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POSITIVE EMOTIONS: FACTORS INFLUENCING KNOWLEDGE SHARING AMONG SOFTWARE INDUSTRY TEAM MEMBERS

EMOÇÕES POSITIVAS: FATORES INFLUENCIADORES DO COMPARTILHAMENTO DE CONHECIMENTO EM MEMBROS DA EQUIPES DA INDÚSTRIA DE SOFTWARE

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Abstract: Knowledge Management (KM) is an interdisciplinary discipline that proposes ways for an organization to capture, structure, and disseminate knowledge. This knowledge can be developed in the organizational environment, in an appropriate space for the interaction of individuals and sharing in groups. However, other variables can influence the interaction with individuals, one of which may be positive emotions, such as joy, interest, love, and contentment. In this context, the objective of this article is to investigate the factors that influence positive emotions in knowledge sharing among members of the software development team. This research has an applied nature with an exploratory and descriptive objective, in which it comprises the mixed approach and technical procedures of bibliographic survey and field research. A questionnaire was applied, followed by interviews with members of software development teams. The results demonstrate four factors that stimulate the internalization of positive emotions: organizational factor, physical infrastructure factor, collaboration factor, and leadership factor for team integration. In turn, we observed that positive emotions of cheer, contentment, fun, happiness, strength, gratitude, inspiration, pride, optimism, and patience influence the sharing of organizational knowledge.

Keyword: Knowledge management; Knowledge dissemination; Software Engineering; Well-being.

Resumo: A Gestão do Conhecimento é uma disciplina interdisciplinar que propõe maneiras para que uma organização capture, estruture e dissemine o conhecimento. Esse conhecimento pode ser desenvolvido no ambiente organizacional, em um espaço adequado para a interação dos indivíduos e o compartilhamento em grupos. No entanto, outras variáveis podem influenciar a interação entre os indivíduos, sendo uma delas as emoções positivas, como alegria, interesse, amor e contentamento. Nesse contexto, o objetivo deste artigo é investigar os fatores que influenciam as emoções positivas no compartilhamento de conhecimento entre os membros da equipe de desenvolvimento de software. Esta pesquisa tem uma natureza aplicada com um objetivo exploratório e descritivo, na qual compreende a abordagem mista e procedimentos técnicos de levantamento bibliográfico e pesquisa de campo. Um questionário foi aplicado, seguido de entrevistas com membros das equipes de desenvolvimento de software. Os resultados demonstram quatro fatores que estimulam a internalização de emoções positivas: fator organizacional, fator de infraestrutura física, fator de colaboração e fator de liderança para a integração da equipe. Por sua vez, observou-se que as emoções positivas de ânimo, contentamento, diversão, felicidade, força, gratidão, inspiração, orgulho, otimismo e paciência influenciam o compartilhamento de conhecimento organizacional.

Palavras-chave: Gestão do Conhecimento; Disseminação do conhecimento; Engenharia de software; bem estar. Interdisciplinaridade.

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INTRODUCTION

KM draws the attention of researchers from various fields, making it an interdisciplinary science that encompasses the exact sciences, technological disciplines, and the humanities. Its importance lies in the way it offers organizations strategies to capture, structure, and share the knowledge held by their members (Dalkir, 2005). One of the most well-known models in KM literature is the SECI model (Nonaka *et al.*, 2008), which outlines four stages of knowledge conversion: socialization, externalization, combination, and internalization.

During the socialization phase, knowledge is created and shared through direct interaction between individuals. This often happens informally in day-to-day organizational activities, through conversations, exchanges of information, and the sharing of personal experiences. Supporting the creation of new knowledge requires fostering an environment where people feel comfortable sharing their interests and ideas, which in turn can help the organization build a competitive advantage and maintain its relevance in the market (Hislop, 2013). Knowledge creation begins in what is known as "Ba," a social space where knowledge is shared through interaction. However, many organizations face barriers to this kind of interaction, such as structural and procedural obstacles, as well as cultural and organizational climate challenges (Chau *et al.*, 2003; Liu and Phillips, 2011). Overcoming these barriers may depend on the organization's ability to foster positive emotions among its members, encouraging them to internalize these emotions and engage more fully in knowledge-sharing activities.

Emotions are shaped by the situations individuals face in their environments, leading to actions that are often accompanied by physiological responses (Nyer, 1997). These responses can be understood at different levels, including biological, physiological, psychological, and philosophical. At the physiological level, for instance, emotions trigger changes in neurotransmitter activity, as well as somatic and autonomic nervous system responses, such as fluctuations in adrenaline, blood pressure, and heart rate. Psychologically, emotions encompass feelings, cognitive evaluations, and motivations—fear, for example, includes the sensation of fear, an assessment of danger, and a motivation to avoid it. Philosophical perspectives might explore emotions in the context of morality or rationality (Ben-Ze'ev, 2000).

Positive emotions are key in expanding individuals' cognitive and behavioral repertoires. When people experience positive emotions, they are more likely to generate and absorb new knowledge, which can then be shared with others (Fredrickson, 1998). This creates

a positive cycle where the desire to share knowledge grows as individuals internalize positive emotions, leading to expanded intellectual, social, and physical resources (Fredrickson, 2001).

In this context, the present research aims to investigate the factors that influence positive emotions and their impact on knowledge sharing among members of software development teams within the software local productive arrangement in Maringá, Paraná, Brazil.

RESEARCH METHOD

This research is applied in nature, with exploratory and descriptive objectives, utilizing a mixed approach (qualitative-quantitative) and technical procedures such as a bibliographic survey and field research. As applied research, it focuses on real-world experiences and practical applications in private, industrial, or governmental organizations (Glaser; Strauss, 2006).

From an objective perspective, the study is classified as both exploratory and descriptive. It is exploratory because it aims to uncover what is happening when variables and theoretical foundations are not well-known, and seeks to generate new knowledge (Creswell, 2013). The exploratory aspect of the research refines data, bringing the findings closer to reality (Mohapatra *et al.*, 2016). The descriptive objective, on the other hand, provides a clear, detailed picture of people, events, or situations. It is used when there is a need for a thorough understanding of the phenomena, necessitating accurate data collection. While the exploratory nature of the research brings a strong quantitative focus, the challenge lies in identifying meaningful quantitative results to further investigate sample sizes (Creswell, 2013).

The quantitative approach is employed to create a suitable instrument for the sample under study, as the roles, groups, organizations, processes, and cultures of individuals may vary significantly (Miles, 2014). The qualitative approach complements this by exploring participants' perspectives, contributing to both phases of the research (Creswell, 2013). It enables the researcher to engage with participants in their natural environment to investigate both routine and unique aspects of their lives, reducing potential biases inherent in purely quantitative methods. Through close attention to participants' words and actions, the researcher seeks to understand how people interpret, explain, and manage everyday situations (Miles, 2014). In this context, the software industry provides the natural environment for data collection, with the researcher and participants within this industry serving as key instruments for gathering information.

The study's theoretical foundation is based on a review of relevant bibliographic sources, enabling the researcher to clarify the theoretical underpinnings of the study and contribute to building new theories (Tong *et al.*, 2007). In addition to bibliographic research, the study involves data collection from a group of individuals through questionnaires and semi-structured interviews (Creswell and Creswell, 2017). Field research is also necessary for generating meaning from data collected in situ, a common practice in qualitative research. This process allows for the examination of the relationship between positive emotions and knowledge sharing among a specific group of participants in an organizational context (Saunders *et al.*, 2009).

The research process began with a meeting involving members of Software by Maringá (SbM), a local productive arrangement in Maringá, Paraná, which includes over 300 companies. During this meeting, interested companies were invited to participate in the study. Follow-up contact was made with all registered participants to schedule Proof-Of-Concept (POC) sessions, after which the questionnaires and interviews were conducted.

This work unfolded in three phases. First, we reviewed various questionnaires designed to assess emotions in the workplace. Second, we administered the selected questionnaire to gather quantitative data on the phenomenon. Participants were chosen through an unintentional random sampling method. Finally, in the third phase, we conducted qualitative interviews to explore participants' perspectives on their emotions in the workplace. Both the quantitative and qualitative data were then analyzed comprehensively.

QUESTIONNAIRE

We built the questionnaire based on the literature, which we divided into two sections. The first section intends to investigate the emotions of software development teams based on three dimensions:

- Dimension 1: organizational support: eight statements aimed at investigating the emotions of the participants and the team in relation to organizational support for the good performance of their work.
- Dimension 2: organizational climate: eight statements aimed at investigating the emotions of the participants and the team regarding the organizational climate.
- Dimension 3: family-work balance: three statements aimed at investigating the emotions of the participants and the team regarding the organization's support for balance between family and work.

The questionnaire, with its respective dimensions and statements, is shown in Frame 1.

Frame 1 - Dimensions and statements of the questionnaire.

