Submission date: 04/11/2022
Resubmission date: 19/02/2023
Camera ready submission date: 21/03/2023

1st round notification: 20/01/2023
2nd round notification: 20/02/2023
Available online: 01/05/2023
Publication date: 27/05/2023

Section: extended version
Extended versions of selected papers from the XVIII Brazilian Symposium on Information Systems (SBSI 2022)

Using an Instrument to Assess Trust, Knowledge, Learning, and Motivation of Agile Teams

Eliezer Dutra[13], Cristina Cerdeiral[2], Patrícia Lima[3], Rafael Escalfoni[1], Bruna Diirr[3], Gleison Santos[3]

[1]CEFET/RJ – Nova Friburgo, RJ – Brazil

[2]Nest Wealth – Toronto, ON – Canada

[3]UNIRIO – Rio de Janeiro, RJ – Brazil

{eliezer.goncalves, rafael.escalfoni}@cefet-rj.br, {bruna.diirr, gleison.santos}@uniriotec.br, cerdeiral@gmail.com

Abstract. *Background: Trust, Knowledge, Learning, and Motivation influence the organizational environment of agile teams. Organizational climate surveys can provide concrete evidence of how the process, project activities, people, and culture work in practice. Using assessment climate instruments that do not consider agile values, principles, practices, and roles in a proper context may create difficulties in analyzing possible causes of problems and the execution of corrective actions within organizational climate management. Objective: We present a preliminary evaluation of TACT, which is an instrument to assess the organizational climate of agile teams, comprising four dimensions, Trust, Knowledge, Learning, and Motivation. Method: We planned and executed a case study considering eight development teams from three organizations. We evaluated TACT using open-ended questions, quantitative methods, and TAM dimensions of Intention to Use, Perceived Usefulness, and Output Quality. Results: TACT captured that the product owner's lack of knowledge and experience probably influenced the adverse climate in team trust and that unrealistic deadlines may have generated a lack of team motivation due to an absence of autonomy to plan the iteration. The team leaders reported intention of future use. Contributions and Impact in the IS area: TACT was grounded in scientific literature and industry observations. TACT items regarding Trust, Knowledge, Learning, and Motivation are grounded in the "agile philosophy" and consider the most common agile practices. At the same time, it allows reflections on the behaviors of the prominent involved roles in agile projects. Based on the evidence gathered, we inferred that TACT captured the organizational climate of the teams correctly and can be used to identify issues better and improve actions aligned with the agile values, principles, and practices while developing Information Systems.*

Keywords. *Organizational climate; Agile software development; Human factors*

Cite as: Dutra, E., Cerdeiral, C., Lima, P., Escalfoni, R., Diirr, B. & Santos, G. (2023). Using an Instrument to Assess Trust, Knowledge, Learning, and Motivation of Agile Teams. iSys: Revista Brasileira de Sistemas de Informação (Brazilian Journal of Information Systems), 16(1), 7:1-7:32. DOI: 10.5753/isys.2023.3005

1. Introduction

The Information Systems (IS) area community shows growing interest in investigating human factors and their effects on agile software development teams [Chagas et al. 2015, Ahmed et al. 2017, Ahmed et al. 2018, Kakar 2020, Dutra et al. 2021] and the organizational climate [Soomro et al. 2016, Serrador et al. 2018, Vishnubhotla et al. 2020, Dutra et al. 2021]. Curtis et al. [Curtis et al. 2009] suggested in the People Capability Maturity Model (P-CMM) that companies could use organizational climate surveys to identify each person's opinion on their working conditions. Organizational climate is the meaning employees attach to the policies, practices, and procedures they experience and the behaviors they observe getting rewarded, supported, and expected [Schneider et al. 2014].

To assess the different organizational climate constructs, researchers and professionals should select organizational climate instruments that have evidence of validity and reliability and that provide useful feedback to those involved in management. Graziotin et al. [Graziotin et al. 2020] reported the abuse and misuse of psychological questionnaires in software engineering research, i.e., the inappropriate use, misunderstanding about the theory of the human factor constructs, and indiscriminate change in the description of instrument items. Wagner et al. [Wagner et al. 2020] argue that software engineering research should favor using validated psychometric instruments. Developing and validating a climate instrument is challenging for researchers of the organizational climate due to difficulty finding companies willing to participate in the preliminary validation of an instrument.

Developing Management Information Systems (MIS) poses different challenges depending on the application domain. For instance, creating a financial MIS or Wealth Management (WM) is challenging due to dozens of software engineers' involvement and the necessary support of several business experts. Also, code analysis of legacy systems, team member turnover, regulatory policies, and security layers demanding from the development teams a broad knowledge of the business, a strong willingness to learn together, and teamwork trust may affect development and maintenance activities [Alasad 2020].

In this challenging environment (highly rigid, bureaucratic, and traditional), organizations have opted for using a hybrid structure considering some agile principles, frameworks, and practices defining their software development processes [Hohl et al. 2018, Reginaldo and Santos 2020, Alasad 2020]. Generally, companies have divided their work groups into agile software development teams. An agile team is an organization or team using agile development and approaches [ISO/IEC/IEEE 2018]. Management must maintain an organizational climate favorable to team autonomy in decision-making about task planning, teamwork, high knowledge-sharing, and constant learning. Keeping team members motivated in this environment is a challenge because "doing agile" is wrongly confused with "being agile" [Hohl et al. 2018]. Organizational climate surveys can provide concrete evidence of how the process, project activities, people, and culture work in practice [Tsai and Cheng 2010]. Conducting an agile climate assessment can positively impact agile transformation journeys [Reginaldo and Santos 2020]. The academia and the industry have shown interest in assessing organizational climate on agile teams

[Soomro et al. 2016, Sherman et al. 2018, Dutra and Santos 2020].

Usually, an organizational climate survey is operated through an instrument. Some organizations assemble their own questions, which can be effortless when the assessment involves measuring the organizational construct, e.g., career progress opportunities or pay and benefits [Dutra et al. 2012, Dutra and Santos 2020]. However, when the construct applied latent variables, e.g., motivation, innovation, trust, or decision-making, an instrument with good psychometric indices should be considered [Graziotin et al. 2020]. Besides, it must be evalualted whether the tool can provide reflections on the culture of the target audience [Dutra and Santos 2020]. The theory on the effects of adopting Agile Software Development Methods (ASDM) under development by Kakar [Kakar 2020] states that feedback on task and psychosocial outcomes leads to continuous improvement and learning. That also corroborates the research on the influence of human factors and organizational climate in ASDM [Dutra and Santos 2020, Serrador et al. 2018, Vishnubhotla et al. 2020]. This theory should be investigated, tested, theorized, and extended to different scenarios [Kakar 2020, Vishnubhotla et al. 2020]. Vishnubhotla et al. [Vishnubhotla et al. 2020] point out the need for further studies to investigate the influence of human factors on the organizational climate of agile teams. Our literature review indicated a lack of organizational climate instruments that assess critical factors for agility using the values and practices considered by the teams [Gonçalves 2022].

TACT is an instrument to assess the organizational climate of agile teams. TACT Previous preliminary versions [Dutra et al. 2020, Dutra et al. 2022b, Dutra et al. 2022a], comprise the dimensions Communication, Collaboration, Leadership, Autonomy, Decision-making, and Client Involvement. This paper presents TACT's evolution considering the dimensions Trust, Knowledge, Learning, and Motivation. In Dutra et al. [Dutra et al. 2022a] we presented a case study in a prominent Brazilian bank and a Canadian software house that maintain a financial MIS. This paper extends that case study by enhancing the data analysis. We (i) added a new agile team from Brazilian fintech, (ii) detailed all steps considered to develop TACT, and (iii) investigated how improvement the climate in the teams. We used qualitative and quantitative procedures to evaluate the results. The quantitative results were intertwined with the perceptions of the team members and leaders concerning the teams' climate and provided preliminary evidence that TACT measured the agile organizational environment correctly. TACT showed high-reliability evidence (internal consistency).

Next, Section 2 discusses correlated studies; Section 3 presents TACT develop; Section 4 presents the case study; In Section 5, we discuss the results; finally, Section 6 shows our final considerations.

2. Related Work

Researchers in the IS area have investigated the team climate using generics scales to measure the climate' constructs and investigated their influence relationship with other factors [Soomro et al. 2016, Gonçalves 2022]. In addition, our literature review identified four [Bhatt et al. 2006, Sharma and Gupta 2012, Serrador et al. 2018, Grobelna and Stefan 2019] studies that proposed items to assess or build a theory about the organizational climate construct in software development teams [Gonçalves 2022].

2.1. Studies Investigating Organizational Climate in Agile Teams

Many studies investigate organizational climate in software development teams [Soomro et al. 2016]. However, most of them consider the teams without mentioning the basis for the development process and utilize climate assessment models of a general nature. The studies [Acuña et al. 2008, Grobelna and Stefan 2019, Vishnubhotla et al. 2020] investigated factors that influenced the development of an organizational climate in agile teams.

Acuña et al. [Acuña et al. 2008] investigated whether the climate of software developer teams has any relation to the software product quality. The authors used the TCI© (Team Climate Inventory) instrument [Anderson and West 1998] to assess the climate. The experimental study was carried out with 105 students allocated into 35 teams. All teams adapted the eXtreme Programming method (XP) to develop the same software. The authors found that the climatic preferences of the team's vision and their participatory security perception were significantly correlated to better software. According to the authors, tracking the teams' organizational climate is essential as it is one of many indicators of the quality of the software to be delivered.

Grobelna and Trzcielinski [Grobelna and Stefan 2019] investigated how the organizational climate factors (e.g., Leadership Style, Autonomy, Rewarding, and Communication) in agile software development teams affected the regularity of work speed and the teams' efficiency. The authors prepared a questionnaire to measure the organizational climate, but the items created were not disclosed. The results confirmed that the desired organizational climate was based primarily on a positive relationship with the leader and other coworkers, commitment to work, and challenges at work. The authors argue that elements point out that the more the team's organizational climate is characterized by the team's preferences, the greater the regularity of the work speed of this team is; the more efficient the team is [Grobelna and Stefan 2019].

Vishnubhotla et al. [Vishnubhotla et al. 2020] investigated the association between personality traits and the climate in agile software development teams. The study was implemented with 43 members in eight agile teams. The authors used the TCI© instrument [Anderson and West 1998] to assess the climate for each dimension (vision, participatory security, support for innovation, and task orientation). The study identified a statistically significant positive correlation between personality (considering the trait of openness to experience) and the climate dimension (support for innovation). They concluded that regression analysis results suggest that more data may be needed. Other human factors and personality traits should also be investigated concerning the agile teams' climate.

2.2. Measures Developed for Assessing the Organizational Climate of Software Development Teams

We identified three specific measures developed [Bhatt et al. 2006, Sharma and Gupta 2012, Serrador et al. 2018] for evaluating the organizational climate of software development teams.

Bhatt et al. [Bhatt et al. 2006] proposed a Model for Outsourced Software to

investigate the influence of different factors in outsourced software maintenance. The dimension denominated ”Organizational Climate” consists of various factors involving tools, leadership, bonus, training, resources (such as PC and desktops), target difficulty, and the project’s under-staffing level. Examples of items include ”Ease of availability of tele/video-conferencing facilities”, and ”Difficulty of targets set for the maintenance team.” The authors did not report validity (factorial structure) or reliability procedures.

