Towards an approach to conflict assessment in software teams

Aline Barbosa[1][0000-0003-3273-2890] and Maria Lencastre[1][0000-0002-8032-8801]

[1] Universidade de Pernambuco, Brasil
[afb, mlpm]@ecomp.poli.br

Abstract. [**Background**] Conflicts are inherent in human relationships; people have different experiences, values, opinions, and ways of carrying out tasks, which can lead to disagreements. The composition of a software development team has a heterogeneity of individuals with different competencies, which impacts their interaction. Conflicts in the software development cycle are inevitable and can occur at any stage; if not well managed, they tend to generate adverse results and financial and time expenses. [**Objective**] In this thesis proposal, we aim to create an approach for evaluating the maturity of conflict management and prevention in software development environments; this occurs based on the analysis of a set of well-established metrics and extracted indicators. [**Method**] Initially, a Systematic Literature Review (SLR) was carried out to verify the state of the art on conflicts and their management in software development. After, a proposal is built to consider ways of identifying the team's level of maturity in terms of conflicts treatment; this evaluation includes an analysis of applied forms of conflict prevention and management and variables that point to high impacts on project success. Also, we want to analyse team members' symptoms that stand out at any given time, as they usually represent a thermometer of conflict problems. Finally, the approach will be validated in a work environment. [**Expected results]** An approach that supports the conflict assessment and management in software teams. [**Conclusions**] The proposed approach aims to help track a team's functioning during the software development life cycle, supporting team managers in a new way to guide the team appropriately.

Keywords: Conflict, Conflict Management, Software engineering.

Nível: Doutorado

Ano de entrada no programa: 2019.2

Data esperada de conclusão: 2023.2

1 Introduction and Problem Characterization

Software development can be considered a complex process between persons in different roles, usually represented by teams formed by individuals with diverse personalities, skills, and knowledge aiming to create complex products and services [1] [2].

In the context of Software Engineering, specifically in Requirements Engineering (RE), there are numerous social interactions, which require a high level of cooperation and empathy between people who generally have different personalities, values, and interests. According to [3], among the competencies identified for a requirements engineer are empathy, communication, conflict resolution, and moderation. However, not all these skills are always found in professionals who work or contribute to the area.

In software development, work's unpredictable and evolving nature makes it a fertile ground to generate conflicts between those involved. De Dreu et al. [4] define conflict as a process resulting from the tension between team members because of real or perceived differences. Complementing this, Jiang et al. [5] indicate that "team conflict exists in all work, as long as there are teams". Conflicts can arise between employees, an employee and a supervisor, teams, or departments, or at an inter-organizational level [6]. These conflicts are sometimes a consequence of the diversity of worldviews, belief systems, personal ego, perspectives, and origins.

The literature describes a strong relationship between conflicts, work, and organizations. Organizations need to pay attention to conflicts' causes and intervene in those situations to improve the team and organizational performance [7]. In the framework presented [8], conflict is described as a variable that influences the performance of teams and the satisfaction of individuals in software development. According to Jiang et al. [5], team conflict has impact on employee satisfaction, which can lead to a significantly bad influence on task performance, and this is not what teams want to maintain.

Conflicts exist within or around groups of people who share differences in goals, opinions, and attitudes and, therefore, can influence behaviour within the group [9]. Leaders are interested in effectively structuring teamwork. It is essential to understand and engage with conflicts, so that teams can gather the variety of knowledge and perspectives of each member to deal with the most complex situations to which they are subjected.

There is a considerable body of research on the conceptualization and effects of conflict in software teams [10] [11]. However, there is a need to better understand the conditions under which teams and their collaborators face conflicts in a software project [12], and to be able to diagnosis what kind of problems the teams are facing. In this scenario, there is a lack of discussions about the assessment of the maturity of the software development team to deal with and prevent conflicts; this analysis could help the team avoid more significant effects on the team itself, clients, and the project. Therefore, this justifies the development of research focused on producing in-depth knowledge about this factor and its use in the software industry.