Dimensions	Affirmations
Organizational Support	A1: The organization values its work.
	A2: Creativity and imagination at work are welcome in the organization.
	A3: It is easy to speak to people at higher levels.
	A4: You feel free to communicate frankly and openly with your superiors
	A5: You feel free to show that you disagree with the opinions of your superiors.
	A6: You have great confidence in your superiors.
	A7: The superiors keep their promises to you.
	A8: When good results are obtained due to the efforts of managers, the credits (e.g., praise or awards) are distributed among a small number of managers.
Organizational Climate	A9: The organization's atmosphere is friendly.
	A10: There is a feeling of family among the people in my organization.
	A11: There are personal favorites in the promotions carried out in the organization.
	A12: People feel discriminated against in the organization.
	A13: People care about the welfare of others.
	A14: I feel that the superiors are honest.
	A15: I feel that I can develop my potential in the organization.
	A16: I feel that I can learn continuously in my organization.
Balance Family / Work	A17: My organization helps me to reconcile work with family life.
	A18: The organization is concerned that my work is reconciled with family responsibilities.
	A19: The organization creates conditions for me to follow the education of my children.

Source: The Authors, (2021).

The second section of the questionnaire is designed to investigate the emotions of team members regarding the project in which they are involved. This section includes forty-one different emotions, such as: alert, frightened, loving, anguished, excited, anxious, passionate, active, calm, tired, full of energy, comfortable, content, determined, dynamic, willing, fun, enthusiastic, hopeful, happy, strong, grateful, humiliated, bothered, restless, inspired, irritated, motivated, nervous, proud, optimistic, patient, upset, worried, resentful, relaxed, serene, fearful, tense, peaceful, and vigorous.

A Likert scale was used for the responses in both sections of the questionnaire, offering five possible choices, where participants select only one option: (1) strongly agree, (2) agree, (3) neither agree nor disagree, (4) disagree, and (5) strongly disagree. The questionnaire was

created in Google Forms and underwent a POC at one of the organizations participating in the study. The POC followed six steps:

1. We took the participant to a reserved room (one by one).
2. We explained to the participant the objective of the research and each item of the questionnaire.
3. We opened the Google Forms questionnaire on a company computer; thus, we left the room.
4. The participant answered the questionnaire, and any questions he had could call us to clear up the questions.
5. We computed the time-answer of the participant.
6. The participant submitted his answer in the browser and called us to finish it.

Three experts from the software industry participated in the proof of concept: one director with eighteen years of experience in the field, and two systems analysts, one with ten years and the other with three years of experience. Each participant took an average of 10 minutes to complete the questionnaire.

Following the POC, the questionnaire was validated by analyzing the responses using Microsoft Excel, where the reliability of the results was assessed through Cronbach's alpha coefficient. This statistical tool quantifies, on a scale from 0 to 1, the reliability of the variability in responses, with a minimum acceptable value of 0.7. The Cronbach's alpha coefficient for the proof of concept was 0.8, indicating a satisfactory level of reliability and confirming that the variability in the responses was appropriate. With the questionnaire validated, the researcher scheduled its administration within each organization, personally engaging with them to ensure the participants received and completed the questionnaire.

The questionnaire was conducted between January and July 2019, with fifty-one participants involved in software development projects from five different companies located in the city of Maringá, Paraná, Brazil. Upon completion, all collected data were thoroughly analyzed. The first part of the questionnaire (items A1 to A19) was evaluated using response percentages and presented through bar graphs. Additionally, the second part, which addressed forty-one different emotions, was analyzed using the Mann-Whitney test, with a significance level of $p \leq 0.05$. This level is used to assess the relationship between two independent variables (De Andrade Martins, 2006).

Moreover, we developed an interview protocol to explore the influence of positive emotions on knowledge sharing among members of the software development team.

Participants were selected based on the maturity of their organization's software processes, specifically those adhering to the Capability Maturity Model Integration (CMMI) at level 4 (CMMI4). This model indicates that software development processes are quantitatively managed using established metrics and indicators (CMMI-DEV, 2010). The selected organization was a medium-sized Brazilian company specializing in technology for business management. The company's headquarters are located in Maringá, Brazil, with additional branches in Curitiba, São Paulo, and Cuiabá, as well as an international software development operation in India. The company's primary products include systems for Business Management, Marketplace, Software Components, Payroll Credit Access Management, and Municipal Health Management Software, in addition to providing software outsourcing services.

Data collection was authorized when ten participants from the same project were available for interviews. We contacted the company via email and telephone, and an employee from the human resources department coordinated the interview scheduling, following a plan proposed by the researcher.

Interviewees were randomly selected based on their roles, length of experience in the project, and overall experience in software development. The organization was asked to provide a range of professional profiles, from beginners to more experienced individuals. Consequently, we interviewed five software developers, two testers, one systems analyst, one project assistant, and one project manager.

The interviews were conducted between February and April 2019, with each interview lasting approximately sixty minutes. Participants provided consent to record the interviews by signing a consent form before the sessions began. They were encouraged to reflect on at least two recent episodes in which they experienced positive emotions during their work performance. Following this reflection, the interviews proceeded according to the established protocol.

All interviews were transcribed verbatim into text documents. To analyze this empirical material, we applied coding procedures as defined by Barney Glaser and Anselm Strauss (Glaser and Strauss, 2006). The transcribed documents were imported into ATLAS.ti for detailed analysis, where we examined the text line by line, identifying and extracting units of analysis. Each unit was then assigned a code — a word that represented its meaning to the researcher (Cassiani *et al.*, 1996).

The coding process was conducted in three stages. First, we performed open (or conceptual) coding, manually reading the interviews line by line and coding words or phrases

that captured the core of the participants' discourse (De Carvalho Dantas *et al.*, 2009). Next, we conducted axial coding, an inductive process of grouping codes into categories, reducing the number of categories by identifying the most significant ones and organizing them into a coherent structure (Cassiani *et al.*, 1996). Finally, in the third stage, we performed selective coding, which refined and integrated the categories to identify the central phenomenon of the study (De Carvalho Dantas *et al.*, 2009).

Finally, we conducted data interpretation focusing on the relationship between 'positive emotions of the subjects and the sharing of knowledge.' We sought to identify connections between the categories that emerged, specifically examining how 'knowledge sharing' and 'positive emotions' were mentioned by participants during the interviews and identified in the second part of the questionnaire. After completing the coding process, we analyzed the interviews to explore how positive emotions influence the sharing of organizational knowledge.

THEORETICAL BACKGROUND

Knowledge is the outcome of learning and can manifest through behavioral changes that are often difficult to articulate (Argote, 2013). In this context, Sanchez (2005) emphasizes that knowledge can be understood as a set of beliefs individuals hold about cause-and-effect relationships in the world and within organizations. It is processed and stored in the human mind through interpretations, ideas, observations, and judgments (Wiig, 1997). Therefore, knowledge is a dynamic process of interaction, continuously evolving within a growing network of relationships between individuals (Nonaka *et al.*, 2008).

In an organizational setting, the ability to generate, create, and disseminate knowledge is crucial for both economic growth and competitive advantage. Knowledge is an asset, incorporated into products and into the tacit knowledge of individuals (Dalkir, 2011). Tacit knowledge consists of cognitive and technical elements found in an individual's mental models, beliefs, paradigms, and perspectives, applied in specific contexts through personal skills (Alavi; Leidner, 2001; Maruta, 2014). To effectively disseminate knowledge within an organization, it is essential to create an organizational space, known as "Ba," which facilitates the use and flow of information and knowledge. This space fosters both the creation and sharing of organizational knowledge (O'Brien *et al.*, 2011; Nonaka and Nishiguchi, 2001).

KM is a pathway through which an organization generates value, primarily based on its knowledge or intellectual capital (Bukowitz and Williams, 1999). It can be defined as a set of processes encompassing the creation, utilization, and sharing of knowledge, all aligned with

organizational objectives (Goldoni and Oliveira, 2010; Pinto and Tenório, 2024). KM involves the investigation, development, application, and innovation of procedures and tools necessary for knowledge creation, which in turn fosters competitive advantage (Navarro and Navarro, 2003). In essence, KM relies on a strong commitment to management. This commitment serves as a model for knowledge sharing, as management leverages its knowledge to effectively manage, administer, and promote knowledge dissemination across all organizational levels. Consequently, it is incumbent upon the organization to support KM initiatives through financial, technological, and human resources (Uriarte, 2008).

Organizations require knowledge management systems to filter and manage the vast amounts of information they handle, preventing information overload. Information such as fax messages, electronic calls, emails, and documents must be filtered and processed to form the specific knowledge required by the organization. For KM to be effective, it is necessary to categorize and codify content through three key phases: i) knowledge creation; ii) knowledge validation and categorization; and iii) knowledge sharing across the organization. In this way, knowledge not only becomes available to the entire organization but can also be re-shared and re-utilized (Mohapatra *et al.*, 2016).

KNOWLEDGE SHARING AND POSITIVE EMOTIONS

The concept of knowledge dissemination involves making public the production of knowledge generated or organized by an institution (Gagnon, 2011). In the organizational context, knowledge dissemination occurs through knowledge sharing, which requires interaction between clients and teams, identification of requirements, and the capture, collection, and retention of knowledge to prevent its loss and ensure its dissemination (Chau *et al.*, 2003).