Sharma and Gupta [Sharma and Gupta 2012] investigated the Organizational Climate for Success of the Software Project. The authors conducted a comprehensive literature review and interviews with 300 software project managers to gauge the organizational climate factors that affected their last project’s success. Through Principal Component Analysis (PCA), the items were loaded into four dimensions: Effective Supervision, High Standards of Work Tasks, Intrinsic Fulfilment, and Role Clarity. An example of dimension Intrinsic Fulfilment is ”There were challenging tasks in my job role.” The authors also presented 23 software project risks and their relations with the investigated climate dimensions.

Serrador et al. [Serrador et al. 2018] identified organizational climate factors influencing a project’s success. Three dimensions (Top Management Support, Sufficient Resources, and Willingness to Adapt) were identified and tested to measure their ability to predict different aspects of project success. A data regression analysis from 449 projects showed that the Climate for Project Success was a significant and robust predictor of Stakeholder Success and Budget/Time success. Top Management Support and Willingness to Adapt positively influenced Stakeholder Success; Top Management Support positively influenced Budget/Time Success. Interestingly, Budget Flexibility, an element within the Sufficient Resources dimension, was negatively related to Stakeholder and Budget/Time Success. Serrador et al. [Serrador et al. 2018] claim that organizations that want to boost the success of their projects must focus on the climate development of (i) senior management support, (ii) engagement of interested parties, (iii) dedicated team, (iv) agile methods support, (v) frequent meetings with product owners, and (vi) a good team attitude to accept changes.

In a general analysis, the Bhatt et al. [Bhatt et al. 2006] model was primarily focused on outsourced software maintenance work. Serrador et al. [Serrador et al. 2018], and Sharma and Gupta [Sharma and Gupta 2012] investigated the factors that influence the climate for software project success with managers and top managers. Furthermore, the Bhatt et al. [Bhatt et al. 2006] model is old and may not reflect the contemporary critical factors, and the three models mentioned are not adapted to the agile context. However, practitioners can use the models to ground, inspire, or develop a new measure to assess the agile team’s climate. An instrument for evaluating the specific agile team’s climate can improve measurement capability, providing a more accurate diagnosis of the practices and the culture involved in agility.

3. TACT Overview

In this section, we present the concept of the *insTrument to Assess the organizational ClimaTe of agile teams (TACT)*. Instruments for organizational climate assessments measure behaviors, attitudes, or preferences [Anderson and West 1998]. As

such, TACT conception and evaluation are based on psychometry concepts [Dima 2018, Graziotin et al. 2020]. We grouped the main steps considered to create TACT and evaluate it preliminary in three phases: *TACT Theoretical Foundation*, *TACT Development,* and *Case Study*. Figure 1 shows these steps.

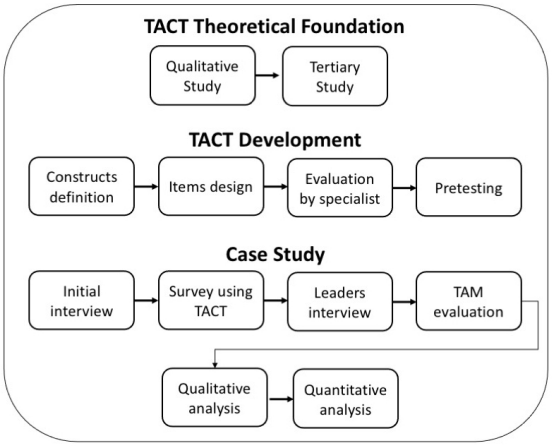

Figure 1. Main steps used to build TACT and to execute the case study

The *TACT Theoretical Foundation* phase aims to motivate, ground, and construct a knowledge base to sustain the TACT development. The *TACT Development* phase involves steps to define constructs, design items, evaluation by specialists, and pretesting. Finally, we show the activities used in the *Case Study* phase to evaluate TACT preliminary, such as data collection, a survey using TACT, team leaders' interviews, and TAM evaluation [Venkatesh and Davis 2000, Venkatesh and Bala 2008].

3.1. TACT Theoretical Foundation

In *TACT Theoretical Foundation phase*, we used *Qualitative Study* results [Dutra and Santos 2020] to define the TACT requirements. The study aimed at understanding how organizations assess the organizational climate of agile teams and which are the benefits, the difficulties, and the pitfalls associated with this assessment [Dutra and Santos 2020]. The four established requirements are: TACT should enable the assessment of the organizational climate in short cycles and continuously; TACT items should be adapted to the agile culture; TACT should provide a knowledge base that presents possible items' relationships with other human factors and project elements; and TACT should measure the critical human factors to agility [Gonçalves 2022].

In the *Tertiary Study* [Dutra et al. 2021], the authors identified 29 studies to review and summarize information about human factors. As a result, the authors identified 101 human factors that influence software development activities from different perspectives. From them, 79 influences were grouped based on their effects into Team Members, Teams, Projects, and Organizations. Furthermore, the authors identified 71 human factors and 60 influences in agile software development. We considered the most investigated factors in our *Tertiary Study* and those reported in Chagas et al. [Chagas et al. 2015] to derive the ten TACT dimensions: Communication, Collaboration, Leadership, Autonomy, Decision-making, Client Involvement, Trust, Knowledge, Learning, and Motivation.

3.2. TACT Development

The *Constructs Definition* step uses results from the literature review to define the instrument's constructs [Spector 1992]. Hence, we used the Dutra et al. [Dutra et al. 2021] results and other sources to identify (i) conceptual definitions to show a general description of the construct measured and (ii) operational definitions to understand how the construct can be assessed [Delgado-Rico et al. 2012, Spector 1992]. An operational definition describes the operations (procedures, actions, or processes) by which it could be observed and measured [VandenBos 2017]. The construct for the Trust dimension is presented below. Appendix A presents all the identified constructs to each TACT dimension.

Construct Trust

- **Conceptual definition**
  - Reliance on or confidence in the dependability of someone or something. In interpersonal relationships, trust refers to the confidence that a person or group of people has in the reliability of another person or group; specifically, it is the degree to which each party feels that they can depend on the other party to do what they say they will do [VandenBos 2017].
  - Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done [Beck et al. 2001].
- **Operational definition**
  - TRU.01. Lack of management confidence and support in agile methods can impact the enthusiasm and motivation of team members [Senapathi and Srinivasan 2013].
  - TRU.02. Team members trust the others to do their part [Dybå and Dingsøyr 2008].
  - TRU.03. Lack of client involvement can be due lack of trust [Chagas 2015].
  - TRU.04. Self-organizing and collaboration increase trust [Chagas 2015].

In the "Conceptual definition" step, we identified formal meanings that may span multiple groups and some other definitions specific to agile teams. The same idea was used in the "Operational definition" to identify elements that allow measuring the construct investigated.

Step *Items Design* aims to propose items that will be used to assess each dimension adapted to the population's culture. We used the previously mentioned constructs and examined other sources to ground the item descriptions. From [Dutra et al. 2021], we identified studies investigating human factors and their influences. From [Gonçalves 2022], we identified studies, instruments, and elements used to assess the organizational climate of development teams. We examined [PMI and Agile Alliance 2017] looking for standardized names of roles, practices, and artifacts considered in agile development. Lastly, the survey [Digital.ai 2020] appointed the primary agile practices used by the organizations. The process for creating an item is described below.

For example, to assess the Motivation dimension, we defined the item "IT63. The team has the autonomy to discuss how and when to deliver the project outcomes with the product owner." Note that the item description explicitly involves (i) the human factors autonomy and communication (see the word "discuss") and (ii) team and Product Owner (PO) roles. Analyzing the excerpt "how and when to deliver the project outcomes," it is understood that it refers, for example, to the planning of project tasks. We were also inspired by the autonomy dimension items of Organizational Climate Measure (OCM) [Patterson et al. 2005]. Appendix B shows the items proposed.

The *Evaluation by Specialist* step aims to evaluate the TACT items. We invited several specialists in agile methods to evaluate as judges of the items through the perspective of Simplicity, Cohesion, and Relevance/Representativeness [Almanasreh et al. 2019,

Delgado-Rico et al. 2012]. Almanasreh et al. [Almanasreh et al. 2019] explain that the Content Validity Index (CVI) provides evidence about the degree to which elements of an assessment instrument are relevant to and representative of the targeted construct for a particular assessment purpose. The evaluation was performed by professionals who are either experienced in agile methods or have scientific publications involving agile methods. Six specialists in agile methods accepted to participate as judges in the evaluation process of the TACT items. Table 1 presents an overview of each judge's background, experience, and dimensions assessed.

Table 1. Judges Profile

ID	Academic education	Exp	Main roles	Pub	Assessed dimensions
J1	Bachelor of Computer Science and Ph.D. in Informatics	10	Professor, researcher, and team leader	15	Trust, Knowledge, Learning, and Motivation
J2	Bachelor in Computer Science and Doctorate in Software Engineering	17	Mentor, consultant, coach, implementer, and leader appraisal of Software Process Improvement	5	Motivation
J3	Bachelor of Computer Science and Master of Technology Development	4	Scrum Master	0	Trust, Knowledge, Learning, and Motivation
J4	Bachelor's and Master's Degree in Computer Science	10	Business Agility Strategist, Enterprise Agile Coach, and DevOps Consultant	2	Motivation
J5	Bachelor in Information Systems and Master in Informatics	9		2	Trust, Knowledge, and Learning
J6	Bachelor's Degree in Information Systems and Master's Degree in Electrical Engineering	13	Developer, Product Owner, Product Manager, Product Designer, Scrum Master, and Agile Coach	6	Trust, Knowledge, and Learning

Exp = Experience on agile methods in years; Main roles = Judges' mains roles involving agile methods; Pub = Number of papers published in agile area

Analyzing Table 1, we observe that the judges are highly educated and have a wide experience in agile methods. Due to the number of items, we divided the evaluated dimensions among the six judges. We adopted this criterion based on judges' reported time availability and to avoid judges' fatigue. At least three judges evaluated each item. For this, the judges used a Likert Scale of 5 points (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). The judges considered three type of criteria to assess each item: the item is simple to understand (Simplicity); the item allows measuring the associated dimension (Coherence); and the item is relevant/representative (Relevance/Representativeness). We also consider two open-ended questions to capture suggestions for changes to items "Do you suggest any adaptation to the item description?" and "In your opinion, are any items in the dimension redundant? Which one(s)?" Supplementary material (see the link https://osf.io/hmvq2/) presents details about evaluation by specialists and TACT items.

Having the six judges finished the evaluation process, we calculated the CVI to assess Simplicity (CVIs), Cohesion (CVIc), and Relevance or Representativeness (CVIr). The calculation was made by dividing the number of judges who attributed values (4 and 5) of the Likert scale (5 points) by the total number of judges who evaluated the item [Delgado-Rico et al. 2012]. Table 2 shows the CVI values by dimension.

Table 2. Content Validity Index (CVI) by dimension

Dimension	Content validity index (CVI)			Items number		
	CVIs	CVIc	CVIr	Initial	Update	Finale
Trust	0.96	0.75	0.86	7	2	7
knowledge	0.89	0.75	0.86	7	6	6
Learning	0.94	0.84	0.88	8	4	6
Motivation	0.91	0.82	0.93	11	7	8

CVIs = Content Validity Index for Simplicity; CVIc = Content Validity Index for Coherence; CVIr = Content Validity Index for Relevance/Representativeness.

