".

In addition to surveying the most cited practices in the literature, it was analyzed what is actually used in the software development market. Some challenges faced to facilitate the inclusion of members with disabilities within these teams through agile practices were also presented. The research in question points to a large contingent of agile practices associated with project management. In this perspective, in addition to PWD professionals, project managers who have or have had PWD professionals in their teams were also involved in this debate.

Based on the results obtained, it can be seen that the techniques used by agile teams, most referenced in the literature, are well accepted in the market, where research participants pondered their experiences about each practice and their use within projects of software development. Research participants pointed out that in meeting-based techniques, one should always consider the presence of a sign language interpreter, who has the correct ability to transmit technical terms necessary for the knowledge of individuals, if this is their need, in addition to it becomes necessary that the framework or tool used to monitor the project itself must essentially be inclusive.

Despite this, the incidence of some challenges related to inclusion in agile environments could also be confirmed: organizations themselves often do not provide adequate infrastructure aimed at accessibility, whether physical infrastructure or related to the work environment itself and tools necessary for daily use. For the execution of activities in the projects; in addition to the communicational aspect, most of them have flaws, whether in the transmission of information to the PCD individual or even when the individual needs to transmit certain information to the team. This problem directly impacts others, such as the dissemination of knowledge and even teamwork.

It was also possible to obtain an overview of how government policies address the context of inclusion of people with disabilities in the professional environment and how the impact of inclusive diversity can add
more excellent value to agile teams and, on the other hand, positively change the lives of PWD individuals. In addition, it was also observed how human aspects directly influence agile practices and how they can be allies in the process of inclusion and integration within teams.

6.1 FUTURE WORKS AND LIMITATIONS

The results obtained by this work are limited by the low number of PWD within the software development environment. The participant’s sample size and the number of organizations involved in the survey are irrelevant to generalizations about the actual inclusion scenario of agile teams. This study also presented several difficulties that limited the scope of the study. For example, about 18 software development organizations responded that they were not available to address the theme or receive a visit.

Contact was also made with the national community of PD who work in the technology area, with more than 200 people from the country, using a contact form to schedule online meetings. However, only one person answered the form, which can be taken as a low engagement, also considering the opinion of the PWD interviewee who answered the contact form.

Finally, this work hopes to leave the seed of the importance of unfolding the concept of a multidisciplinary team to also involve PWD. Including a process review to embrace these people and pointing out the organizational policies that highlight the relevance of this cause.

In this context, as a direction for possible future work, we highlight the need to broaden the horizons of research for practitioners of agile methods from other technological centers and regions in order to identify new perspectives on how agile teams have treated inclusion; The perspective of agile management focused on inclusive practices; Questioning about inclusive practices amid business management; Addition of the PWD perspective on the selection process in a humanized and inclusive way; In-depth assessment of software engineering human aspects and PWD, mapping and correlating this relationship; Encompass research from the perspective of cognitive/intellectual disabilities; and Application and evaluation of the practices catalog itself in a company.
REFERENCES