Knowledge that is not effectively disseminated remains constrained. Publications, presentations, websites, and libraries are the primary means of knowledge dissemination. Equally important are group participation, partnerships, and the establishment of knowledge centers (Mohapatra *et al.*, 2016). The dissemination process can take various forms, resulting in diverse products and services, depending on the focus and priorities of the information (Gagnon, 2011; Choo, 2003; Lesca and Almeida, 1994).

Individual knowledge is shared based on personal values, beliefs, experiences, and capacities, which transform it into "collective knowledge" or "organizational knowledge" (Teixeira and Valentim, 2012). Knowledge sharing allows one person to follow another's

thought process. Insights, for instance, can help others better understand a given situation (McDermott, 1999; Tenório *et al.* 2017). In this context, knowledge sharing frequently occurs within workgroups through observation, explanations of worldviews, and the values held by group members (Edmondson, 1999; Pinto and Tenório, 2024). Providing incentives for individuals to share useful knowledge is a keyway for organizations to secure a competitive advantage, enhance performance and productivity, and foster innovation (Liu and Phillips, 2011). Knowledge sharing also meets the continuous learning needs of employees, keeping them qualified for their roles. Therefore, sharing involves both giving and receiving information in context, while also recognizing the source (Steil, 2007).

Knowledge sharing is one of the most critical components of Knowledge Management (KM). The literature presents various KM cycles that emphasize knowledge sharing. These cycles organize information, transforming it into knowledge. Generally, a KM cycle provides processes for the capture, encoding, dissemination, sharing, access, and application of knowledge (Mohapatra et al., 2016). Different researchers characterize KM cycles using varying nomenclatures for the phases or steps involved. Among the most established KM cycles are those proposed by Wiig (1993), Nonaka and Takeuchi (1997), Burk (1999), McElroy (1999), Bukowitz and Williams (2003), and Lee, Lee, and Kang (2005).

Although the concept of emotion is commonly understood, there is no scientific consensus on its precise definition. Emotion, at its core, is an evolutionary legacy that provides individuals with impulses for immediate action (Sobral, 2010). Emotion is the result of a personal appraisal of an event's significance for well-being (Lazarus, 1991; Tenório *et al.*, 2017). It involves feelings, reasoning, psychological and biological states, and action tendencies. The author also notes that there are hundreds of emotions, with countless combinations, variations, mutations, and nuances (Goleman, 2011).

Emotion is a cognitive assessment influenced by the individual's situation and environment. Emotions lead to subjective experiences and tendencies for action, often accompanied by physiological responses (Nyer, 1997). Emotions are also states of readiness triggered by cognitive evaluations of events or thoughts, which can be observed through gestures, postures, and facial expressions (Bagozzi *et al.*, 1999).

As a subjective experience, emotion involves the whole person—mind and body. It is a complex reaction triggered by stimuli or thoughts, involving organic reactions and personal sensations. Emotional responses encompass multiple components, including observable reactions, physiological arousal, cognitive interpretation, and subjective experience (Pinto,

2001). Finally, emotion can be defined as a natural means of assessing the surrounding environment and reacting adaptively (Camões, 2006).

In literature, emotions are categorized as either positive or negative. One theory that addresses both types of emotions is the control theory of behavior. This theory posits that emotional responses can be understood through the lens of behavior, suggesting how emotions arise and influence human actions. Positive emotions inform the individual that they are progressing toward a desired goal, while negative emotions signal that no meaningful progress or action is being made (Carver and Scheier, 1990).

Negative emotions arise when an individual perceives negative changes in personal or related situations (Ben-Ze'ev, 2000). These emotions represent a broad dimension of subjective distress and unpleasant engagement, encompassing various aversive moods such as anger, contempt, disgust, guilt, fear, and nervousness (Watson *et al.*, 1988). Additional negative emotions include frustration, irritation, depression, annoyance, hostility, worry, and lack of motivation (Kahneman *et al.*, 2004), as well as anxiety, sadness, and anger (Fredrickson, 2001). However, positive emotions can serve as effective antidotes to the lingering effects of negative emotions, helping to counteract or undo their impact (Fredrickson, 2001).

Fredrickson's "broaden-and-build theory" (1998), explains that positive emotions could expand an individual's momentary thought-action repertoires, ultimately building lasting personal resources—ranging from physical and intellectual to social and psychological (Fredrickson, 1998). Positive emotions arise when individuals perceive positive changes, significantly improving a situation (Ben-Ze'ev, 2000). These emotions reflect how enthusiastic, active, and alert a person feels, creating a state of high energy, focus, and pleasurable engagement (Watson *et al.*, 1988). Frame 2 presents the main types of positive emotions identified in the literature.

Frame 2 - Identification of positive emotions.

References	Identification (Positive emotions)
Watson, Clark e Tellegen (Watson et al., 1988)	Enthusiastic, active, alert.
Fredrickson (Fredrickson, 1998)	Joy, interest, contentment, love.
Bagozzi, Gopinath e Nyer (Bagozzi *et al.*, 1999)	Satisfaction, joy, pleasure, pride, relief, affection, love, hope.
Kahneman, Krueger, Schkade, Schwarz e Stone (2004)	Happy, friendly, fun.
Lyubomirsky, King e Diener (Lyubomirsky & Layous, 2013)	Joy, interest, pride.
Kok, Catalino e Fredrickson (2008)	Joy, serenity, gratitude, love.
Lima (2014)	Joy, love, happiness, fulfillment, pride, admiration.
Berg e Karlsen (Emil Berg & Terje Karlsen, 2014)	Joy, strength, optimism, gratitude, self-efficacy.

Source: The Authors (2021).

Joy, happiness, interest, pride, contentment, and love are among the emotions that involve the experience of positive feelings. Happiness typically arises in safe and familiar contexts, requiring minimal effort, while more enthusiastic, active, and alert emotions can expand an individual's thought-action repertoire. These emotions not only promote personal growth but also have incidental effects, enhancing physical, intellectual, and social skills.

Although joy is often used interchangeably with happiness, happiness is more specifically defined as a desire to act and engage in activities such as dancing, singing, hugging, reading, painting, or laughing (Lazarus, 1991). People who are satisfied with their lives tend to experience joy over time and are more likely to pursue new goals with less conflict and more cooperation within teams. Therefore, happiness is characterized as the frequent experience of positive emotions over time (Lyubomirsky *et al.*, 2005).

Interest, as an emotion, stimulates curiosity. To satisfy this curiosity, individuals are driven to explore new information and experiences. Through this process, their knowledge base expands, shifting from momentary satisfaction to a more durable foundation of understanding (Fredrickson, 2001).

Pride is an emotion that arises from personal achievements, especially when others recognize an individual's performance. This recognition can occur within groups, where members acknowledge the skills and contributions of others (Van Den Hooff *et al.*, 2012). Pride not only expands an individual’s knowledge but also creates a desire to share achievements, fostering a vision for future successes (Barrett et al., 2008). As such, pride can lead to a strong belief in one's ability to contribute valuable knowledge to the group, thereby increasing willingness to share (Van Den Hooff *et al.*, 2012).

Contentment arises in situations perceived as safe, with a high degree of certainty and low effort. This emotion fosters a desire to savor the current moment, reflecting on life experiences, circumstances, recent successes, and new perspectives about oneself and the surrounding world (Fredrickson, 1998).

Love, unlike other emotions, is experienced in different forms, such as romantic love, companionate love, care-based love, and attachment. These experiences are directed toward specific individuals, such as a mother, confidant, lover, or child. Love encompasses various positive emotions, including interest, contentment, and joy, amplifying the thought-action repertoires as people explore, savor, and engage with those they love. Over time, love-driven interactions help to build and strengthen lasting social bonds (Fredrickson, 1998).

Satisfaction is an emotion defined by three key components: values, the importance of these values, and perception (Hollenbeck; Wagner, 2006). Job satisfaction, for example, results from an individual's perception of the importance of their work and the fulfillment of personal goals. According to Staw, Sutton, and Pelled's (1994) model, positive emotions lead to favorable outcomes in the workplace through three sets of processes. The first suggests that positive emotions have beneficial effects on individual productivity and persistence, independent of relationships with others. The second suggests that people with positive emotions elicit more favorable responses from others and are more successful at influencing them. The third set proposes that individuals with positive emotions react more favorably to others, resulting in greater cooperation. Together, these processes lead to improved workplace outcomes, including better evaluations from supervisors, higher remuneration, greater autonomy, and stronger support from colleagues and supervisors (Staw *et al.*, 1994). It is evident that individuals' positive emotions influence their work within organizations.

Additionally, emotions impact cognitive processes such as learning, attention, perception, and memory. People who internalize positive emotions tend to solve organizational problems more efficiently, demonstrating creativity and ease in problem-solving (Babiker *et al.*, *2015*; Isen *et al.*, 1987).