All CVI values were acceptable ($>= 0.7$) [Delgado-Rico et al. 2012]. The first author and another researcher discussed all comments and suggestions made by the specialists. After that, we made adaptations and exclusions in items accordingly (see Table 2). For instance, the CVIs values were 0.5 (see Supplementary material) for the item *"The product owner scans the organizational environment to deepen knowledge about software requirements."* Then, due to the CVIs values, we opted to exclude the item. In another example, a judge suggested the adaptation of an item. He proposed changing *"The product owner has sufficient knowledge about the users' actual practice"* to *"The product owner has sufficient knowledge about the users' actual needs."* In this case, we accepted the suggestion.

Finally, a *Pretesting* was performed with 2 developers to identify possible problems of interpretation for the TACT items and layout. In the end, the developers reported no difficulties in answering the survey. A layout suggestion presented in this step was implemented by the authors. To continue the preliminary assessment of TACT, a *Case Study* [Yin 2013] was performed and is described in the next section.

4. Case Study

A case study is commonly used to investigate a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not evident [Recker 2013]. Therefore, the case study evaluated the cases addressed and TACT itself [Recker 2013].

4.1. Case Study Planning

Our *goal* was to understand the teams' climate and gather initial evidence if TACT measured the climate context correctly. To achieve the aim, the *research questions* (RQ) are defined as follows:

- RQ1. How is the organizational climate in the examined agile teams?
- RQ2. How was TACT's performance in the climate assessment?
- RQ3. How to improve the organizational climate in the examined agile teams?

The *participants* are software engineers from three organizations, named B, C, and D for confidentiality purposes. We considered both small and large organizations. Each organization's mediators indicated teams by convenience to participate in the case study. Organization B teams were nominated B1, B2, B3, and B4 and Organization C teams were C1, C2, and C3. Finally, the only team in Organization D was named D1. We used a consent form to guarantee data confidentiality and to present and assure ethical aspects.

Organization B is a prominent Brazilian bank with millions of customers. It has dozens of development teams composed of employees and outsourced collaborators. Regarding leadership, some teams have a Scrum Master, but in others, this role is played by the hierarchical leader of the team. Business experts perform the function of PO. Each team defines the software development process and can choose traditional (structured and RUP) or agile (Scrum, Kanban, XP) methods, among others.

Organization C is a Canadian technology company with more than 20 years of existence. It develops a Wealth Management (WM) system. Its software process is based on Scrum and, in a lesser degree, SAFE. The software development teams have one technical lead, one Scrum Master (shared with another team), one PO, from 2 to 4 developers, and one quality champion (i.e., a developer also accountable for the quality assurance activities).

Organization D is a fintech specialized in instant payment systems. It has 19 employees, of which 9 work in a single development team. Its software process is based only on Scrum. The roles considered in the process are the PO, tech leader, developer, and quality analyst. The Chief Technology Officer plays the Scrum Master role.

For the *data collection*, we used TACT and interviews. For Organizations B and D, we used both instruments in Portuguese. For Organization C, we used English versions of the instruments. The first and third author conducted the interviews with Organizations B and D. The second author conducted the interviews with Organization C. Data collection took place between May and November 2021. The first procedure was the assessment of the organizational climate in the teams. All team members were invited to participate voluntarily and anonymously in the study. In addition to the items present in TACT, we also asked each team member's characteristics. Two additional open-ended questions were introduced ("*In your opinion, what most influences the [trust, knowledge, learning, and motivation) dimension in your team?"* and *"How to improve your team's organizational climate?"*).

The second procedure involved semi-structured interviews with the leaders of the respective teams. These interviews were designed to present the climate assessment results and capture the leader's perception of TACT and the team's organizational climate. To do this, they were asked some questions such as *"How do you evaluate the results, by dimension/item, of the organizational climate assessment carried out by the team? Do the results by dimension/item represent your perception of the team's daily life?"*. We were only able to conduct interviews with B1, B2, B3, B4, C2, and D1 teams leaders. At the end of the interview, we sent a link to the leaders to evaluate TACT through TAM (Technology Acceptance Model) [Venkatesh and Bala 2008]. The dimensions of Intention to Use, Perceived Usefulness, and Output Quality were used [Venkatesh and Davis 2000, Venkatesh and Bala 2008]. In the interviews, we used a consent form to present and assure ethical aspects.

For the *data analysis*, we used analysis of frequencies, polychoric correlations matrices [Almanasreh et al. 2019], Iclust Graphs [Revelle 2018], and α-Cronbach value for quantitative analyses. We also considered evaluation using TAM and reports from the participants. In the qualitative analysis, we used direct quotations to reference the

answers to open-ended questions in the climate assessment and the leaders' interviews. Our goal was to show qualitative evidence concerning the teams' climate context to the measured TACT dimensions to offer the reader explanations of the climate formation. Thus, a chain of evidence was established through the quantitative and qualitative results. To answer RQ3, we used thematic analysis [Cruzes and Dyba 2011, Saldaña 2013]. The first themes used in the coding were the human factors considered by TACT items (e.g., communication, motivation, and trust). In case the answer written by the team member could not be associated with any human factor, project elements (as planning) were used. The first author analysed the data. The results were discussed and revised by the other authors.

4.2. Case Study Results

Table 3 shows the team profiles. In total, 39 team members participated in the study. The team members are aged around 40 years, all members have an under-graduation degree, and 10 (26%) have a master's or doctorate, 16 (41%) participants have more than five years of experience in agile methods, 13 (33%) of the respondents were female. Teams B4 and D1 are the newest in the sample. Their team members have been working together for less time than teams B1 and C2. Moreover, organization C teams have more experience than Organization B teams in agile methods. In general, considering the computer area, there is gender diversity in the sample. The respondents are highly educated, have experience in agile methods, and have worked together for over a year.

Table 3. Teams profile

Team					Gender		Experience			Time		
ID	Country	Size	Part.	Age (σ)	M	F	3 to 4	5 to 9	>= 10	<= 12	13 to 23	>= 24
B1	BRA	9	7	41(8)	4	3	6	1	0	0	1	6
B2	BRA	5	4	53(8)	4	0	3	1	0	1	1	2
B3	BRA	4	3	46(8)	1	2	2	0	1	1	2	0
B4	BRA	4	4	42(6)	2	2	4	0	0	4	0	0
C1	CA	5	3	38(5)	2	1	1	2	0	0	2	1
C2	CA	5	5	40(11)	3	2	0	4	1	0	2	3
C3	CA	5	4	37(4)	3	1	0	3	1	2	2	0
D1	BRA	9	9	30(4)	7	2	7	1	1	7	0	2
Total		46	39	40(6)	26	13	23	12	4	15	10	14

Experience = in agile (year); Time = allocated together (month); Part. = Participants; (σ) = Standard deviation; BRA = Brazil; CA = Canada

4.2.1. How is the organizational climate in the examined agile teams (RQ1)?

Table 4 and Table 5 show the frequencies value for each dimension assessed. The "Dimension" column represents the description of the dimension. For each team, the relative frequencies (count for each value assigned by the members) and absolute frequencies (percentage in parentheses) were calculated according to the aforementioned Likert scale. In Table 4 and Table 5, we chose to count the values "strongly agree" and "agree" in the column "Positive", and "strongly disagree" and "disagree" in the column "Negative". Finally, we considered the frequency of "neutral" to categorize the organizational climate as neutral. Higher frequencies in the "Positive" column can be considered a favorable organizational climate to each dimension. Likewise, higher frequencies in the "Negative" can be considered an adverse climate.

Table 4. Results of the organizational climate assessment for the Trust and Knowledge dimensions

Team	Trust (%)			Knowledge (%)		
Name	Negative	Neutral	Positive	Negative	Neutral	Positive
B1	22 (45%)	7 (14%)	20 (41%)	18 (43%)	8 (19%)	16 (38%)
B2	2 (7%)	3 (11%)	23 (82%)	2 (8%)	0 (0%)	22 (92%)
B3	1 (5%)	1 (5%)	19 (90%)	6 (33%)	3 (17%)	9 (50%)
B4	0 (0%)	1 (4%)	27 (96%)	2 (8%)	1 (4%)	21 (87%)
C1	1 (5%)	4 (19%)	16 (76%)	4 (22%)	5 (28%)	9 (50%)
C2	3 (9%)	7 (20%)	25 (71%)	13 (43%)	4 (13%)	13 (43%)
C3	0 (0%)	5 (18%)	23 (82%)	2 (8%)	11 (46%)	11 (46%)
D1	1 (2%)	3 (5%)	59 (93%)	5 (10%)	10 (18%)	39 (72%)

Table 5. Results of the organizational climate assessment for the Learning and Motivation dimensions

Team	Learning (%)			Motivation (%)		
Name	Negative	Neutral	Positive	Negative	Neutral	Positive
B1	15 (35%)	17 (40%)	10 (24%)	18 (32%)	17 (30%)	21 (37%)
B2	0 (0%)	0 (0%)	24 (100%)	3 (9%)	1 (3%)	28 (87%)
B3	1 (6%)	4 (22%)	13 (72%)	9 (37%)	2 (8%)	13 (54%)
B4	2 (8%)	3 (12%)	19 (79%)	2 (6%)	0 (0%)	30 (94%)
C1	0 (0%)	7 (39%)	11 (61%)	2 (8%)	2 (8%)	20 (83%)
C2	3 (10%)	4 (13%)	23 (77%)	7 (17%)	7 (17%)	26 (65%)
C3	0 (0%)	8 (33%)	16 (67%)	1 (3%)	5 (16%)	26 (81%)
D1	0 (0%)	3 (6%)	51 (94%)	2 (3%)	6 (9%)	64 (88%)

When analyzing the results in Table 4 and Table 5, higher frequencies can be observed in the "Positive" column in several dimensions for the majority of the teams, except for the B1 Team since a negative organizational climate can be observed in every dimension. Together, neutral and negative results represent points of attention for analyzing possible causes and impacts on active roles, elements of the process, the development project, or the team's culture in general. For example, the non-positive evaluations for the knowledge dimension are above 45% (considering negative plus neutral) for B3, C2, and C3 Teams. Analyzing the aggregate results of negative and neutral elements can be a good strategy for climate management.

In the following sections, we investigated the results of organizational climate assessment with TACT items by dimension. The quantitative results were intertwined with the answers to the open-ended questions asked to the team members and the team leaders' interviews. We emphasize that team leaders and members did not have access to the answers to their respective teams' open-ended questions.

Analysis from Trust Dimension: Analyzing the Trust dimension (see Table 4), we observe a positive climate for all teams except the B1 team. The negative highlight in B1 Team was the item IT43, which assesses trust between the team and the PO.

The B1 Team had the worst performance for the Trust dimension (45% of the items assessed negatively). Questioned about the factors that most influence the trust in the team, the members said, *"the outsourced developers are upstanding and committed, the others have no idea what they're doing," "there is a lack of commitment among some members," and "there is no consistency at work. Priorities constantly change, especially when it comes from the PO's work."*

Regarding the Trust dimensions, the B1 Team Leader said, *"the results are posi-*

tive when related to the team or team members (IT38). However, at the time of the survey, there was an apparent lack of trust concerning the PO (IT43) as there was no clear alignment between the several POs envolved, generating the lack of confidence. Another point is (the perception of) agility (IT39), concerning knowledge and management support on agile values, principles, and practices as the team performs a hybrid methodology. Agility is starting, and we are using only some (agile) practices. From this, the team may understand that the management does not have as much knowledge to provide the necessary support."