In this thesis proposal, we aim to create an approach for guiding and giving support to trace and evaluate the functioning of teams in the context of software development. Based on a set of well-established metrics, we aim to extract indicators about the team's maturity in terms of conflict management and prevention; also, we want to analyse symptoms that stand out at any given time, as they usually represent the existence of problems. So, the proposed approach will help track a team's functioning and guide it during the software development life cycle.

2 Background

Conflict is understood as any type of opposition or antagonistic interaction originated by several reasons, such as different values, resources, or social position and power dispute [7]. The word conflict is related to divergence, discord, dissonance, controversy, or antagonism [2]. According to Kofman [13], being human implies having conflicts, they are part of human nature, and it is inevitable to escape from our needs, fears, selfishness, and annoyances.

Conflicts can have either a positive or a negative impact on teams. As for their classification, they can be divided into two: functional conflict and dysfunctional conflict. Functional conflict is a healthy and constructive disagreement between groups or

individuals, while dysfunctional conflict is an unhealthy disagreement that occurs between groups or individuals [14].

2.1 Conflict Process

For Robbins [7], conflict is "like a process that begins when one of the parties perceives that the other party affects, or can affect, negatively something that the first one considers important". As conflict is considered a difficult process to contain, the more it evolves, the faster it will spread. Next, the five stages of the conflict process described by [7] will are presented.

Stage I. Potential opposition or incompatibility: the first step is to identify the causes, sources, or conditions which are opportune for the emergence of the conflict. Robbins [7] separates into three general categories:

- Communication: is related to the insufficient exchange of different information, noise in the communication channel, premature evaluation of the message, or interruption.
- Structure: issues related to the organization's own structure. The causes may be related to several sectors of the same organization with different types of guidelines, norms, and standards: internal disputes between units with functions.
- Personal variables: include each person's values, images, and personality characteristics. As such, differences in value systems such as judgments and disagreements are an important source of potential risks

Stage II – Cognition and Personalization: if the antecedent conditions of Stage I affect the interest of one of the parties, the definition of the opposition or incompatibility - which is the conflict - is carried out in Stage II.

- Perceived conflict: the very definition of conflict is that one of the parties involved needs to be aware of the existence of antecedent conditions, that is, to have the perception that something has happened [7].
- Feeling conflict: when people become emotionally involved, that is, when the parties experience anxiety, tension, frustration, or hostility. Emotions play a leading role in the configuration of perceptions: negative emotions – produce an excess of simplification of questions, decreased trust, and negative interpretations of the other.

Stage III – Intentions: the intentions refer to decisions to act in a certain way; for this, Robbins uses two dimensions: Cooperation (the degree to which one of the parties also tries to satisfy the interests of the other) and Affirmation (the degree to which one of the parties tries to satisfy the other's interests) [7]. Five techniques can be considered:

• Competing: when a person pursues his own interests, regardless of the impact this will have on other parties to the conflict.

• Collaborate: when the conflicting parties want to satisfy the interests of both, we have a situation of cooperation and the search for mutually beneficial results.

• Avoid: the person recognizes that the conflict exists and tries to suppress it or get rid of it.

• Accommodating: when one of the parties seeks to appease the other, it may be willing to put its interests before yours; that is, one of the parties may sacrifice itself to maintain the relationship.

• Concession: when each party in conflict gives up something, sharing takes place, which leads to compromise.

Stage IV – Behaviour refers to explicit attempts to implement intentions (Stage III), including the following stimuli: statements, actions, and reactions of the conflicting parties [7]. The behaviour has several points of view according to its intensity, they are: (1) Mild disagreements or misunderstandings; (2) Explicit questioning or challenge; (3) Verbal attacks; (4) Threats and ultimatums; (5) Physical aggression and (6) Explicit efforts to destroy the other party. When at lower intensity, conflicts are categorized as mild, whether disagreements or misunderstandings; this is where functional conflicts meet. As the intensity increases, conflicts are categorized as destructive/dysfunctional, that is, strikes, revolts and wars are at this higher level.