Unlike knowledge, positive emotions are not stored and retrieved independently. However, conditions can be created to trigger the recall of positive emotions, leading to emotional responses and fostering their internalization (Bagozzi *et al.*, 1999). The emergence of positive emotions encourages individuals to maintain, enhance, share, or prolong these feelings, ultimately improving both their performance and the organization's overall success (Bagozzi *et al.*, 1999). This synergy between individuals and the organization contributes to positive outcomes in knowledge sharing and task performance.

Positive emotions, such as happiness, also promote greater interaction between people (Isen *et al.*, 1987). The empirical studies by Vidotti *et al.* (2016) and Tenório and Vidotti (2017) pointed out that emotions like joy, interest, contentment, and love, when internalized, strongly encourage individuals to share knowledge within organizations. These emotions foster a desire to share experiences, thus expanding social interactions (Becker *et al.*, 2024). Such interactions typically occur face-to-face through dialogue or questions, facilitating knowledge sharing (Goldoni and Oliveira, 2010).

Certain factors, such as organizational support and socialization activities, further facilitate knowledge sharing (Osinski *et al.*, 2015). Socialization occurs when individuals

interact and build trust within the organization (Holste and Fields, 2010). Fredrickson's 'Broaden-and-Build Theory' (Fredrickson, 1998) posits that individuals who internalize positive emotions are inclined to share these emotions with others. Over time, this sharing creates lasting personal resources, including social connections, coping strategies, and environmental knowledge. Positive attitudes, such as interest and curiosity, lead to more accurate knowledge acquisition through experiential learning, making knowledge a lasting personal resource (Fredrickson and Losada, 2005).

As these resources accumulate, they function as reserves to manage future challenges and improve survival chances. Additionally, positive emotions enhance individuals' social integration, making them more informed, effective, and resilient. This integration fosters greater sharing of experiences, emotions, and resources (Fredrickson and Losada, 2005).

Emotions can also spread in groups through emotional mimicry, where individuals imitate the emotions of others. As people align their emotions with those of the group, positive emotions can spread from one individual to another. When an individual expresses positive emotions, they evoke similar emotions in observers. This ripple effect can extend beyond small groups to larger ones (Menge sand Kilduff, 2015). Consequently, the desire to share positive emotions can significantly influence knowledge sharing within a work environment.

RESULTS

This section presents the results obtained from conducting a questionnaire to a group of individuals in the software industry, as well as the results of interviews with these individuals. The results revealed that there are emotions related and unrelated to the dimensions and themes defined in this research. Likewise, the analysis of the interviews indicated four factors of influence on the individuals' positive emotions for knowledge sharing. In the end, the results and discussions of this research are presented.

ANALYSIS OF THE PARTICIPANTS' EMOTIONS

Before administering the questionnaire to participants in the first phase of the research, the emotions of the participants within the context of software development projects were investigated. Three dimensions were considered: organizational support, organizational climate, and the organization's support for balancing family and work responsibilities. In this phase, data were collected from fifty-one active participants across five different software development organizations. The participants had an average age of 28.5 years, ranging from 19

to 40 years. The length of time participants had worked in their respective organizations varied from 3 months to 18 years. Table 1 presents the percentage distribution of the participants' roles.

Table 1 -Participants profile.

Role	Participants (%)
Software development	58%
Project manager	11%
Systems analyst	11%
Testers	4%
Support	12%
Project leader	2%
Director	2%

Source: The Authors, (2021).

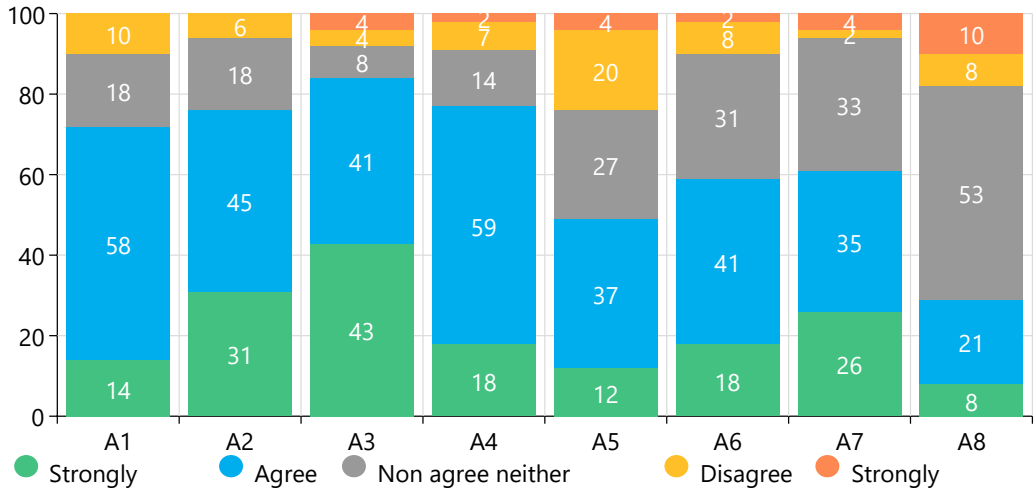
For data analysis, descriptive statistics we used median, mode, total amplitude (or range), and interquartile values based on the Likert scale, i.e., 1 to 5, (Sweeney *et al.*, 2013).

Throughout the statistics, we identified the relationship between the proposed statements and the dimensions analyzed: organizational support, organizational climate, and family-work balance. Moreover, running Mann Whitney's hypothesis test, in which calculated the relationship between 'affirmation' and 'emotion' variables, we identified what emotions were (or not) related to the participant’s project.

ORGANIZATIONAL SUPPORTING OF EMOTIONS

This first dimension investigates the participants' emotions regarding organizational support. We analyzed eight statements regarding appreciation of work (A1), creativity (A2), easy flow communication with superiors (A3), open communication with superiors (A4), openly disagrees with superiors (A5), trust in superiors (A6), promises from superiors (A7) and positive feedback (A8), all presented in Figure 1.

Figure 1 - Participants' emotions regarding organizational support.



Source: Authors (2021).

The results show that most participants fully agree or agree (72%) that the organization values the work they do (A1) and supports creativity and imagination (A2). For communication between hierarchical levels was considered easy (A3), and more than half of the participants (77%) feel free to communicate openly with their superiors (A4). However, only (49%) are comfortable showing that they disagree with the opinions expressed by their superiors (A5). It is also observed that (59%) of the participants trust their superiors (A6), and these, most of the time, keep the promises made (A7). It is also observed that less than half (29%) fully agree or agree that the good results obtained due to the efforts of managers are distributed among a small number of managers (A8).

According to the participants, the organization values its work, supporting creativity and imagination. Also, it is clear that there is a fluency of communication between the different hierarchies and that individuals feel free to communicate with their superiors. It is noted that in these organizations, there is communication between the working groups. This communication contributes to the sharing of knowledge between individuals in the groups (Edmondson, 1999). Knowledge sharing is a way of ensuring that individuals are passing on the knowledge they have, ensuring the dissemination and possession of knowledge to the organization (Liu and Phillips, 2011).

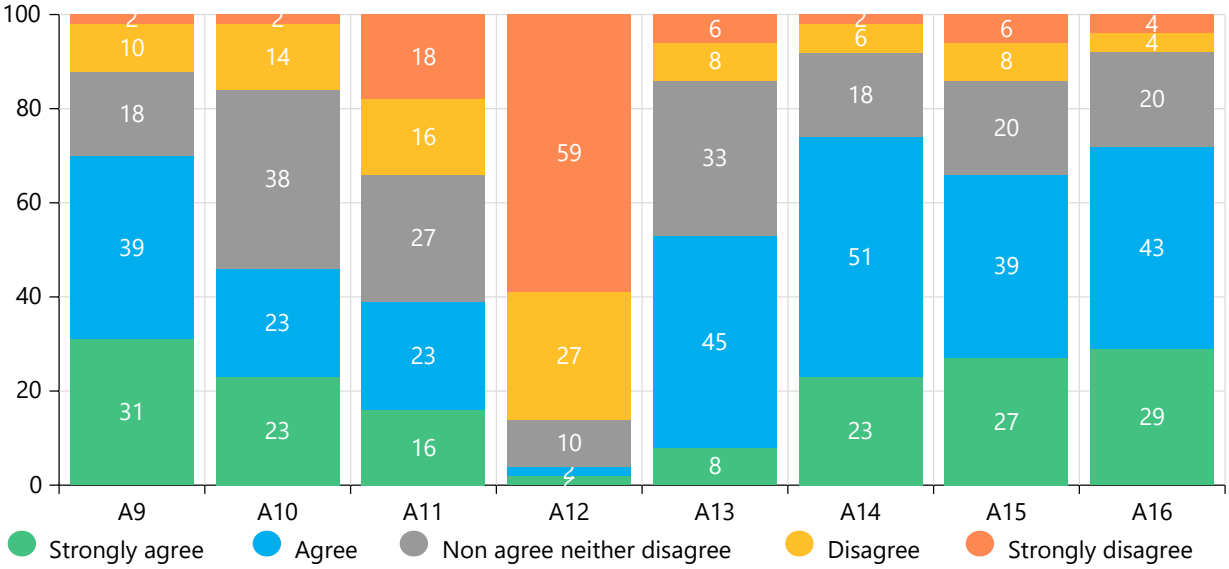
The dissemination of knowledge supported by the organization facilitates the communication process and promotes dialogue and interaction between the members involved (Chau *et al.*, 2003). The sensation of interaction, i.e., is the response of an emotion triggered by

a stimulus or thought (Pinto, 2001). Thus, organizational support can help individuals to share knowledge and internalize positive emotions.