The B2 team members (82% positive) highlighted *"Teamwork and commitment," "Transparency"* and *"The entire team's commitment to delivering an excellent product."* The B2 Team leader confirmed these statements. She declared, *"regarding trust in the team and the individual components of the team (IT39, IT41, and IT42), the percentage is very positive. Trust and knowledge among the team are very high. Everyone is on the same curve. Only the PO (IT43) was out of line with the whole. We had a problem with the PO; he did not know the product, so the team did not trust him."* The item IT43 had only one value assessed as negative and the other as neutral.

Analyzing the results of the B3 Team, the leader said, *"the team is united. They (members) work well as a team, help each other, and have complementary profiles. The team perceives the commitment and availability of the PO. There is trust among team members, and they have been working together for almost a year and no loss or inclusion of new employees, stable staff, and high productivity."* Corroborating the leader's statement, one member wrote, *"the team is cohesive. They have been working together for some time, and knowledge complements each other."*

The C1 and C2 Teams members have confirmed the environment of trust. They reported, *"everyone wants the best as a team," "we have the willingness to admit mistakes and ask for help when required,"* and *"the team has coordination and open communication."*

The C2 Team leader commented on the neutral evaluation in items IT39 (support for agile) and IT43 (trust in the PO). She said, *"there was some perception that management was not supporting proper agile practices. The PO was hired without proper business knowledge and could not provide clear information to the team. Also, the client was not engaged by the PO or the team."* The C2 Team leader declaration was confirmed by a team member, who wrote, *"the PO does not have business knowledge, so sometimes the team misses proper requirements." Another team member reported that the team's climate most influences are "the management" and "professionalism of team members."*

Analysis from Knowledge Dimension: Table 4 shows that only the B2 and B4 Teams presented a positive climate superior to 85% in the Knowledge dimension.

A B2 Team member confirmed the excellent environment. He wrote, *"the experience and daily interaction together with the exchange of knowledge and experience that end up happening when there is any doubt or need to deepen a certain item."* Another member of the B Team pointed out that the biggest challenge facing the team's work is the *"difficulty of prioritizing"* for the knowledge dimension. Regarding the Knowledge

dimension, the B2 Team Leader said, *"the tracking of functionalities, the backlog and the kanban are well organized. Everything is documented, so inputs are easily located even if there is an exit/entry of team members. The whole team, including those who joined it recently, has extensive knowledge of the product business and the system. The organization offers training and qualification to (OMITTED Company) and the outsourcing company."*

The B4 Team had 87% positive values to the Knowledge dimension. Team members did not comment. However, the team leader said, *"the PO is very present and available (...) despite being a new team, some members had already worked together, so this ends up strengthening and uniting the group."*

Considering the results of the knowledge dimension, the worst consequences were those from the B1 and C2 (43% negative) teams.

We identified an unfavorable and troubled climate by analyzing B1 Team members' comments. They declared, *"part of the team knows a lot, and the other does not care to learn," "many people do not seek the knowledge they need (PO, for example). Therefore, we always need extensive meetings with managers (PO and stakeholders), which, if they happened frequently, would not need to be extensive. Some people are centralizers. Other people do not seek transparency for fear of influencing productivity," "the team is not as committed as it should be and needs to look for more technology and business knowledge."* Analyzing the negative result for items IT45 (loss of knowledge with the exchange of members) and IT47 (loss of knowledge between client and team), the B1 Team Leader comments, *"Concerning IT45, it is related to the software factory. The (OMITTED Company) team is very dependent on the (software) factory. If all the factory members go out to service, we do not have the (OMITTED Company) internal technical capacity to continue the system. There is no internal developer, what makes it very difficult. There is no transfer of knowledge. It exists on paper, but it does not happen. When it happens, it can suffer distortion and loss of information. It is not straightforward (referring to IT47 item)."*

In the C2 Team, a member wrote, *"there is little or no training on the business. Our PO does not know the business (he relies on other people). The team depends on people who know the legacy code because lack of documentation. Also, most of the time, we do not have clients/users' feedback during the development process."* In the analyses of possible causes of negative assessment in Knowledge dimension, the C2 Team Leader said, *"the team had to understand the legacy code to migrate it to the new tech. The legacy code was poorly written/designed and it is hard to understand, and there was almost no documentation to assist that. Therefore, there was a high dependency on people with some knowledge of business rules."* A member appointed a suggestion to improve the team knowledge. He wrote, "we need formal and informal knowledge transfer sessions among team members."

According to the D1 Team evaluation, the worst result was in the Knowledge dimension. Unlike in C2 Team, the PO knowledge was evaluated positively in all assessments (IT50). Corroborating this quantitative result, the member wrote, "the PO performs its role very well." On the other hand, the D1 Team members wrote, "we need greater availability of leadership," the organization does not have a training program," and "the

knowledge transfer process needs to improve."

Analysis from Learning Dimension: The B2 Team was unique to show 100% of the items evaluated as positive, the B1 Team obtained the worst result (35% as negative), and the other teams had positive climate between 60% and 80% (see Table 5).

B2 team members highlight the team supports knowledge sharing, positively influencing the team climate. As the leader said, *"the retrospective meeting is used to 'lay the cards on the table,' everyone speaks, and actions are recorded so that they can be put into practice."*

The B1 team evaluated 15 out of 42 items (7 members multiplied by 6 items) as negative (36%) and 17 out of 42 items (40%) as neutral. Item "IT54 The team aims to continuously improve existing agile practices and incorporate new Software Engineering practices" was the most negatively rated item (4 as negative, 2 as neutral, and 1 as positive). Regarding IT54, the B1 team leader said, *"the team is still not running fully agile, despite using some practices. The PO is also not interested in using the practices that agility offers."* Somewhat, team members reported a lack of team interest and a lack of incentive by the management to improve learning. They wrote, *"I perceive that the team does not search for learning opportunities," "there is no incentive or interest for most people to learn something new,"* and *"...support (it's no use for the team to be willing, but hierarchically to be 'hindered."* About item "IT56. The team discusses new emerging technologies," the B1 team leader declared, *"there is no discussion of emerging technologies. There is rarely anything that uses API, BUS, but the transaction is carried out daily in a batch way."*

In the C2 Team, the item "IT52. In this organization, people are promoting the effective use of agile methodologies" obtained only one evaluation as positive. The C2 Team Leader said about this assessment, *"there was some perception that management was not supporting proper agile practices. Therefore, the team felt uncomfortably pressured."* The team members show positive points. They wrote, *"the collaboration level of the team helps us all learn from each other"* and *"the team itself is the highlight."*

The Learning dimension was evaluated as the better one by the D1 Team (6% as neutral 94% as positive). D1 Team members reported *"cooperation among team members regardless of their level of knowledge"* and *"our organization is growing, so there are many newcomers in the team who still need support to perform the tasks"*. Concerning Learning, the D1 Team Leader said *"I think our main difficulty is the lack of trust. We use several technologies (programming languages), and the developer doesn't want to use another language. I think they don't have enough confidence or they don't want to learn another language."*

Considering all teams, item "IT55. The team teaches me how to handle my difficulties in the tasks" deserves to be highlighted for its positive evaluation. Twenty-three members, i.e., 85% of the sample, confirmed the perception of self-help among team members.

Analysis from Motivation Dimension: In this dimension, autonomy was the most discussed theme. The B1 Team member wrote, *"we don't have autonomy."* In the

B3 Team, members analyzed *"the lack of autonomy to define the deadlines for carrying out tasks negatively influences the team's motivation"* and *"the lack of autonomy directly influences the team's motivation. The team runs into the Company's internal bureaucracy that does not provide tools and grant access to the customer's environment quickly."* In the C2 Team, a developer reported, *"...unfeasible deadlines deliver stress and hurt the team autonomy in planning its tasks."*

B3 and C2 Team leaders corroborate the analysis of the team members. The B3 team leader said, *"the Motivation dimension has the most negative responses. The current project is critical, with short delivery times, pressure and stress. The first iterations were planned according to the delivery deadline, and there was no or little autonomy of the team regarding the deliverables or adopted architecture."* In the same direction, the C2 Team revealed, *"the team was being asked to finish a project in an unrealistic deadline and not being heard about the risks, which resulted in a lot of stress. Even their bonuses were mentioned as a possible impact of that project's success. During this situation, the team felt "abandoned," expecting management to come around once realizing there were impossible deadlines, which explains the lack of clear planning perception. Due to this situation, the team was always told when to deliver, and suffered pressure to cut corners and lower quality, losing autonomy on both when and how."*

The lack of the teams' autonomy manifested through the product delivery fixed deadlines and the lack of planning considering the speed and capacity of the team, probably generating a lack of motivation and stress in developers. In the sample, the items with the most negative ratings were IT61 (feel stressed and pressured to execute the tasks), with 16 assessments as negative and 5 as neutral, and IT62 (the team organizes its tasks'), which has 7 negative reviews and 7 as neutral.

The satisfaction of seeing the product delivered and being helpful to clients motivates the team. The B1 Team members wrote: *"product delivery impacts our (team),"* corroborating the statement from C3 team member, *"product delivery influences motivation positively."* The B2 Team member reported satisfaction and recognition as motivation factors. He wrote, *"our motivation driven by pride and satisfaction in seeing the product delivered and useful to the customer."* D1 Team Member reported that the degree of interest influences motivation. He exposed that *"people that are more discouraged or not so interested end up negatively influencing motivation and product delivery."*

Analyzing the sample, we did not note differences in opportunities between the gender. All-female participants (13 out of 13) evaluated the item "IT58. In the current project, I have opportunities to develop my skills and knowledge" as positive. Corroborating this result, 20 out of 26 male members also evaluated the "IT58" item as positive. We also observed that team members (30 out of 39) feel recognized ("IT59") for their work.

4.2.2. How was TACT's performance in the climate assessment (RQ2)?

Analyzing the answers to the open-ended questions asked to the team members, together with the leader interviews, we have observed that it allows us to infer that the TACT could

correctly capture the organizational climate of the investigated teams. We also found that the TACT items allowed team members to reflect on their activities and feelings by answering open-ended questions. The members said, *"we need a space for the factory (outsourced company) to feel free to talk about what bothers us. Like this form (TACT),"* and *"if there is more dialogue and exchange among team members and other teams, I'm sure we will change many aspects of the key points discussed by this form (TACT)."*

To continue the assessment of the performance of TACT, we invited team leaders to evaluate TACT considering TAM dimensions of Intention to Use, Perceived Usefulness, and Output Quality [Venkatesh and Bala 2008]. Some items that considered the assessment were *"Assuming I have access to the instrument, I intend to use it," "Using the instrument improves my performance in my job"* and "*The quality of the output I get from the system is high."* Considering a Likert scale, most of the leaders' responses were the options "Somewhat agree" and "Strongly agree" for all items of dimensions of Intention to Use, Perceived Usefulness, and Output Quality. Only three leaders participated in this evaluation.