Stage V – Consequences: The last stage generated by the conflicting parties' actions and reactions (behaviours) result in consequences that can be functional or dysfunctional [7]. Functional consequences are forces that contribute to improving group performance, increasing the quality of decisions, and stimulating creativity and innovation; they prevent the group from making decisions based on weak premises without considering the relevant alternatives [7]. On the other hand, the dysfunctional consequences are destructive forces of the conflict on the performance of the group, diminishing its effectiveness; the main consequences are a mismatch in communication, reduction of cohesion, subordination of goals to priorities that are in conflict [7].

3 Research Methodology

This session describes the research strategy to be followed for the thesis proposal. Figure 1 describes the main steps.

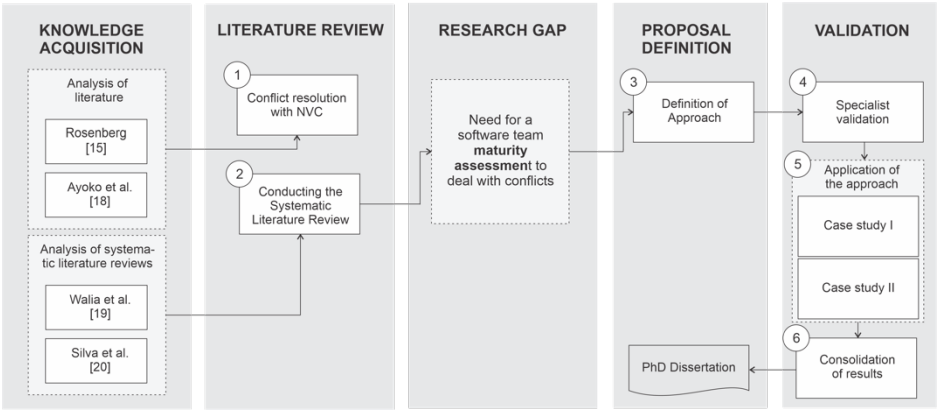

Fig. 1. Research Phases

Knowledge acquisition: this phase is dedicated to acquiring knowledge about conflicts. For this, we used a basis study by leading researchers in the area, such as Ayoko et al. [18]; they dedicated their work "Handbook of Conflict Management Research" to detailing the conflicts in the most diverse visions. In parallel, Rosenberg's book [16] with the Non-Violent Communication (NVC) technique contributed to the understanding of the possibilities that effective communication can contribute to conflict resolution. Also, the analysis of systematic literature reviews [19] and [20] contributed to understanding how conflicts are studied in software development environments.

Literature review: In this step, we ran different searches on scientific databases to investigate the application of NVC in software development environments; however, the results were not promising. We also conducted a new systematic literature review (RSL)

to provide an overview of studies related to conflicts in the context of software development. We did this using the string: (“Conflict” OR “disagreement”) AND (“software” OR “information technology” OR “agile team” OR “agile development”). Moreover, we specifically collected evidence on the antecedent, management, and impacts of conflicts on software teams and projects; concepts and metrics were also identified to measure conflicts.

Research gap: The RSL provided consistent evidence of the main concepts researched, which involved conflicts in the context of software development, identification of proposed approaches for dealing with conflicts. However, we observed a gap in using consolidated and integrated factors and metrics to assess software teams' maturity in dealing with conflicts. To be sure that there were not already defined models in this context, we also searched the literature for maturity models focused on conflicts in software teams; we used the search string ("maturity models" AND "conflict" AND "software"). However, we found no research evidence related to the focus of this research; we only found maturity models in other IT areas.