ORGANIZATIONAL CLIMATE

This second dimension investigates the participants' emotions in relation to the organizational climate. Eight statements were analyzed regarding friendly atmosphere (A9), sense of family (A10), personal favoritism (A11), discrimination (A12), concern for well-being (A13), the honesty of superiors (A14), potential for individual development (A15) and continuous learning (A16), all shown in Figure 2.

Figure 2 - Emotions of the participants regarding the organizational climate.



Source: Authors, (2021).

Data from the second dimension investigated to show that there is a consensus among the participants (70%) that the organization has a friendly climate (A9), giving the feeling that its members can continuously learn in the organization (A16). The feeling of a family environment (A10) to work on is felt by only (46%) of the participants. It is also observed that the majority of the team members (53%) note that the other members of the organization are concerned with the well-being of each other (A13). Less than half of the participants (34%) disagreed about the existence of personal favoritism in the promotions carried out (A11), and the vast majority (86%) do not feel discriminated against in the organization (A12). The honesty of the superiors (A14) and the development of my potential (A15) was also a consensus among the participants (74% and 66%, respectively).

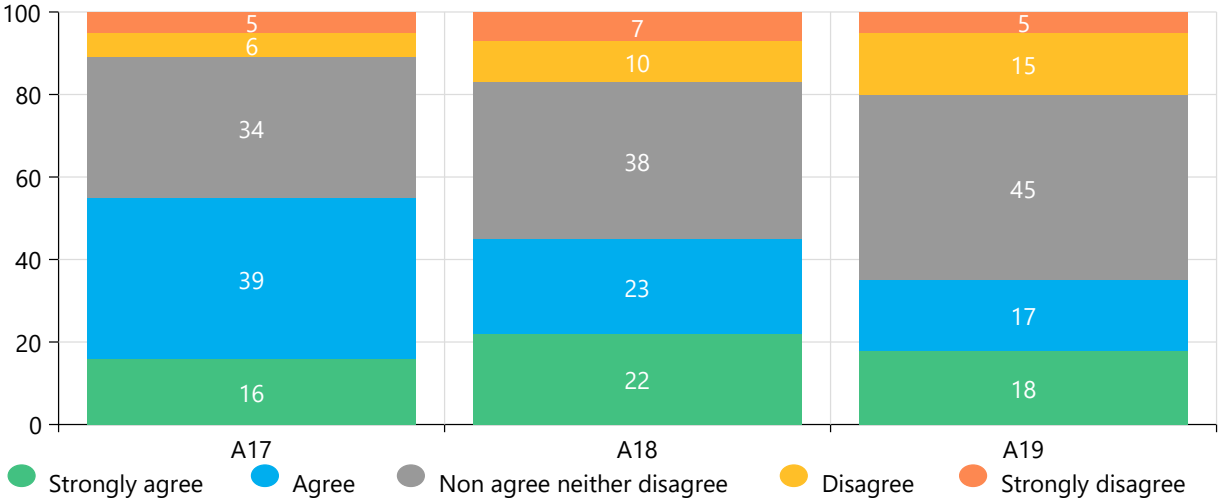
The data shows that there is a friendly atmosphere in this organization. Likewise, there is a consensus among respondents that their organization invests in continuous learning and development, in addition to offering a family environment where concern for others is evident. Furthermore, most disagree that there are personal favorites and discrimination against people in the organization. Thus, they claim that their superiors are honest and that there is room in the organization for the development of their skills.

Therefore, a 'good' organizational climate only tends to collaborate for the internalization of positive emotions because these emotions are consequences of the situations in which the individual is in the environment (Nyer, 1997). Such an environment should be a social space for groups that provides the sharing of knowledge through participation and interaction between these groups (Hislop, 2009). When this interaction happens, individuals tend to share more, and the environment becomes conducive to the creation of new knowledge and the resolution of problems (Fredrickson, 2001).

FAMILY AND WORK BALANCE

The family-work balance dimension investigates the emotions of the participants in relation to the balance between commitments to the family and work activities. This dimension investigated three statements related to help from organization (A17), to concern from organization (A18), and to monitor the education of children (A19), as shown in Figure 3.

Figure 3 - Emotions of the participants regarding the organization's support for family-work balance.



Source: Authors (2021).

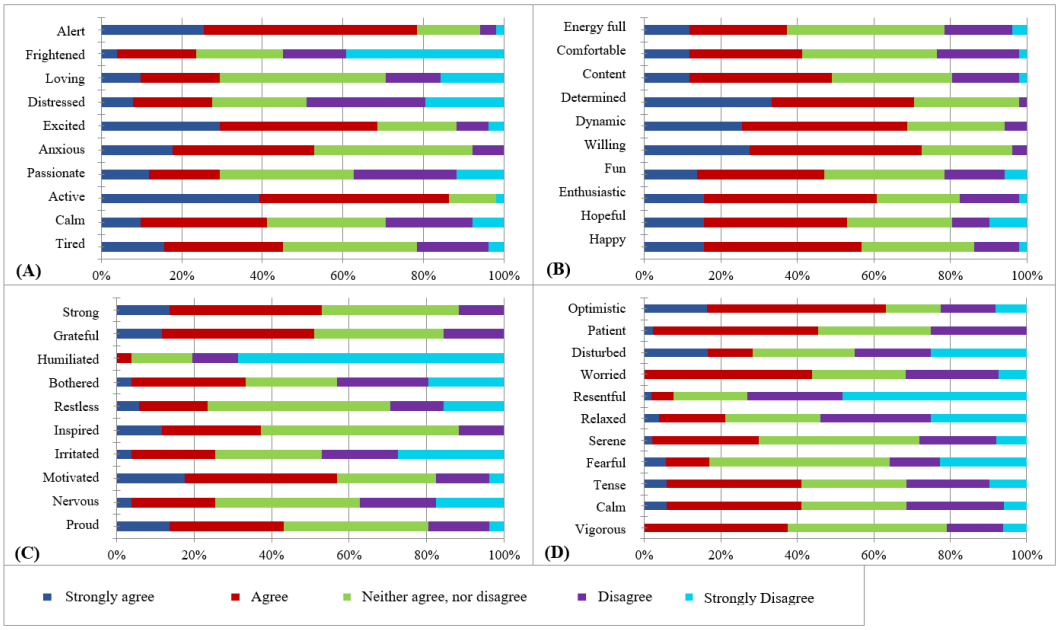
Most participants (55%) fully agree or agree that the organization helps to reconcile work with family life (A17). Only 45% of the participants agreed that the organization in which they work is concerned with reconciling work and family life (A18). In addition, (35%) fully agree or agree that the organization offers conditions for monitoring their children's education (A19).

It is evident in view of these results that the organizations surveyed collaborate to provide the members who work in it with conditions for a balance between family life and work. Emotions influence work because individuals bring their traits, humor, and emotions to work (George, 2000). Thus, it is necessary to improve the emotional quality of individuals in the organization through changes in the organizational environment and better clarification of work requirements.

EMOTIONS AND WORK

The second part of the questionnaire investigates the emotions of the participants in relation to the project in which they are working. To this end, 41 different emotions of the participants were analyzed in relation to the activities performed by them in the organization, as well as the integration with their teammates and challenges and difficulties faced in the project.

Figure 4 – Positive emotions in the software development teams.



Source: Authors, (2021).

It is observed in Figure 4(A) that the participants fully agree or agree that they feel the following emotions regarding the project they are working on: alert (78%), excited (69%), anxious (53%), active (86%), calm (41%) and tired (45%). It is observed that some participants did not know how to express their opinion on the emotions of loving (41%), anxious (39%), and passionate (33%).

Figure 4(B) shows that participants fully agree or agree about feeling willing (73%), determined (71%), dynamic (69%), enthusiastic (61%), happy (57%), and hopeful (53%). It is noted that some of the participants did not know how to express their opinion about the emotion of energy (41%), comfortable (35%), and also about the emotion of happiness and fun (31%).

Figure 4C shows that the participants fully agree or agree on the emotions of motivated (57%), strong (53%), grateful (51%), proud (43%), and inspired (37%). However, they did not know how to express an opinion on the emotions of inspired (51%), restless (47%), nervous and proud (37%).

Figure 4(D) shows that the participants fully agree or agree with the emotions of optimism (65%), concerned (55%), patient (53%), tense, calm and vigorous (41%), and serene (31%). However, they did not know how to express their opinions about the fearful emotions (49%), serene (41%), vigorous (39%), and disturbed (31%).