Besides the qualitative evidence presented, we chose to continue investigating initial evidence of the validity of TACT. The adopted procedures have an initial exploratory purpose and are not conclusive because of the small sample size (n = 39). The quantitative results were processed using the R tool (v. 4.0.2) using primarily the *psych library* [Revelle 2018]. To investigate the initial structure of the TACT dimensions, their reliability, and how the items are interrelated, we plotted the polychoric correlations matrices and Iclust Graphs of TACT dimensions (Fig. 2).

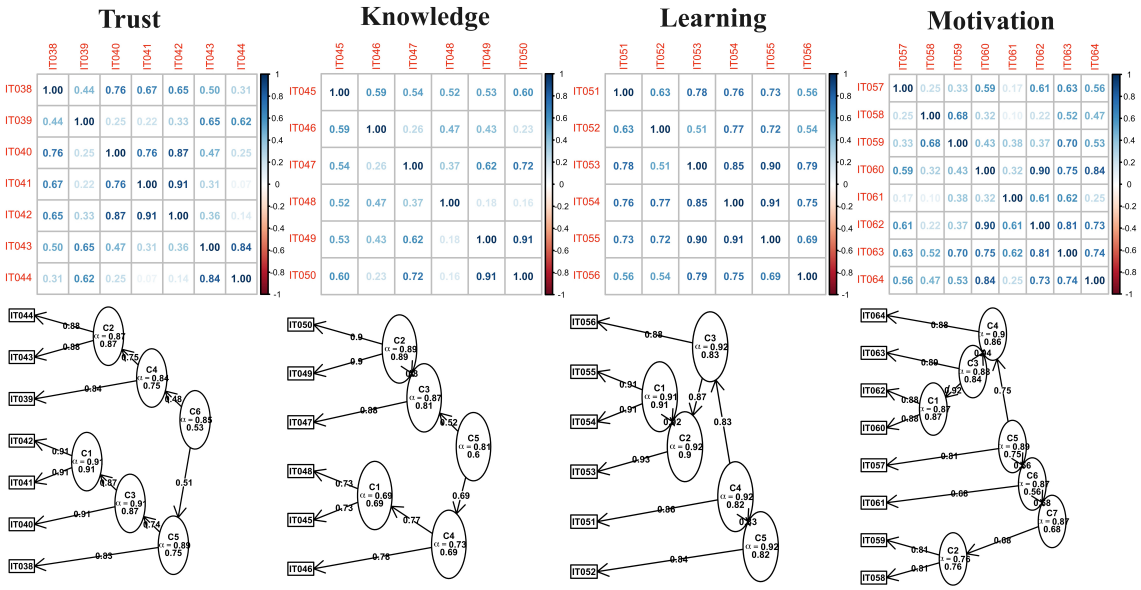

Figure 2. Correlation matrix and Iclust graph of the dimensions

Polychoric correlations are the best option to analyze latent constructs, which are measures using a Likert scale (ordinal date) [Field et al. 2012]. A correlation with other variables of the same dimension in latent variables is expected [Field et al. 2012]. If sev-

eral correlation values are below 0.3 in the dimension, it is possible to exclude the items. Conversely, correlations with values above 0.8 can be considered multicollinearity (i.e., very correlated variables) and singularity (perfectly correlated variables). In this case, it may also be viewed as excluding variables. Field et al. [Field et al. 2012] argue that the process of excluding items is an empirical one. In this study, we decided not to exclude any items.

We analyze the reliability using clusters, also considering the β coefficient (see Figure 2, the second value into the cluster), a more conservative estimate of reliability [Revelle 2018]. The purpose of cluster analysis is to reduce the complexity of the data and try to identify homogeneous subgroups. The item cluster analysis (iclust algorithm [Revelle 2018]) examines similarities among items. It generates solutions by grouping items to maximize the value of Cronbach's α on the resulting scale, considering the coefficient β [Revelle 2018].

Analyzing the polychoric correlations matrices (Figure 2), we can observe: i) absence of negative correlations; ii) IT39 and IT44 with insignificant positive correlations with several variables, iii) few variables of the same dimension with very high values (e.g., IT55), and iv) in general, high and moderate positive correlation among items in the dimensions. Critical values of correlations (0.9 to 1 - very high; 0.70 to 0.90 - high; 0.51 to 0.70 - moderate; 0.31 to 0.5 – low; and 0 to 0.3 - insignificant) [Hinkle et al. 2003].

Considering the Iclust graphics and matrices of polychoric correlations (see Figure 2), we can observe in the Trust dimension that the items IT41 and IT42 have a high and moderate correlation with other items. The C1 cluster shows the best values (0.91) for α and β. Together with the C3 cluster (IT40) the best solution was identified (α = 0.91 and β = 0.87). Thus, IT40, IT41, and IT42 may be considered in a possible item reduction. Concerning the Motivation dimension, more clusters (7) are observed among all dimensions and lower β values in the final clusters (e.g., β = 0.68 in the C7 cluster). This segregation of clusters may indicate different types of motivation in the dimension or a specific composition for the sample. Anyway, more studies are needed to assess the structure of the dimensions. The C4 cluster demonstrates value for Motivation dimension (α = 0.9 and β = 0.86). Thus, IT62, IT60, IT63, and IT64 may be considered more influential and used in item reductions. Cronbach's alphas (α) of all of the dimensions were over 0.8 (acceptable) [Field et al. 2012].

4.2.3. How to improve the organizational climate in the examined agile teams (RQ3)?

To answer this research question, we asked, "How to improve your team's organizational climate?" to all participants. Table 6 presents the actions suggested by the team members. The actions ("codes") and categories presented were identified using the thematic analysis procedures described in Section 4.1. In summary, we identified 25 actions. We showed the suggested actions grouped by organizations B, C, and D. We highlight that we did not critically analyze the relevance or coherence of the participants' suggested action on the open-ended question. Direct quotes reported by team members also are presented.

Table 6. Actions to improve the team's climate suggested by its members

Team	Category	Actions (Code)
B1	Knowledge	Promoting knowledge about the product in development
	Teamwork	Improving the teamwork feeling
	Engagement	Improving the Project Manager's engagement in the project/client - Outsourcing
	Engagement	Performing the organizational climate assessment considering the outsourced team members
	Engagement	Promoting the members' engagement in the remote team
B2	Work overload	Hiring more team members
	Recognition	Recognizing teamwork
B3	Communication	Communicating all changes, improvements, and corrections regarding the developed product to the team
	Knowledge	Training the team in new technologies
	Knowledge	Stimulating knowledge sharing among team members
	Communication	Improving communication in the team
C1	Autonomy	Giving autonomy for developers to define release deadlines
	Autonomy	Using flexible releases planning
	Transparency	Top management should be more transparent
	Learning	Implementing agile methods effectively
C2	Recognition	Recognizing teamwork
	Autonomy	Giving developers autonomy to define the delivery deadline
C3	Planning	Conducting objective meetings
		Avoiding unplanned scope changes
D1	Knowledge	Improving knowledge on the development process
	Sense of belonging	Emphasizing the importance of each individual to the success of the team
	Collaboration	Team members should ask for assistance to deal with difficulties in performing tasks
	Planning	Improving iteration planning
	Planning	Better organizing the workflow
	Planning	Making planning tasks clearer

As per Table 6, B1, B2, and B3 team members answered our question. The B1 team members work together for longer than the B2 and B3 members. However, that was insufficient to produce an "Engagement" climate among team members. The "Engagement" actions are most actions suggested to improve the climate. Concerning "Engagement", the members wrote, *"the project manager should engage more in the project daily activities to keep up with the difficulties faced by the organization and the client company"* and *"it is a challenge to engage and manage a team remotely to promote improvements in the organizational climate."* In the B2 team, a member reported "Work Overload." He wrote, *"we have a lack of resources today, which, if addressed, would improve and ease the burden of needing to perform different roles without the necessary time to perform them."* The B3 team members cited the "Communication" and "Knowledge" categories. They wrote, *"communication product changes, enhancements, and fixes should be exposed to the whole team to increase the knowledge of the product, learning of new technologies, and facilitate decision making for new definitions"* and *"I believe that more integration among the whole team and spreading the knowledge widely among the project members can increase the team motivation. Currently, I work in two teams with very distinct characteristics. One team is totally dedicated to a single project; everyone exchanges ideas during the day, and the leader puts himself on an equal footing with the team members, even sharing his tasks during the daily meeting. On the other team, everyone barely talks to each other. Each team stays isolated without exchanging related perceptions that could connect the project from end to end. Should the team dialogue more and promote information exchange, I am sure we would improve many aspects related to the critical points discussed in the climate evaluation."*

In the Organization Canadian (C), team members reported actions to improve the climate, mainly concerning the Autonomy to Plan. They exposed, *"deadlines should not be assigned because agile projects don't work that way. We follow a strict and rigid release model. Also, I feel some of the uncertainties are not considered," "we should have flexible releases instead of fixed releases throughout the year, so we are not tied to a specific deadline, and more transparency from upper management,"* and *"unfeasible deadlines stress and hurt the team's autonomy in planning tasks. Also, there is a lack of proper recognition."*

In the D1 Team, the "Planning" category had three actions. A team member reported *"I believe that at the moment, we should just organize the workflow so that tasks are defined more and more clearly."* Concerning "Knowledge," a team member reported that *"improving the knowledge transfer processes"* may improve the climate. Another member reported dissatisfaction about "Collaboration." He wrote, *"if people were more open to asking for help on things they have difficulty with (...), it would bring a sense of evolution to the whole team, making the climate more pleasant, everyone closer together technically speaking."*

In Table 6, it is possible to notice that the suggested actions represent each team's specific needs to improve the team's environment. This analysis is essential to strengthening the relevance of measuring the climate at the team level. Bringing the discussions about climate management to the agile team could increase the members' motivation, recognition, and sense of belonging. We present other actions that can be taken to improve the climate in the next section. For this, we consider the literature, the quantitative results, and reports from team members and leaders.

5. Discussion

5.1. Case Study

We execute a case study to preliminarily assess TACT and its dimensions of Trust, Knowledge, Learning, and Motivation in eight agile development teams. The case study was carried out in two Brazilian Organizations and a Canadian company developing Management Information Systems (MIS) in the financial domain. In addition to the items established in TACT, open-ended questions were used to understand the context. Ultimately, we interviewed the team leaders to understand the possible causes or impacts of the items evaluated. TACT evaluated the organizational climate of the teams adequately. Therefore, we have initial evidence about the influence of human factors such as trust, knowledge, learning, and motivation in forming organizational climate in agile software development teams. This evidence is grounded in assessing climate using the TACT items, the team's reports, and the leader's interviews.

It is worth remembering that the TACT instrument measures latent variables (e.g., manifest behavior, feelings, or those that can be directly measurable). According to Boehm and Turner [Boehm and Turner 2003], the main differences between traditional process and agile approaches lie in the people issues. The authors reported that the customer, developers, and organizational culture have a significant influence on the success of agile projects. Several years have passed since the initial discussions proposed by Boehn

and Turner [Boehm and Turner 2003]. However, the challenges are still latent, including for banking companies [Alasad 2020].