Proposal definition: We will define this new model proposal as an approach to conflict assessment in software teams. We will use maturity models already consolidated in the literature, such as CMMI, to take as the bases of our proposal; also, all the knowledge recovered from the RSL research questions.

Validation with experts: Finally, we will apply the proposal will be validated by specialist in the area and through two case studies to validate its operation.

4 Results from the SLR

This section shows a set of data extracted from the Systematic Review of the Literature that will contribute to the basis of the proposed approach to assess the team's maturity in terms of conflicts. This SLR sought to understand the research scenario focusing on conflicts in software development [17]. The process of carrying out the SLR used rigorous steps and detailed analysis of the evidence. A total of 38 primary studies were included through automatic searches (List of studies are at the link: encurtador.com.br/ajkyR). These primary studies were retrieved from reputable sources and research bases, providing an overview and update of the last 6 years of the of state-of-the-art (2015 to 2021) on conflict in software teams.

Specifically, in this article, we will only detail the results of metrics, conflict predictors, conflict management, conflict impact, and conflict types extracted from the SLR, described in the following sub-topics.

4.1 Metrics of conflict

Considering the evidence found in the SLR, we identified that, because there are different types of conflicts, the metrics can reveal more details about how to evaluate or infer conflicts. These metrics can vary from study to study and depend on what is available in each evaluated context. Table 1 shows in column 1 types of conflicts and in column 2 the list of studies that used some metric in their work.

Table. 1. Studies that measure conflicts

Construct	Studies
Conflict	P9
	P24

Constructive conflict	P4
Job-leisure conflict	P11
Relationship conflict	P37
	P25
	P23, P31
Task conflict	P25
	P4, P23
	P12
Team Conflict	P27
Affective conflict	P26
Cognitive conflict	P26
Work-family Conflict	P2, P7
	P11

We observed that the works used a single source or a combination of them to measure conflict, as was the case with P27, who used three bases to build his assessment instrument on team conflict. The analysis of the results was varied; that is, some studies carried out statistical analysis, while others carried out a simple quantitative analysis of the data.

4.2 Predictors of conflict

Conflict predictors refer to the antecedent conditions of the conflict. According to Korsgaard et al. [P7] "conflicts are triggered by latent conditions that predispose to the occurrence of unfavourable encounters between the parties". These latent conditions include contextual, social, and individual factors.

Filippova et al. [37] empirically investigate different types of conflict in Free and Open-Source Software (FOSS) development teams, their antecedents, and their impact on developers' sustained participation. In particular, the study examines four antecedents: task interdependence, geographic distribution, leadership style, and relative distribution of decision making.

Work-family conflict (WFC) is analysed from a macro and micro perspective in the study by Xueyang et al. [P6]. The authors identify that macro factors (social policy, economy, ideology and culture, demographic characteristics) and micro factors (organizational characteristics, corporate culture, family characteristics, professional women's values, personality characteristics) contribute to the generation of conflicts. In a similar context, Hoffmaster et al. [P11] investigated the turnover intentions of Information Technology specialists in business environments, specifically focusing on the impact of work-family and work-leisure conflicts.

The job design helps understand how work gets done and how it can affect the results of individuals working as a team. Queda et al. [P10] evaluate a set of characteristics of software development work and assess the possible relationships of these characteristics with work exhaustion, role conflict, and role ambiguity.

The FLOW distance is a concept used by Klünder et al. [P33] to measure the perceived distance between two people considering the media used for communication. In this case, communication was analysed as one of the predictors to help the project leader recognize the lack of information flow and facilitate the detection of conflict situations to intervention.

4.3 Conflict management

Conflict management involves activities and strategies to resolve or reduce conflicts to minimize the negative aspects of conflicts in a team. Different studies in this review related conflict management in their proposals (13 studies). Conflict management strategies help effectively deal with different degrees of conflict in different applications, industries, and academic environments.