The data presented in 4(A), 4(B), 4(C) and 4(D) suggest that, in relation to the project in which the participants are inserted, they agree or fully agree to feel alert, excited, anxious, active, calm, tired, determined, dynamic, willing, enthusiastic, hopeful, happy, strong, grateful, inspired, motivated, proud, optimistic, patient, concerned, serene, tense, calm and vigorous. Therefore, the results presented here are essential for studies on episodes in the workplace and for managers who want to improve the emotional quality of work and the lives of workers.

RELATIONSHIP OF EMOTIONS WITH DIMENSIONS

To verify which emotions are related to the three dimensions investigated (organizational support, organizational climate, and family-work balance), the Mann-Whitney hypothesis test was performed. This test aims to verify that two small samples investigated with the investigated dimensions do not vary; therefore, the emotion is related to that dimension.

The Mann-Whitney test was performed to calibrate the positive emotions to be investigated in the interviews based on the data of the statistical analysis. Therefore, the following hypothesis was tested for all three dimensions, with all 41 emotions investigated in the second part of the questionnaire:

h₀: there is a relationship between emotion x and dimension y

Thus, the following alternative hypothesis was considered:

h₁: there is no relationship between emotion x and dimension y

Thus, p values ≥ 0.05 indicate that there is an emotion-dimension relationship, and hypothesis ***h0*** was purchased. Otherwise, for p <0.05, this relationship does not exist, and the alternative hypothesis ***h1*** is proved (de Andrade Martins, 2006).

An example of the formulated hypothesis and its alternative hypothesis are presented below:

h₀: there is a relationship between the emotion Alert and the dimension Organizational Support

h₁: there is no relationship between the Alert emotion and the Organizational Support dimension

In Frame 3, the column 'Related Emotions' presents the emotions that obtained a level of confidence with p ranging between 0.05 and 0.62, proving ***h₀***. Such behavior of the data points to indications that the emotions in the first column of Frame 3, "Related Emotions," are related to organizational support.

On the other hand, the emotions in the second column, 'Unrelated Emotions,' had a value of p between 6.00E-33 and 0.03, thus showing signs of having no relation to the organizational support dimension, thus proving the hypothesis ***h₁***.

Frame 3 - Organizational Support and the emotions of the participants.

Dimension 1: Organizational Support	
Related Emotions	**Unrelated Emotions**
Alert; Cheered up; Anxious; Determined; Dynamic; Willing; Enthusiastic; Hopeful; Happy; Strong; Thankful; Motivated; Optimistic; Patient; Worried.	Frightened; Loving; Distressed; In love; Active; Calm; Tired out; Full of energy; Comfortable; Happy; Funny; Humiliated; Troubled; Restless; Inspired; Riled up; Nervous; Proud; Disturbed; Spiteful; Chilled out; Serene; Fearful Tense; Quiet; Vigorous.

Source: Authors, (2021).

In Frame 4, the column 'Related Emotions' presents the emotions that obtained the p-value ranging from 0.06 to 0.88. This means that there is evidence that such emotions are related to the organizational climate, proving h0. On the other hand, unrelated emotions had a p-value in the range of 3.12E-14 and 0.04, and it confirms ***h₁***, demonstrating that such emotions are not related to the organizational climate dimension.

Frame 4 - Organizational climate and the emotions of the participants.

Dimension 2: Organizational Climate	
Related emotions	**Unrelated emotions**
Cheered up; Anxious; Tired out; Happy; Dynamic; Willing; Funny; Enthusiastic; Hopeful; Happy;	Alert; Frightened; Loving; Distressed; In love; Active; Calm; Full of energy; Comfortable; Determined; Humiliated; Troubled; Restless; Riled

Strong; Thankful; Inspired; Motivated; Proud; Optimistic; Patient; Worried.	up; Nervous; Disturbed; Spiteful; Chilled out; Serene; Fearful; Keyed up; Quiet; Vigorous.

Source: Authors, (2021).

In Frame 5, the column 'Related Emotions' presents the subjects' emotions with the p-value ranging from 0.05 to 0.99, a result that confirms h_1 and refute h_0. Thus, there is evidence that such emotions are related to the family-work balance.

Frame 5 - Family-work balance and the participants' emotions.

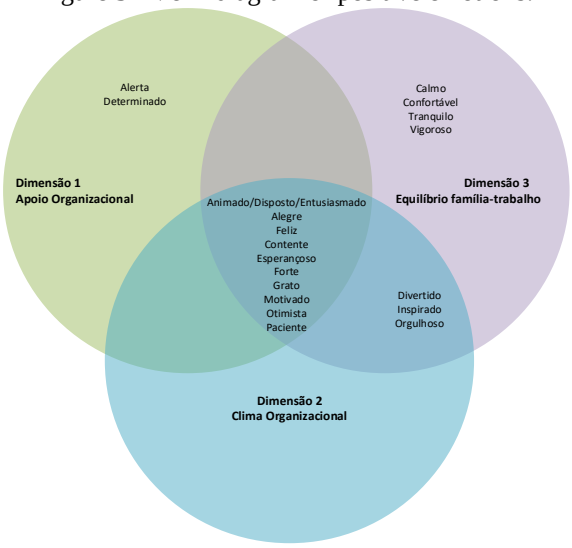
Dimension 3: Family-Work Balance	
Related emotions	**Unrelated emotions**
Cheered up; Anxious; Calm; Tired out; Full of energy; Comfortable; Happy; Dynamic; Funny; Enthusiastic; Hopeful; Happy; Strong; Thankful; Inspired; Motivated; Proud; Optimistic; Patient; Worried; Keyed up; Quiet; Vigorous.	Alert; Frightened; Loving; Distressed; In love; Active; Determined; Willing; Humiliated; Troubled; Restless; Riled up; Nervous; Disturbed; Spiteful; Chilled out; Serene; Fearful.

Source: Authors, (2021).

The emotions presented in the column 'Unrelated Emotions' had a level of confidence in the range between 3.82E-24 and 0.04, which shows signs of not being related to the family-work balance dimension, confirming hypothesis h_1.

The emotions of the participants concerning the project in which they work showed the relationship between emotion-themes and emotion-dimension. This means that the survey results showed that the majority of participants have both positive emotions related and unrelated to the dimensions analyzed. Therefore, based on the positive emotions found in the literature and also those investigated in the questionnaire and the Mann-Whitney test, it is considered to investigate related emotions that have an intersection between dimensions, *i.e.*, dimensions 1, 2 and 3. Therefore, the positive emotions to be investigated in the interviews are presented at the intersection of the dimensions of the Venn Diagram in Figure 5, which are: excited/willing/enthusiastic, happy, contented, hopeful, strong, grateful, motivated, optimistic and patient, yet fun, inspired and proud.

Figure 5 - Venn diagram of positive emotions.



Source: Authors, (2022).

Thus, it is considered that the positive emotions of 'excited/energy full/willing/enthusiastic' will be referred to as a positive emotion of 'mood' or 'excited.' Therefore, to find the factors that influence positive emotions in the knowledge sharing among the members of the software development team, the interviews are analyzed based on the following positive emotions of the individuals: cheerful, excited, contented, fun, hopeful, happy, strong, grateful, inspired, motivated, proud, optimistic and patient.

RESULT OF INTERVIEWS ABOUT POSITIVE EMOTIONS IN KNOWLEDGE SHARING

This section presents the results of the interviews conducted in Phase 3 of the survey. The interviews investigated the factors that influence positive emotions in knowledge sharing among members of the software development team. Such positive emotions investigated in the interview phase were guided by the literature review about positive emotions (Phase 1) and the Mann-Whitney hypothesis questionnaire and test (Phase 2). The emotions investigated in the sharing of knowledge were cheerful, excited, content, fun, hopeful, happy, strong, grateful, inspired, motivated, proud, optimistic, and patient. Five software developers, two test analysts, a system analyst, a project assistant, and a project manager were interviewed, totaling ten interviews. Therefore, the interviews reveal four factors influencing positive emotions in knowledge sharing among members of the software development team: organizational factor, physical infrastructure factor, collaboration factor, and leadership factor for team integration, all presented below.

THE ORGANIZATIONAL FACTOR

According to the interviews conducted, the first factor that influences positive emotions in knowledge sharing is the organizational factor, a factor composed of support and organizational climate, as well as the family-work balance. The organization encouraged a test analyst, who stands out for organizing his workspace, to share his knowledge with his teammates, through "tips" or "recommendations" on how to be organized daily. This test analyst sent weekly recommendations via e-mail to his colleagues to assist them on topics such as working with schedules, centralizing project information, and even setting tables.

> I send a recommendation on Monday, for example, 'there' I let a week pass [...]. Recommendations about things that apply every day [...], how to organize the table, how to work with an agenda, how to centralize all the information in one place. The team management praised the way I wrote, put stickers, images, it was cute, with a very friendly and very intuitive font. This made me proud of my work and motivated me to continue [with the recommendations]. You know, 'right'? We 'are' helping the group, seeing the people put it into practice (Test Analyst II, 03/30/2019).