PO, the customer representative: The PO was responsible for managing the product backlog in the investigated companies. Boehm and Turner [Boehm and Turner 2003] explained that the customer should be Collaborative, Representative, Authorized, Committed, and Knowledgeable (CRACK). An unfavorable organizational climate was manifested in teams in which the PO had no knowledge of the business domain or experience. Within the B1 Team, business managers conduct the PO activities. Concerning PO activities, the B1 Team Leader said, *"we have three business managers (PO), so things get little loose ends. They have not yet reached a consensus on who will own the product. At the moment, each one answers for one part of the system, so sometimes it gets very confusing for the team and the business managers themselves."* She adds by analyzing the business model adopted by the Company, *"the model does not favor knowledge training/management. A business manager (PO) who alone takes care of 6 products. To whom and how will he pass on knowledge of his own? If he leaves the area, knowledge is gone. It is a chronic problem that the organization presents."*

In the C2 Team, the negative assessment captured by TACT in the members' reports and the leader's interview were not about a person's dissatisfaction but exclusively the lack of knowledge of the PO. The C2 team members evaluated the PO commitment "IT43" as positive, but the item "IT50" about PO Knowledge was evaluated negatively by all team members. On the other hand, in the B3 and C3 Teams, all TACT items describing the PO activities were evaluated as positive. Corroborating the quantitative data, a C3 Team member wrote, *"the PO does an excellent job analyzing business requirements."* The leader said about the B3 Team PO, *"sometimes the PO has difficulties specifying business/product rules and reflecting some changes during functionality development. But the team perceives his commitment and availability."*

Team Members: Critical factors for success in agile methods include trust, knowledge, and learning [Dutra et al. 2021, Chagas et al. 2015]. Boehm and Turner [Boehm and Turner 2003] argued that agile methods tend to need a richer mix of higher-skilled-talented people. We believe that a favorable climate can influence several other factors. In comparison, an adverse environment can negatively affect the project's success.

All B1 Team evidence indicates an adverse or deliverable climate for all dimensions. There is friction between outsourced members with company employees. A Team member reported, *"part of the team knows a lot, the rest doesn't care to learn."* Another member wrote, *"the PO is often rude, even humiliating (rarely) the team, making it seem like we are in their shoes (The project has three PO). He does not master the knowledge about his own business. Many of the development team's ideas do not even get heard because managers (PO) feel like we are taking their authority away."*

A B4 Team member was allocated in two teams with outsourced and company employees. However, she highlights the differences when the team trusts and has active leadership. She reported, *Currently, I work in 2 teams with very different characteristics: one team is totally dedicated to a single project, where everyone exchanges ideas during*

the day and the leader puts himself on an equal footing with those he leads, including sharing his daily tasks with us. In the other team, members speak ill of other members all the time. Each team remains isolated to its core without exchanging related perceptions between subjects that are integrated, connecting the end-to-end project."

Agile Culture: Boehm and Turner [Boehm and Turner 2003] reported that in agile culture, team members feel comfortable and empowered when they have many degrees of freedom to define and work problems. Team members reported a lack of autonomy to define deadlines and tasks. A C2 Team member wrote, *"unfeasible deadlines deliver stress and hurt the team autonomy in planning its tasks."* A C1 Team member said about factors influencing the Motivation dimension, *"previous commitments with unrealistic deadlines, and the unwillingness of management/engineering/process do not have their agenda and are not willing to negotiate priorities."* The C1 Team member reported dissatisfaction with the partial implementation of agile methods *"if organization claimed use of Agile methodology, then all layers have to commit and follow it not only on paper but in reality."*

How to improve Teams' Climate: We considered the discussions of Boehm and Turner [Boehm and Turner 2003], team members' suggestions, and the leaders' reports in the interviews to propose four actions to improve team climate. Those responsible for managing the organizational climate should consider these guidelines to foster a favorable organizational climate in the agile software development teams.

Listen to the team members: An open communication between all team members and stakeholders is essential for the success of any project. However, sometimes it is necessary to collect information anonymously. Conducting the organizational climate assessment is an effective way to capture the feeling of giving a voice to employees. Using an organizational climate instrument (such as TACT), which allows specific reflections on the agile culture, allows a more detailed understanding of the team's reality. Regarding this matter, a member reported, *"if there is more dialogue and exchange among team members and other teams, I'm sure we will change many aspects of the key points discussed by this form (TACT)."* Also, the B4 Team leader reported, *"the TACT items enabled to identify items that may have a problem or need improvement."*

Promote actions to disseminate knowledge and learning: Developing complex information systems in a legacy environment that is highly regulated as the systems from Organization B and C is a challenge for the teams. In addition, a high turnover of team members is typical in Brazil and Canada. The team has difficulties understanding the context, rules, and laws in this environment. A member reported, *"there is little or no training on the business. Our PO does not know the business (he relies on other people). The team depends on people who know the legacy code because of documentation."* The team members suggested several kinds of actions to disseminate knowledge and learning. Among their suggestions are *"(having) training sessions," "trying out new technologies,"* and *"formal and informal knowledge transfer sessions among team members."*

Empower the team: Beck et al. [Beck et al. 2001] call out "build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done." The organization that claims the implementation of agile meth-

ods should ensure autonomy to decision-making concerning task planning deadlines, and timeboxing. Fixed-term deadlines for delivery not taking into account speed and the teams' capability possibly corroborates to an unfavorable climate resulting in lack of motivation. Concerning how to improve team climate, the C1 Team members wrote, *"I would say not to assign deadlines to projects that are not the way how agile works. We follow a pretty strict and rigid release model. Also, we feel some of the uncertainties are not considered and flexible releases instead of fixed releases throughout the year not to be tied to a specific deadline."*

Have a PO CRACK: Boehm and Turner [Boehm and Turner 2003] explained that the customer should be a CRACK. This might seem obvious, but we believe that the PO should i) be experienced in identifying and analyzing requirements, ii) know the system domain, iii) show availability and open communication to discuss and clarify user stories with the team, and iv) be simply the owner of the product. Concerning PO activities, a B2 Team leader said, *"the PO was not someone that really understood the product. He had a managerial role. He was connecting the true PO (who was in other bank functions) and the team. When the team questioned something, he never got the answer right away, and when he tried to answer right away, he usually got it wrong. The team had to perform rework."* The C2 Team leader said, *"from the Trust dimension, I perceived the team needs business knowledge to help create a healthier product backlog and support better iteration planning. Thus, I would replace the Product Owner and build a knowledge base inside the team to capture business knowledge."*

5.2. TACT Comparison with Other Approaches

An organizational climate assessment can be operationalized through different data collection methods, for example, observations, interviews, and questionnaires. Although interviews and observations make it possible to diagnose a greater diversity of issues in the employee's day-to-day life, depending on the size and scope of the assessments, the volume of data requires considerable analysis. On the other hand, questionnaires with close-ended questions allow a quick analysis of results. Anyway, practitioners and researchers can be difficult to recognize the possible causes or elements involved in an item evaluated negatively in an Organizational Diagnosis assessment [Dutra and Santos 2020, McFillen et al. 2013]. Dutra and Santos [Dutra and Santos 2020] identified that practitioners had "difficulty analyzing data from organizational climate assessments containing many open-ended questions" and "difficulty understanding dissatisfaction reported by team members." McFillen et al. [McFillen et al. 2013] reported that the lack of rigor in the diagnostic process is likely to be a significant factor in the high failure rate of change initiatives reported in the literature. For the agile context, Dutra and Santos [Dutra and Santos 2020] analyzed that assessment instruments that do not consider agile values, principles, practices, and roles in a proper context may create difficulties for the analysis of possible causes of problems and the execution of corrective actions within organizational climate management. For example, in the nursing area, new measures have been developed and validated to assess the organizational climate considering the specific activities of nurses [Hsiung et al. 2021]. Thus, to try to mitigate the difficulties inherent in analyzing a climate assessment with many open questions or with generic climate instruments, TACT was created.

Concerning other instruments to measure the organizational climate, we analyzed that the model proposed by Bhatt et al. [Bhatt et al. 2006] only has specific items for outsourced software maintenance teams. It is not specific to agile teams. We did not identify validity and reliability evidence. The Climate for Project Success [Serrador et al. 2018] model intended to construct a theory [Serrador et al. 2018]. In the study, the authors did not define the instrument items. Thus, the results [Serrador et al. 2018] can be used to operationalize a new instrument. Organizational Climate for Success of the Software Project [Sharma and Gupta 2012] showed good initial validity and reliability evidence. However, the four dimensions do not reflect the critical factors of agility. The questionnaire items elaborated by Grobelna and Trzcielinski [Grobelna and Stefan 2019] were not published. Also, we did not identify validity and reliability evidence for the proposed measure [Grobelna and Stefan 2019]. Acuña et al. [Acuña et al. 2008], and Vishnubhotla et al. [Vishnubhotla et al. 2020] measured the climate using the TCI instrument [Anderson and West 1998]. The TCI dimensions represent factors that influence the innovation capability of teams. TCI instrument is grounded in a theoretical model to measure vision, participatory security, support for innovation, and task orientation dimensions [Anderson and West 1998]. The TCI dimensions do not measure the critical human factors that affect the organizational climate of agile teams. Furthermore, small organizations may find it difficult to adopt instruments with copyright.

Concerning adapting existing instruments to determine the language or national culture, it is essential to notice that any change in the original items can change their psychometric properties. Thereby, the threats to validity must be investigated and addressed. Depending on the changes made to the measures, a new process for evaluating the measure should be conducted. The procedures described in Graziotin et al. [Graziotin et al. 2020] should be used to validate a new or adapted measure. The procedures described in Zhang et al. [Zhang et al. 2015] and Antino et al. [Antino et al. 2014] can help translation and trans-cultural adaption.

Regarding the use of questionnaires or generic scales to assess the organizational climate in agile teams, we claim that the use of assessment instruments that do not consider agile values, principles, practices, and roles in a proper context may create difficulties for the analysis of possible causes of problems and the execution of corrective actions within organizational climate management [Dutra and Santos 2020]. Therefore, there is a need for specific instruments to measure the organizational climate of agile teams. We used Chagas et al. [Chagas et al. 2015] results, and our Tertiary Study results [Dutra et al. 2021] to delimit the main human factors measured in TACT, such as communication, collaboration, leadership, autonomy, decision-making, client involvement, knowledge, learning, and motivation. To foster the use and applicability of the climate instrument proposed, we have decided to use the roles (Team Facilitator, Product Owner, and Team Members [PMI and Agile Alliance 2017]) as generically as possible.

5.3. Limitations and Threats to Validity

We performed a case study as a pilot to identify improvements and initial evidence sources. The main limitation of this study is the sample size (n = 39). Also we use Recker's [Recker 2013] guidelines for evaluating qualitative and quantitative studies.

Concerning *reliability*, we showed a contextual description of organizations and the teams, as well as direct quotes from team members and leaders, which were considered to support the analysis. We plotted the polychoric correlations matrices and Iclust Graphs of TACT dimensions to investigate how the items are interrelated and calculate the reliability of the dimensions. The reliability for the case study sample is high (α-Cronbach > 0.8).

To address possible threats to *internal validity*, we decided to use multiple sources of evidence. We triangulated the climate assessment quantitative results with the team member opinion (open-ended questions) and leader reports (interviews). Thereby, the review of the evaluation results was assured (which also relates to measurement validity). Regarding TACT, judges experienced in agile methods evaluated TACT items for Simplicity, Cohesion, and Relevance/Representativeness. The initial values of the Content Validity Index (CVI) were acceptable ($>= 0.7$) [Delgado-Rico et al. 2012].

External validity concerns how much and when the results of a study can be generalized to other cases or domains [Recker 2013]. It is impossible to guarantee similar outcomes in another cycle in the same examined teams or even in different groups of the same organization. Therefore, generalizations cannot be realized. However, we detailed the organizations' and teams' contexts to assess how the environment characteristics match other research fields.