Several approaches can be used to resolve conflicts: models such as the graph model for conflict resolution [P10]; tools: communication behaviour [P33]. In [P1], the ASEST Framework aims to develop and improve the cohesion of agile teams, for which agreements on team rules support communication and conflict management to improve team collaboration.

The technique used to manage the conflict interferes with the success of the project. Nunkoo et al. [P3] identifies that a win-win approach is always desired so that both parties are equally happy with the outcome of the conflict. Therefore, techniques such as accommodation and competition should be used at a minimum.

Felices et al. [P18] propose a method that consists of brief training on leadership styles to assist in conflict management. Complementing this, Gren et al. [P22] present ideas for which aspects to consider in such training to help with negotiation and conflict resolution skills. Facilitation requires a third party to assist with conflict resolution. In Cho [P9], it is highlighted that IT managers can help in resolving third-party conflicts.

Leadership with the Top Management Team plays an important role in generating a solid innovation focus in the company. Strategic decisions aligned with conflict management contribute to the generation of innovation [P26].

In both works by Tshabalala ([P16, P19]), effective conflict risk management is evidenced, which involves the creation of effective strategies to reduce conflict dysfunctions and increase the constructive functions of conflict to improve the effectiveness of the team and the organization. In [P21] the risks related to conflicts are studied in two dimensions: probability and impact.

Conflict management was also studied to identify how this action can channel the productivity effects [P31] and team performance [P35].

4.4 Impact of conflicts

Different aspects are investigated when considering the impact of conflicts in the software context, such as team performance, software project success, cohesion, and others.

Different impacts were analysed when considering the WFC. In Alok et al. [P2] the authors showed a positive relationship between the WFC and the demand for professional self-efficacy through managerial support.

In [P4], the authors report that constructive conflict affects innovative work behaviour through people's readiness to discuss opposing ideas more often (positive conflict value) and their ability to explore creative ideas from broad, unconventional, and different perspectives (cognitive flexibility).

Team diversity improves project performance through trust and absorptive capacity [P5]. In contrast, team diversity can help in the emergence of subgroups, negatively affecting team results [P24]. Gren [P30] argues that agile team members need training in conflict resolution techniques to decrease the risk of interpersonal conflict negatively

affecting team productivity. Wickramasinghe et al. [P37] identifies that diversity in team composition leads to relationship conflict, relationship conflict leads to team performance, and team leader support moderates the latter relationship.

Knowledge sharing and different types of conflicts are directly linked to team performance. Team members who experience task conflicts tend to share more knowledge and improve performance, team members who experience process or relationship conflicts are less likely to share knowledge, and team performance is also impacted [P8]. High levels of relationship conflicts moderate the direct impacts of task conflicts on knowledge sharing adversely. In contrast, low levels of relationship conflicts magnify the impact of task conflicts on knowledge sharing [P23].

Task conflict reduces the effect of Transactive Memory Systems (regarded as a collaborative division of labour to allow a team to learn, remember, and communicate knowledge) on software process tailoring (SPT). Whereas STC (a shared understanding of the time-related aspects of a collective task execution) amplifies the influence of TMS-SPT performance [P12].

Basirati et al.[P13] results assert that there is a negative correlation between both Human-rooted conflict (HRC) and Non-human-rooted conflict (NHRC), and the success of software projects. Complementing this, Zhang et al. [P15] mention that task conflict and people conflict in software testing are inevitable and can affect the effectiveness and efficiency of the software development process.

Code review can generate negative experiences among developers. According to Egelman et al. [P14] such negative experiences are relatively rare in practice but have negative repercussions. Shameem et al. [P25] conduct their study on Requirements Engineering, indicating a strong positive relationship between requirements instability and variability and relationship conflict. In addition, it was observed to have a stronger negative effect of relationship conflict on team effectiveness than task conflict during requirements uncertainty.