The attitude reported by the test analyst resulted in a compliment from the team management, as he reported. The "recommendations" were being put into practice by colleagues, which made the test analyst feel motivated and proud of the activity of helping colleagues by sharing their knowledge. Another fact that presents the organizational support for the project team was when the whole team received a compliment from the client regarding the last delivery of software functionality. Such functionality was developed with all the quality required by the customer and without failures or communication problems. This sparked positive emotions across the team, as one software developer reported.

> There was a compliment from the client [regarding the last delivery of a project functionality], and 'there' money [from the organization] 'pro' barbecue was released. We were happy, very happy. I, at least, am motivated to make another delivery like this (Software developer II, 03/16/2019).

Given the satisfactory result, the organization promoted a social event (barbecue) as a way of commending and valuing the work done by the team. The organization's support influenced the internalization of positive emotions of contentment and motivation, according to the developer's report. Thus, support from the organization is part of the first factor, the organizational factor, which influences the sharing of knowledge in the organization through positive emotions of contentment, motivation, and pride.

According to the interviewees' report, some time ago, new people were hired for the project team with a more outgoing profile, which considerably improved the organizational climate. This is because the new hires for the software development team joined, through leadership actions, and began to invite the oldest members of the team to social events (i.e., bars, parties, and barbecues), as shown in the excerpts from interviews below.

> [...] it was not like that before, in the past there were many cliques, a group that went out together, another group that talked (Project manager, 03/10/2019).

> Hiring more extroverted people ended up changing this team climate. He started calling people ‘to’ go out, people ‘to’ have a barbecue, and then people ‘are’ talking more. So, I know that people have already become safer and more content with the new environment (Project assistant, 04/06/2019).

Thus, it is observed by the reports that the atmosphere within the team became more friendly, contributing to the improvement of the organizational climate and arousing positive emotions of spirit, fun, and contentment in the individuals. It is also noted that individuals are led to a positive emotion of hope for the team since, in the speech of the project manager, the new hires ended the 'cliques' and joined the team.

The achievements achieved by the team are also reasons for celebration events, as the test analyst reveals.

> The automated test [new testing process implemented to serve the customer more quickly], was more than a year to convince the customer. When we succeed, our lady! It was a tremendous relief! Everyone was happy! We set up a barbecue to celebrate (Test Analyst I, 03/17/2019).

As with organizational support, it is observed that a social event to celebrate a result causes the individual to be led to a positive emotion of motivation in relation to their work. Thus, the improvement in the organizational climate is perceived by the team with the approach and interaction of people, which, in turn, provides for the sharing of knowledge among its members.

The organizational climate becomes even better when people have the knowledge to share with others. Some of this knowledge was brought in through new hires, according to the interviewees. Thus, the ideal environment for sharing knowledge is one that has several people on the team who bring new and useful knowledge to all of its members, as reported by one of the software developers and the project manager.

> When the person [hired] brings something new, and you can learn from everyone, then I think it's the best thing that can happen [for the team] (Software developer II, 03/16/2019).

> It is they are always looking to use the knowledge that they have acquired in other companies or that they study abroad. They are always sharing this among themselves to come up with better solutions. I think this is cool! (Project manager, 03/10/2019).

This situation also highlights the positive emotions of the spirit and motivation of individuals about the organizational climate because people bring new knowledge from outside to be shared with the oldest members of the team. Therefore, these emotions of cheer, fun, hope, contentment, and motivation can influence the sharing of knowledge. Therefore, the climate of the organization is part of the organizational factor, which stimulates positive emotions and influences the sharing of knowledge in the organization.

It was also observed, in the report of a test analyst, that there is support from the organization for the balance between family and work. When something happens to the family, and the participant needs to leave the company, the request is supported by the organization, in addition to being understood and helped by the team members.

> Some people sometimes say: Ah! It happened ‘this, this and this’ with my family, today I ‘am’ a little sad or I ‘am’ in a certain situation. So we try not to disturb this person, we also try to help by giving them a helping hand, talking to them, you know what these things are like (Test Analyst II, 03/30/2017).

Thus, it was observed that the situation experienced in the family was shared with coworkers and team managers, as well as the help of colleagues when trying to internalize the positive emotions of motivation, strength, and spirit in the colleague who was facing family problems. Also, the positive emotion of patience was noticed when another interviewee reported the situation in which there was support from the team managers. This manager was concerned with investigating what affected the development of the individual's work, as one of the causes considered the possibility of family problems.

> We understand that, you know, depending on the situation, the guy grows, grows, grows, grows and then, at that point [showing a high level with his hand], he decreased [bringing his hand down]. 'Wait a minute,' let's see what happened. Sometimes, he has a problem in the family, a personal problem, all of this is done (Project assistant, 04/06/2019).

According to the situation reported in the interview, the organization tries to understand what is happening to the members and motivating their low performance at work. Thus, sharing

a family fact makes the organization aware of the employee's situation and can support him so that he maintains the balance between family commitments and his tasks in the organization. Another situation that converges to the relationship between family and work occurred when a software developer was surprised with a customer call outside the physical work environment, asking for help with a software problem, and the participant reported that he had as much patience with the client as with his family.

> You have to have a lot of patience to deal with the client [...] because, whether or not we have a family, we have a little voice trying to learn to use Facebook (Software developer II, 03/16/2019).

Patience was reported by the participant when serving the customer, which allowed this developer to share his knowledge to resolve the situation. Thus, these emotions of courage, strength, and patience can influence the sharing of knowledge. Therefore, the balance between family and work is also part of the organizational factor that stimulates positive emotions and influences the sharing of knowledge in the organization. Therefore, it was found that the organizational factor stimulates positive emotions of cheer, contentment, fun, hope, strength, motivation, patience, and pride.

THE PHYSICAL INFRASTRUCTURE FACTOR

It was observed in the interviews that collaboration is a team practice and that it is performed whenever possible. Thus, according to the same software developer, he notes that team members are grateful and happy to have learned something or been helped by someone to solve a problem that appeared in the project. It is what is perceived in the response of the software developer when asked about what he perceives in the other people with whom he shares knowledge in the moment of collaboration.

> I believe that [they, the people] are happy, right? At least the times I help the person, I think he leaves satisfied, happy. She ends up thanking him for help (Software developer III, date 03/30/2019).

Based on the report of the software developer, it is observed that collaboration generates happiness in the individual being helped and that happiness is perceived by the one who helps. It is also noticed that there is a virtuous cycle of positive emotions that, when internalized by individuals who help others, make them want to continue to share their knowledge and help

more people. This is what can be seen in the report by the same software developer and a test analyst.

> I feel happy, very happy, passionate, and satisfied. It is pleasant to 'pass on' my knowledge to someone (Software developer III, 03/30/2019)
>
> I feel very good about sharing my knowledge. I feel very happy! (Test Analyst II, 03/30/2019).

In the speeches of the two interviewees, there is a certain enthusiasm in being able to share their knowledge with their teammates. It is also noted that this collaboration allows individuals to learn to resolve work situations and still have the courage to share them with other team members. Therefore, it was found that the collaboration factor stimulates positive emotions in individuals of spirit, happiness, and gratitude.

THE LEADERSHIP FACTOR FOR INTEGRATION

The fourth and last factor observed is that of leadership, integrating the team through lunches held itself in the organization. To improve integration between team members, the project manager started organizing monthly lunches that took place during the week in the work environment. This occurred mainly after hiring new members. On occasion, the project manager scheduled a meeting with the entire team to introduce the new members and provide a moment for everyone to get to know each other. Likewise, the manager presented the importance of the role of each member of the team for the project. Then he proposed that the team meet monthly to have lunch together in the organization.

> Once a month, we have lunch together. Not everyone was going, but I said: ‘whoever can, guys, come! The presence of everyone is important to us! ’. This action improved the team's integration. Today I no longer need to do this; they do and organize these lunches alone. Somehow, they integrated. Of course, there are always those who cannot go, it is difficult to get everyone together, but most will. I noticed a certain optimism [in the members] and, thus, their motivation also improved. It inspires me more and more to do something for them (Project Manager, 03/10/2019).

This action by the project manager made the team members feel optimistic and motivated by the atmosphere of the project. The manager also felt inspired to take more actions to integrate the team. Thus, socialization events, such as barbecues or meetings outside working hours, are held with a certain frequency to celebrate the positive results achieved by the team. The positive emotions of motivated, inspired, and optimistic stimulate the sharing of knowledge in the team and even during these events, as individuals feel good in each other's company.

Thus, it was found that the leadership factor for team integration stimulates positive emotions in individuals of motivation, inspiration, and optimism.