6. Final Considerations

We presented a case study to evaluate the partial version of TACT designed to measure the dimensions of Trust, Knowledge, Learning, and Motivation. This article extended [Dutra et al. 2022a] by including data from a new organization and a new team. We also investigated how to improve the organizational climate in agile teams. We executed the organizational climate assessment in eight agile teams from two Brazilian organizations and a Canadian company. TACT items, interviews, and open-ended questions were used to collect the data.

TACT was grounded in scientific literature and industry observations. TACT items regarding Trust, Knowledge, Learning, and Motivation are grounded in the "agile philosophy" and consider the most common agile practices. At the same time, it allows reflections on the behaviors of the prominent involved roles in agile projects. Based on the evidence gathered, we inferred that TACT captured the organizational climate of the teams correctly and can be used to identify issues better and improve actions aligned with the agile values, principles, and practices while developing Information Systems. Also, TACT presented high levels of reliability.

Analyzing the qualitative and quantitative data of the investigated agile teams, we found early evidence that the PO's experience and knowledge about the system's domain may have influenced the teams' perception of the Trust and Knowledge dimension. Knowledge-sharing among team members may have positively impacted the Learning dimension. In the opposite direction, the lack of people promoting agile methodology and the unwillingness to improve agile practices may have negatively influenced Learning among teams. The lack of team autonomy in delivery planning may have harmed the mo-

tivational dimension. Contrarily, recognition for the work done and satisfaction in seeing the product is helpful to the customer were motivating factors. Although the case study results may be common to other agile teams, case study results cannot be generalized.

The different suggestions reported by the team members revealed the need to broaden the discussions on climate management to the team level. We identified 25 actions to improve organizational climate. Based on the results and the literature, we discussed other actions that can positively enhance the organizational climate of agile teams. Guaranteeing agile team member participation in the climate management process will provide team empowerment.

6.1. Future works

Considering all the evaluated dimensions in this and other preliminary studies [Dutra et al. 2020, Dutra et al. 2022b, Dutra et al. 2022a], TACT has 64 items grouped in 10 dimensions: Communication, Collaboration, Leadership, Autonomy, Decision-making, Client Involvement, Trust, Knowledge, Learning, and Motivation. Therefore, as future work, we will proceed with the TACT validation process by executing a survey to investigate and validate the factorial structure of all TACT dimensions. We will use Exploratory and Confirmatory Factor Analysis to investigate and confirm the measured dimensions. Also, we will create a short version of TACT with fewer items and dimensions. We also intend to investigate the influence of other human factors on the organizational climate, such as gender, team size, team diversity, change/adaptability, and team members' experience with agile methodologies.

7. Acknowledgement

We thank UNIRIO (PPQ 03/2021; PPINST 05/2020) and FAPERJ (E-26/210.231/2021) for their financial support. This study was carried out with the support of CEFET/RJ.

References

Acuña, S. T., Gómez, M., and Juristo, N. (2008). Towards understanding the relationship between team climate and software quality—a quasi-experimental study. *Empirical Software Engineering*, 13(4):401–434.

Açıkgöz, A. and Gunsel, Ayse, C. K. (2015). Climate and Product Quality in Software Development Teams: Assessing the Mediating Role of Problem Solving and Learning. *Journal of Administrative Sciences*, 13(16):7–40.

Ahmed, S., Ahmed, S., Ali, M., Naseem, A., Razzaq, A., and Ahmed, N. (2018). A Systematic Literature Review of Success Factors and Barriers of Agile Software Development. *International Journal of Advanced Computer Science and Applications*, 9(3):1–14.

Ahmed, S., Ahmed, S., Naseem, A., and Razzaq, A. (2017). Motivators and Demotivators of Agile Software Development: Elicitation and Analysis. *International Journal of Advanced Computer Science and Applications*, 8(12):1–11.

Akgun, A. E., Lynn, G. S., and Reilly, R. (2002). Multi-dimensionality of learning in new product development teams. *European Journal of Innovation Management*, 5(2):57–72.

Alasad, H. (2020). *The Impact of Agile Processes on Organisational Behaviour Within Current Banking Practice*. Master degree, Auckland University of Technology.

Almanasreh, E., Moles, R., and Chen, T. F. (2019). Evaluation of methods used for estimating content validity. *Research in Social and Administrative Pharmacy*, 15(2):214–221.

Anderson, N. R. and West, M. A. (1998). Measuring climate for work group innovation: development and validation of the team climate inventory. *Journal of Organizational Behavior*, 19(3):235–258.

Antino, M., Gil-Rodriguez, F., Martí, M., Barrasa, A., and Borzillo, S. (2014). Development and validation of the Spanish version of the Team Climate Inventory: a measurement invariance test. *Anales de Psicología*, 30(2).

Beck, K., Beedle, M., Bennekum, A. V., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R. C., Mellor, S., Schwaber, K., Sutherland, J., and Thomas, D. (2001). Manifesto for Agile Software Development.

Bhatt, P., Shroff, G., Anantaram, C., and Misra, A. K. (2006). An influence model for factors in outsourced software maintenance. *Journal of Software Maintenance and Evolution: Research and Practice*, 18(6):385–423.

Boehm, B. and Turner, R. (2003). *Balancing Agility and Discipline: A Guide for the Perplexed*. Pearson Education, Boston (USA), 1st edition.

Chagas, A. (2015). *(In Portuguese) O impacto dos fatores humanos nos métodos ágeis*. Masters dissertation, Universidade Federal de Pernanbuco, Pernanbuco.

Chagas, A., Santos, M., Santana, C., and Vasconcelos, A. (2015). The Impact of Human Factors on Agile Projects. In *2015 Agile Conference*, pages 87–91, National Harbor, MD, USA. IEEE.

Cruzes, D. S. and Dyba, T. (2011). Recommended Steps for Thematic Synthesis in Software Engineering. In *2011 International Symposium on Empirical Software Engineering and Measurement*, pages 275–284, Banff, AB, Canada. IEEE.

Curtis, B., Hefley, W. E., and Miller, S. A. (2009). People Capability Maturity Model (P-CMM) Version 2.0, Second Edition. Technical report, Carnegie Mellon University.

de O. Melo, C., Santana, C., and Kon, F. (2012). Developers Motivation in Agile Teams. In *2012 38th Euromicro Conference on Software Engineering and Advanced Applications*, pages 376–383, Cesme, Turkey. IEEE.

Delgado-Rico, E., Carretero-Dios, H., and Ruch, W. (2012). Content validity evidences in test development: An applied perspective. *International Journal of Clinical and Health Psychology*, 12(3):449–460.

Digital.ai, T. (2020). 14th Annual State of Agile Report. Technical report, Digital.ai.

Dima, A. L. (2018). Scale validation in applied health research: tutorial for a 6-step R-based psychometrics protocol. *Health Psychology and Behavioral Medicine*, 6(1):136–161.

Dutra, E., Cerdeiral, C., Lima, P., Diirr, B., and Santos, G. (2022a). Organizational Climate Assessment of Trust, Knowledge, Learning, and Motivation of Agile Teams - A Case Study. In *XVIII Brazilian Symposium on Information Systems*, pages 1–8, Curitiba, Brazil. Association for Computing Machinery.

Dutra, E., Diirr, B., and Santos, G. (2021). Human factors and their influence on software development teams - a tertiary study. In *Brazilian Symposium on Software Engineering*, SBES '21, page 442–451, New York, NY, USA. Association for Computing Machinery.

Dutra, E., Lima, P., Cerdeiral, C., Diirr, B., and Santos, G. (2022b). Tact: An instrument to assess the organizational climate of agile teams - a preliminary study. *Journal of Software Engineering Research and Development*, 10:1:1 – 1:21.

Dutra, E., Lima, P., and Santos, G. (2020). An Instrument to Assess the Organizational Climate of Agile Teams - A Preliminary Study. In *19th Brazilian Symposium on Software Quality*, pages 1–10, São Luis, Brazil. Association for Computing Machinery.

Dutra, E. and Santos, G. (2020). Organisational climate assessments of Agile teams – a qualitative multiple case study. *IET Software*, 14(7):861–870.

Dutra, J. S., Fischer, A. L., Nakata, L. E., Pereira, J. C. R., and Veloso, E. F. R. (2012). The use categories as indicator of organizational climate in Brazilian companies. *Revista de Carreiras e Pessoas*, 2:145–176.

Dybå, T. and Dingsøyr, T. (2008). Empirical studies of agile software development: A systematic review. *Information and Software Technology*, 50(9-10):833–859.

Field, A., Miles, J., and Field, Z. (2012). *Discovering Statistics Using R*. SAGE Publications, London, 1 st edition.

Gonçalves, E. (2022). *An Instrument to Assess the Organizational Climate of Agile Software Development Teams*. PhD thesis, UNIRIO.

Graziotin, D., Lenberg, P., Feldt, R., and Wagner, S. (2020). Psychometrics in Behavioral Software Engineering: A Methodological Introduction with Guidelines. *ACM Trans. Softw. Eng. Methodol.*, I(1):Article 111 – 49 pages.

Grobelna, K. and Stefan, T. (2019). The Impact of Organizational Climate on the Regularity of Work Speed of Agile Software Development Teams. *Entrepreneurhip and Management*, 12(1):229–241.

Hinkle, D., Wiersma, W., and Jurs, S. (2003). *Applied Statistics for the Behavioural Sciences*. Houghton Mifflin, Boston, 5th edition.

Hohl, P., Klünder, J., van Bennekum, A., Lockard, R., Gifford, J., Münch, J., Stupperich, M., and Schneider, K. (2018). Back to the future: origins and directions of the "Agile Manifesto" – views of the originators. *Journal of Software Engineering Research and Development*, 6(1):15.

Hsiung, K. S., Colditz, J. B., McGuier, E. A., Switzer, G. E., VonVille, H. M., Folb, B. L., and Kolko, D. J. (2021). Measures of Organizational Culture and Climate in Primary Care: a Systematic Review. *Journal of General Internal Medicine*, 36(2):487–499.

ISO/IEC/IEEE (2018). *ISO/IEC/IEEE 26515: 2018. Systems and software engineering — Developing information for users in an agile environment*. International Standards Organization., Switzerland.

Kakar, A. K. (2020). A Theory of Agile Software Development. In *Southern Association for Information Systems (SAIS 2020) Proceedings*, page 8, Virtually. AISeL.

McFillen, J. M., O'Neil, D. A., Balzer, W. K., and Varney, G. H. (2013). Organizational Diagnosis: An Evidence-based Approach. *Journal of Change Management*, 13(2):223–246.

Oliveira, R. and França, C. (2019). Agile Practices and Motivation. In *Proceedings of the Evaluation and Assessment on Software Engineering*, pages 365–368, New York, NY, USA. Association for Computing Machinery.

Patterson, M. G., West, M. A., Shackleton, V. J., Dawson, J. F., Lawthom, R., Maitlis, S., Robinson, D. L., and Wallace, A. M. (2005). Validating the organizational climate measure: links to managerial practices, productivity and innovation. *Journal of Organizational Behavior*, 26(4):379–408.

PMI, P. M. I. and Agile Alliance, A. A. (2017). *Agile Practice Guide*. PMI, Pennsylvania, 1st edition.