Jiang et al. [P28] show that emotional, task, and cognitive conflict significantly influence employee satisfaction in a geographically distributed software development team (GDD). Rutz et al. [P36] explore factors influencing performance in global virtual teams in outsourced software development projects: team cohesion, goal setting, task conflict, awareness climate, trust climate, leadership, shared understanding, collaboration, communication, and cultural diversity.

Peculiarly, Zakaria et al. [P20] study the mobility patterns of individuals along with the experience of intra-group conflicts; that is, the patterns are detected using a Wi-Fi-based internal location system and a group detection system that discreetly informs the location of the group's participants at 5-minute intervals.

4.5 Types of conflicts

As illustrated in Figure 3, in the first and second positions, we observed the same number of citations about the type of relationship and task conflict, representing 15 studies (39.47%). Another information extracted is that 11 studies simultaneously consider the type of relationship and task conflict in their research ([P3], [P8], [P13], [P20], [P23-P26], [P28], [P34], [P38]). Of these 11 studies, 7 consider the third position, the conflict of processes, in parallel with the other two.

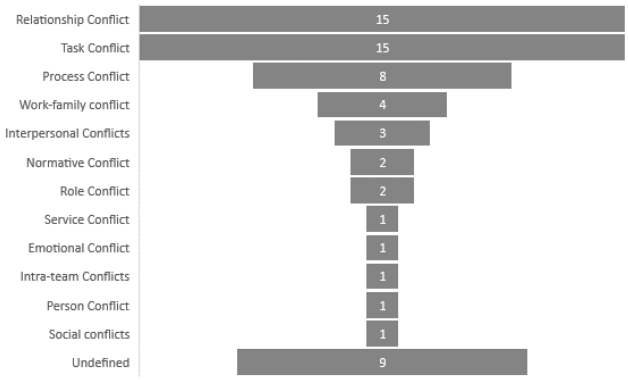

Fig. 2. Type of Conflicts

Some studies are confusing when classifying conflicts and how to call them; so, we consider that cognitive conflict and task conflict mean essentially the same thing [18]. In contrast, relationship conflict and affective conflict mean nearly the same thing. We observed in most cases, that the three types of conflicts (Relationship, Tasks, and Processes) when defined use the reference from the renowned researcher Karen Jehn.

On the other hand, some studies focused only on the type of conflict, namely: Work-family conflict ([P2], [P6], [P7], [P11]), Task ([P12], [P36]), Interpersonal ([P14], [P30]), Processes [P17], Relationship ([P31], [P35], [P37]), Role [P32] and Social [P33]. We also identified a trend. Studies considering work-family conflict represent 75% of studies published in 2021, demonstrating the interest in seeking harmony between work and family of those participating in software teams.

5 Conclusion

It is part of human nature to experience conflict situations since it is inevitable to run away from our needs, fears, selfishness, and annoyances. Therefore, facing conflict and its dynamism is essential to avoid destructive problems or even generate ideas in searching for solutions.

This paper sought to present a research proposal that focuses on creating an approach to guide and support the tracking and evaluation of the functioning of software teams in terms of their ability to deal with conflicts. For this, initially a systematic review of the literature was carried out, which was identified the main researched concepts that involved conflicts in the context of software development, identification of proposed approaches to deal with conflicts, factors and possible indicators of evaluations on the conflicts. Thus, the approach will seek to gather the findings of the literature and align the contributions of experts in the field to help track the functioning of a team and guide it during the software development life cycle regarding conflicts.

In the next steps, we will delve deeper into the maturity models and their functioning to base our proposal on. In addition, an in-depth analysis will be carried out on the factors identified with the systematic review of the literature.

Acknowledgment

The authors would like to thank Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brazil (CAPES) – Finance Code 001, for the financial support for the development of this research.

References

[1] L. Capretz, "Personality types in software engineering." International Journal of Human-Computer Studies 58.2 (2003): 207-214.