Frame 6 summarizes and organizes the four factors presented here, with their respective positive emotions. According to this picture, the organizational factor stimulates the internalization of positive emotions such as cheer, contentment, fun, hope, strength, motivation, patience, and pride. The physical infrastructure factor stimulates the internalization of positive emotions such as courage, contentment, and motivation. The collaboration factor stimulates the internalization of positive emotions such as mood, happiness, and gratitude. Finally, the leadership factor for team integration encourages the internalization of positive emotions such as inspiration, motivation, and optimism. All of these emotions are discussed throughout the next section.

Frame 6 - Factors that influence positive emotions.

Factor	Positive emotions
Organizational	Mood, contentment, fun, hope, strength, motivation, patience, and pride.
Physical infrastructure	Mood, contentment, and motivation.
Collaboration	Mood, happiness, and gratitude.
Leadership team integration	Inspiration, motivation, and optimism.

Source: Authors (2021).

DISCUSSIONS

This research was designed in three phases. The first phase consisted of a literature review about the relationship between KM, knowledge sharing, and positive emotions, where few studies were found that pointed out this relationship. In the second phase, a questionnaire was administered to verify the emotions related and not related to the following dimensions: organizational support, organizational climate, and family-work balance. In phase 3, interviews were carried out with software development professionals and, thus, it was observed that the emotions investigated in phases 1 and 2 were confirmed by the interviewees in phase 3. Thus, four factors were observed which stimulate the internalization of positive emotions of individuals. The first factor is ‘organizational,’ which encourages the internalization of positive emotions such as cheer, contentment, fun, hope, strength, motivation, patience, and pride. The second factor is that of ‘physical infrastructure,’ which encourages the internalization of positive emotions such as courage, contentment, and motivation. The third factor is that of ‘collaboration,’ which encourages the internalization of positive emotions such as cheer, happiness, and gratitude. The fourth, and last factor, is that of ‘leadership for team integration,’ which encourages the internalization of positive emotions such as inspiration,

motivation, and optimism. Therefore, the positive emotions produced by these four factors influence the sharing of knowledge among members of the software development team.

In this context, the positive emotion of spirit, observed in both organizational and physical infrastructure factors, and also in the collaboration factor, is responsible for promoting the coordination of interaction, through subtle non-verbal channels, such as rhythm and synchrony. of a conversation with individuals. With the internalized spirit, the person tends to share knowledge because excited individuals are connected and willing to perform tasks that arise to move towards a wide variety of goals (Goleman, 2006; Pinto and Tenório, 2024).

The positive emotion of contentment is observed in the organizational factors and physical infrastructure. This emotion, when internalized, makes the individual want to share his knowledge because it arises in situations evaluated as safe, where some recent experiences or successes can contribute with new points of view (Fredrickson, 1998; Becker *et al.*, 2024).

Fun, as well as strength, patience, and pride, are positive emotions observed only in the organizational factor. The fun, when internalized, makes the individual have an instant repercussion, with laughter and entertainment in the first place (Davidoff, 2001). This contributes to the sharing of knowledge because the more individuals have fun, the more in sync, excited, and happy they are (Goleman, 2006). Strength, when internalized, is developed by the individual through frequent practice. This leads to sharing their knowledge because the positive emotion of strength is present to varying degrees in all individuals, developing courage, self-discipline, holistic thinking, and wisdom (Becker *et al.*, 2024).

In turn, patience is a positive emotion that arises over time, as an alternative to 'manners,' i.e., nervous attacks or fleeting irritation. Patience favors the sharing of knowledge since, when an individual internalizes it, he gets closer to other individuals more easily, becoming in tune with them (Davidoff, 2001; Goleman, 2011). The positive emotion of pride makes the individual have a strong conviction that he can contribute to a group and with other individuals in the organization considering what he, the individual, knows (Barrett *et al.*, 2008).

Happiness and gratitude are positive emotions observed only in the collaboration factor. Happiness is a desire to act and do things, such as dancing, singing, hugging people, reading a novel, painting or laughing and it favors the sharing of knowledge because when an individual internalizes it, it provides him with a frequent experience of emotions positive over time (Lyubomirsky *et al.*, 2005). Gratitude is a positive emotion that provides a high degree of calm. Such emotion leads the individual to share his knowledge because gratitude stems from lifelong learning (Silva, 2010), making it shared with other individuals.

Inspiration and optimism are positive emotions observed only in the leadership factor for team integration. The leader is responsible for supporting his work team, for modulating positive emotions such as inspiration and optimism (George, 2000). Inspiration is a positive emotion that, when internalized, makes the individual propose his ideas and lead them to a group to support them, valuing individual differences between individuals, leadership them to share knowledge through participation and interaction of individuals (Besen *et al.*, 2017). In turn, optimism is a positive emotion that carries with it the memory of positive events. Such emotion makes it possible to share knowledge because it presents positive expectations about the future, as well as actively seeking what is considered important (Hutz, 2014).

Positive emotions facilitate the creation of knowledge and thus improve the results of the project, in addition to favoring the reinterpretation of complex and challenging situations (Hutz, 2014). It is remarkable that positive emotions affect work in organizations, have desirable effects independent of a person's relationships with others, including better productivity and persistence in tasks. In addition, people with positive emotions benefit from more favorable responses and are more successful in influencing other people, as well as being more pleasant and possessing desirable attributes (Staw *et al.*, 1994).

People with internalized positive emotions react favorably to others, which reflects in greater cooperation between individuals. Thus, the combination of these processes leads to favorable results in the workplace, including evaluations by supervisors, higher remuneration, autonomy, feedback, support from co-workers and supervisors (Staw *et al.*, 1994). Thus, through the results of the three phases of this research (e.g., review of the literature, conduction of the questionnaire with hypothesis testing and interviews), there are strong indications that the positive emotions of individuals influence the sharing of knowledge.

However, it is necessary to remember that human emotions are constantly changing. The brain maintains balance by neutralizing the intensity of positive and negative emotions (Solomon, 1980). Human experiences arouse emotions that, in turn, trigger post-reactions, which contrast emotions, i.e., anxiety arouses a post-reaction of calm. After the experience ends, the emotion disappears, but the post-reaction persists. Therefore, if similar experiences occur frequently, the emotion of the experience weakens, and the post-reaction intensifies. Thus, it is clear that positive and negative emotions will be present to a greater or lesser extent in all individuals. Both types of emotions are malleable and constant, this interplay of positive and negative emotions is present in the daily lives of individuals, and it is important to realize the positive aspect of having both types of emotions (Solomon, 1980).

Thus, the organizational factor stimulates the internalization of positive emotions of cheer, contentment, fun, hope, strength, motivation, patience and pride; the physical infrastructure factor stimulates the internalization of positive emotions of cheer, contentment, and motivation; the collaboration factor stimulates the internalization of positive emotions of cheer, happiness, and gratitude; and the leadership factor for team integration encourages the internalization of positive emotions of inspiration, motivation, and optimism. Therefore, there is strong evidence that all these positive emotions influence the sharing of knowledge in the software development team, the object of this study.

CONCLUSION

This research investigated the factors that influence positive emotions in the knowledge sharing among the members of a software development team. We accomplished bibliographic review, data collection conducting through a questionnaire and interviews. The questionnaire, containing nineteen statements distributed in three dimensions, namely, organizational support, organizational climate and support from the organization for balance between family and work; followed by forty-one different emotions for the individual. Data were collected through field research, with fifty-one professionals from five different organizations administering the questionnaire. The analysis of the questionnaire data was performed using the Mann Whitney hypothesis test, to verify the proximity between the two independent variables, the statements, and the emotions. As a result of this second phase, a set of positive emotions related to the software development work was identified.

The interviews were conducted with ten professionals from the same software development project, following a semi-structured interview protocol. The purpose of the interviews was to investigate in detail which factors influence positive emotions in knowledge sharing among members of the software development team. The interview data were analyzed using coding and interpretation procedures.

Our findings indicate that the general goal of this research was achieved once such factors were identified and that there are strong indications that such factors influence the sharing of knowledge among members of a software development team, as they stimulate the internalization of emotions positive as cheer, contentment, fun, hope, strength, motivation, patience, pride, happiness, gratitude, inspiration and optimism. Such emotions, according to the literature, have a direct influence on the sharing of knowledge between individuals.

This research presents two relevant contributions. First, the contribution is to present findings that fill the existing academic gap related to positive emotions and knowledge sharing, which allows a closer look at the emotions of individuals and their influence on the KM theory. Second, instead of our research is limited to software projects, the four factors, identified here, could stimulate the internalization of the positive emotions of individuals and, thus, obtain the benefits of those emotions influencing different sort of teams.

For future research, a greater research effort is suggested to i) expand the sample, including representatives from different hierarchical levels, especially directors and partners and other software development teams; ii) listening to customers, collecting their opinions and perceptions about themselves, their work and the software development team that serves them; and iii) expand the study to other countries or global software projects to better understand the interference of cultural traits in positive emotions.

Finally, it is observed that the software industry is a knowledge-intensive sector and has work characteristics marked by creativity, productivity, and innovation. Thus, stimulating the positive emotions of its individuals can significantly improve Knowledge Management and, consequently, the innovation and sustainability of organizations in this industry in the market in which they operate.

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