Raza, M. M., Minhas, N. M., Khan, H. U., and Asghar, I. (2015). Impact of Stress on Software Engineers Knowledge Sharing and Creativity [A Pakistani Perspective]. *International Journal of Business Intelligents*, 004(002):69–73.

Recker, J. (2013). *Scientific Research in Information Systems*. Springer Berlin Heidelberg, Berlin, Heidelberg.

Reginaldo, F. and Santos, G. (2020). Challenges in Agile Transformation Journey. In *Proceedings of the 34th Brazilian Symposium on Software Engineering*, pages 11–20, New York, NY, USA. Association for Computing Machinery.

Revelle, W. (2018). How to: Use the psych package for factor analysis and data reduction. Technical report, Northwestern University.

Saldaña, J. (2013). *The Coding Manual for Qualitative Researchers (2nd Ed.)*. SAGE Publications Ltd.

Schneider, B., Barbera, K. M., Schneider, B., and Barbera, K. M. (2014). Summary and Conclusion. In Barbera, B. S. and M., K., editors, *The Oxford Handbook of Organizational Climate and Culture*, chapter Summary an, pages 1–14. Oxford University Press, New York, NY, USA.

Senapathi, M. and Srinivasan, A. (2013). Sustained agile usage. In *Proceedings of the 17th International Conference on Evaluation and Assessment in Software Engineering - EASE '13*, page 119, New York, New York, USA. Association for Computing Machinery.

Serrador, P., Gemino, A., and Horner, B. (2018). Creating a climate for project success. *Journal of Modern Project Management*, May/August:38–47.

Shahzad, F., Xiu, G., and Shahbaz, M. (2017). Organizational culture and innovation performance in Pakistan's software industry. *Technology in Society*, 51:66–73.

Sharma, A. and Gupta, A. (2012). Impact of organisational climate and demographics on project specific risks in context to Indian software industry. *International Journal of Project Management*, 30(2):176–187.

Sherman, S., Hadar, I., and Luria, G. (2018). Leveraging organizational climate theory for understanding industry-academia collaboration. *Information and Software Technology*, 98:148–160.

Soomro, A. B., Salleh, N., Mendes, E., Grundy, J., Burch, G., and Nordin, A. (2016). The effect of software engineers' personality traits on team climate and performance: A Systematic Literature Review. *Information and Software Technology*, 73(May 2016):52–65.

Spector, P. (1992). *Summated Rating Scale Construction: An Introduction*. Sage Publications, Inc, California.

Tsai, M.-T. and Cheng, N.-C. (2010). Programmer perceptions of knowledge-sharing behavior under social cognitive theory. *Expert Systems with Applications*, 37(12):8479–8485.

VandenBos, G. R. E. (2017). APA Dictionary of Psychology.

Venkatesh, V. and Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions. *Decision Sciences*, 39(2):273–315.

Venkatesh, V. and Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science*, 46(2):186–204.

Vishnubhotla, S. D., Mendes, E., and Lundberg, L. (2018). An Insight into the Capabilities of Professionals and Teams in Agile Software Development. In *Proceedings of the 2018 7th International Conference on Software and Computer Applications - ICSCA 2018*, pages 10–19, New York, New York, USA. Association for Computing Machinery.

Vishnubhotla, S. D., Mendes, E., and Lundberg, L. (2020). Investigating the relationship between personalities and agile team climate of software professionals in a telecom company. *Information and Software Technology*, 126:106335.

Wagner, S., Mendez, D., Felderer, M., Graziotin, D., and Kalinowski, M. (2020). *Contemporary Empirical Methods in Software Engineering*. Springer International Publishing, Cham.

Yin, R. K. (2013). *Case Study Research: Design and Methods*. Sage Publications, Los Angeles, 5th edition.

Zhang, H., Luo, X. R., Liao, Q., and Peng, L. (2015). Does IT team climate matter? An empirical study of the impact of co-workers and the Confucian work ethic on deviance behavior. *Information and Management Management*, 52(6):658–667.

A. Appendix - Conceptual and Operational definition of TACT's constructs

Construct Trust

- **Conceptual definition**
  - Reliance on or confidence in the dependability of someone or something. In interpersonal relationships, trust refers to the confidence that a person or group of people has in the reliability of another person or group; specifically, it is the degree to which each party feels that they can depend on the other party to do what they say they will do [VandenBos 2017].
  - Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done [Beck et al. 2001].

- **Operational definition**
  - TRU.01. Lack of management confidence and support in agile methods can impact the enthusiasm and motivation of team members [Senapathi and Srinivasan 2013].
  - TRU.02. Team members trust the others to do their part [Dybå and Dingsøyr 2008].
  - TRU.03. Lack of client involvement can be due lack of trust [Chagas 2015].
  - TRU.04. Self-organizing and collaboration increase trust [Chagas 2015].

Construct Knowledge

- **Conceptual definition**
  - The state of being familiar with something or aware of its existence, usually resulting from experience or study. The range of one's understanding or information [VandenBos 2017].
  - "Development of software is the process of sharing data. To create a quality product [P25] in which no member as part of the extended team has accurate and complete knowledge of all aspects of the project [P25] [P26], the knowledge of an individual, unless linked to the work of the group has no value [P27]. It involves sharing of knowledge among team members engaged in software development, client and other stakeholders are necessary for the successful project development [P25]" [Raza et al. 2015].

- **Operational definition**
  - KNO.01. Team and Product Owner know the software domain and client necessity [Chagas 2015, Raza et al. 2015].
  - KNO.02. When a person or several people move out from a team, knowledge retention or poor documentation can be evidenced [Chagas 2015].
  - KNO.03. User stories are viewed as an essential tool for knowledge sharing [Chagas 2015].
  - KNO.04. Good knowledge sharing in the team is imperative for the success of agile project [Chagas 2015].
  - KNO.05. The organization offers training opportunities [Bhatt et al. 2006, Raza et al. 2015, Shahzad et al. 2017].

Construct Learning

- **Conceptual definition**
  - Team learning is conceptualized as the collective acquisition, combination, creation, and dissemination of team members' knowledge [Açıkgöz and Gunsel, Ayse 2015].
  - Learning in new product development teams spans many activities, such as acquiring, processing, disseminating, retaining and retrieving information [Akgun et al. 2002].

- **Operational definition**
  - LEA.01. The team member has an attitude from willingness to learn. Attitude refers to team members' prominent positive or negative beliefs about the consequences of continuing to use agile methods [Senapathi and Srinivasan 2013].
  - LEA.02. Better communication leads to better learning and knowledge transfer [Chagas 2015].
  - LEA.03. There are people using a variety of influences (e.g., social, political) to eliminate barriers to successful diffusion of agile methods, facilitate and encourage their on-going usage, and mentor teams [Senapathi and Srinivasan 2013].
  - LEA.04. Teams which focused on continuously improving their existing practices and included new techniques/artefacts experienced major improvements [Senapathi and Srinivasan 2013].
  - LEA.05. Active learning and improvement [Vishnubhotla et al. 2018].

Construct Motivation

- **Conceptual definition**
  - The impetus that gives purpose or direction to behavior and operates in humans at a conscious or unconscious level [VandenBos 2017].
  - Motivation is mainly described by the engagement and focus of individuals. What differentiates the engaged individual from an unengaged is: the level of involvement with work, applied effort, concern with results and proactivity in a work episode [Oliveira and França 2019].
  - Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done [Beck et al. 2001].
  - Motivation refers to the individual/team members' aspirations and is recognized as a key success factor for software projects [Senapathi and Srinivasan 2013].

- **Operational definition**
  - MOT.01. Sense of belonging: Software engineers have assigned different tasks which have divided per interval. These tasks demand a sense of belonging from practitioners. This sense of belonging can be divided into intrinsic and extrinsic factors. Intrinsic belonging contain self doing of work, whereas extrinsic belonging may contain supportive role of management [Ahmed et al. 2017, Ahmed et al. 2018].
  - MOT.02. Employee participation: Individual participation is like owning a problem and try to solve it by individual force; however, as a team each member participation is necessary [Ahmed et al. 2017, Ahmed et al. 2018].
  - MOT.03. Recognition: The credit of work should be given to the employee. By given the due recognition of work motivate them to work better for the future work [Ahmed et al. 2017, Ahmed et al. 2018].
  - MOT.04. Clear Identification with Task: Understanding project requires the clarity of doing work. By clearing understanding, productivity of the system can be increased [Ahmed et al. 2017, Ahmed et al. 2018, de O. Melo et al. 2012].
  - MOT.05. Variety of work [Ahmed et al. 2017, Ahmed et al. 2018].
  - MOT.06. The team autonomy [Ahmed et al. 2017, Ahmed et al. 2018, de O. Melo et al. 2012].
  - MOT.07. High quality performance [Ahmed et al. 2017, Ahmed et al. 2018, de O. Melo et al. 2012].
  - MOT.08. Decision time (prioritize work product; completion; business satisfaction) [Ahmed et al. 2017, Ahmed et al. 2018].
  - MOT.09. Dynamic and fast changing adopted environment [Ahmed et al. 2017, Ahmed et al. 2018].
  - MOT.10. Stress/pressure [Ahmed et al. 2017, Ahmed et al. 2018].
  - MOT.11. Lack of bureaucracy in the development process [de O. Melo et al. 2012, Ahmed et al. 2017].
  - MOT.12. Experience/skill [Ahmed et al. 2017, Ahmed et al. 2018].
  - MOT.13. Problem solving (Decision-making) [de O. Melo et al. 2012]

B. Appendix - TACT Items

Trust: IT38. In the current project, there is a feeling of trust among team members; IT39. In this organization, the management knows and supports the agile values, principles, and practices; IT40. In the current project, team members develop tasks with high quality and performance; IT41. In the current project, team members would feel a sense of loss if we could no longer work together; IT42. I see no reason to question each team members' competence and technical skills; IT43. The PO is fully committed to providing clear information about user stories; IT44. The client is fully committed to providing clear information about user stories.

Knowledge: IT45. If key members decide to leave the team, the new members would NOT have difficulties understanding the code or the product backlog and its dependencies; IT46. The team knows the skills and technical expertise of the team members; IT47. The knowledge transfer chain between the client and the team is NOT long and does NOT suffer information distortions and loss; IT48. My team has excellent knowledge about the domain of the software developed; IT49. The organization offers training opportunities; IT50. The PO has sufficient knowledge about the users' actual needs.

Learning: IT51. In each iteration, the team improves its ability to handle the most significant problems; IT52. In this organization, people are promoting the effective use of agile methodologies; IT53. Team members have a willingness to learn about the project; IT54. The team aims to continuously improve the use of existing agile practices and incorporate new Software Engineering practices; IT55. The team teaches me how to handle my difficulties in the tasks; IT56. The team discusses new emerging Technologies.

Motivation: IT57. In the current project, my team fulfills very well the definition of done and the acceptance criteria of the user stories; IT58. In the current project, I have opportunities to develop my skills and knowledge; IT59. In the current project, I am recognized for the work done, IT60. The team responds quickly to changes that need to be done; IT61. In the current project, I DO NOT feel stressed or under much pressure to execute my tasks; IT62. The team organizes and plans its tasks clearly; IT63. The team has the autonomy to discuss with the product owner how and when to deliver the project outcomes; IT64. The team can use new ideas to improve the performance in the tasks and the deliverables.