[2] A. Kakar, “How do team conflicts impact knowledge sharing?”, Knowledge Management Research & Practice, 16:1, 21-31, DOI: 10.1080/14778238.2017.1401194

[3] K. Pohl, C. R. Fundamentos da Engenharia de Requisitos. 2011. 1 ed., vol. 3, CA.

[4] C. De Dreu, and L. Weingart, “Task versus relationship conflict, team performance, and team member satisfaction: A meta-analysis”. Journal of Applied Psychology, 88(4), 741–749, 2003. https://doi.org/10.1037/0021-9010.88.4.741

[5] J. -j. Jiang, Z. -y. Wang and M. Yin, "Research on impact of team conflict upon employee satisfaction in geographically distributed software development team," 3rd International Conference on Information Management (ICIM), 2017, pp. 136-139, doi: 10.1109/INFOMAN.2017.7950362.

[6] S. Rispens, “Beneficial and detrimental effects of conflict”. In O. B. Ayoko, N. M. Ashkanasy, & K. A. Jehn (Eds.), Handbook of conflict management research (pp. 19–32), 2014. Edward Elgar Publishing. https://doi.org/10.4337/9781781006948.00008

[7] S. Robbins, T. Judge, B. Millett, and M. Boyle, “Organizational behavior”. Pearson Australia, 2016.

[8] F. Silva, C. França, C. Magalhães, and R.. Santos, “Preliminary Findings about the Nature of Work in Software Engineering: An Exploratory Survey”. In Proceedings of the 10th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM '16). Association for Computing Machinery, New York, NY, USA, Article 10, 1–6, 2016. https://doi.org/10.1145/2961111.2962625

[9] A. Radford, B. Majolo, and F. Aureli, “Within-group behavioural consequences of between-group conflict: a prospective review”. Proceedings of the Royal Society B: Biological Sciences, 283(1843):20161567, 2016.

[10] D. T. Avila, W. V. Petegem, and M. Snoeck, "Improving Teamwork in Agile Software Engineering Education: The ASEST+ Framework," in IEEE Transactions on Education, vol. 65, no. 1, pp. 18-29, Feb. 2022, doi: 10.1109/TE.2021.3084095.

[11] D. Nesterkin; and T. Porterfield, "Conflict management and performance of information technology development teams", Team Performance Management, Vol. 22 No. 5/6, pp. 242-256, 2016. https://doi.org/10.1108/TPM-05-2016-0018

[12] C. Zakaria, K. Goh, Y. Lee, and R. Balan, “Exploratory Analysis of Individuals' Mobility Patterns and Experienced Conflicts” in Workgroups. In Proceedings of the 5th ACM Workshop on Mobile Systems for Computational Social Science (MCSS '19). Association for Computing Machinery, New York, NY, USA, 27–31, 2019, https://doi.org/10.1145/3325426.3329946

[13] F. Kofman, “Metamanagement: o sucesso além do sucesso” 2004. São Paulo: Pioneiras

[14] S. García, e. a. “Influencia de la aplicación de la comunicación no violenta en la entrega de resultados de una evaluación de desempeño a empleados administrativos”, 2017.

[15] M. Rosenberg, “Comunicação Não Violenta”. Editora Ágora, 2006.

[16] A. Barbosa, F. Neto, and M. Lencastre, “Conflicts in the software context: a systematic review of the literature”, 2022, Submitted to IEEE ACESS.

[17] T Simons, R.S. Peterson, “Task conflict and relationship conflict in top management teams: the pivotal role of intragroup trust”. J. Appl. Psychol. 85 (1), 102–11, 2000.

[18] O. Ayoko, N. Ashkanasy, and K. Jehn, “Handbook of conflict management research”. Edward Elgar Publishing, 2014

[19] A. Walia, "Characteristics and Impact of Interpersonal Conflicts on Requirements Risks." (2012).

[20] Silva, N.: Uma teoria sobre conflito em equipes presenciais de desenvolvimento de software.: Tese Doutorado – UFPE CIN, 2019.