A THEORETICAL MODEL TO EVALUATE THE IMPACT OF ORGANIZATIONAL CLIMATE ON INNOVATIVE CAPABILITIES AND INNOVATION PERFORMANCE FOR COMPANIES IN THE SOFTWARE INDUSTRY

Doru ŞUPEALĂ
Babeş-Bolyai University, Faculty of Economic Sciences and Business Management
58-60 Teodor Mihali Street., 400591 Cluj-Napoca, Romania
doru.supeala@econ.ubbcluj.ro

Levente SZASZ
Babeş-Bolyai University, Faculty of Economic Sciences and Business Management
58-60 Teodor Mihali Street., 400591 Cluj-Napoca, Romania
levente.szasz@econ.ubbcluj.ro

Abstract. *Organizational climate is strongly influential for the business-creative capabilities, the degree of innovation novelty, and the innovation performance of contemporary organizations, and consequently for their long-term sustainability and profitability. Based on an extensive academic literature review, this paper provides a theoretical model and a validation research design to explain how organizational climate can influence firms' innovative capabilities and performance with a special focus on the software industry. The model combines three established organizational climate research tools: Personal Initiative, Psychological Safety, and Team Climate Inventory (with its four latent variables - Vision, Participative Safety, Task Orientation, and Support for Innovation) and two fundamental dimensions of organizations' innovative capability (innovations' degree of novelty and innovativeness), linking them ultimately to innovations' business performance to explain how climate factors should be leveraged to enhance firms' market success. The paper proposes a research design and measurement model that can be used to apply the theoretical model in the software industry.*

Keywords: *Organizational Climate, Innovativeness; Innovation Performance; Team Climate; Personal Initiative; Psychological Safety; Innovation Management.*

1. Introduction

Innovation is a means for any organization to transform change into opportunities and income, but also a solid source of long-term sustainability and profitability (Moghimi & Muenjohn, 2014), as innovations have a crucial role in a firm's market success and competitive advantage (Crossan & Apaydin, 2010). Innovation is strategically necessary in today's highly competitive economic setting, particularly in dynamic markets such as the software industry (Patterson et al., 2009). For most of organizations in knowledge-related economic sectors, one of the biggest challenges is to motivate professionals with a natural and trained brain power to think creatively and generate profitable change, be it incremental or radical (Shipton et al., 2006). To do that, organizations can develop an appropriate culture and climate for creativity and innovation by strategically focusing on creating novelty (Pallas et al., 2013). A climate for innovation is positively associated with organizational performance (Glisson, 2015; Shanker et al., 2017). To differentiate

from the competition and win the market battles, managers need to nurture creativity, create an appropriate climate, and develop appropriate structures and processes for innovation (Kandampully, 2002; Ritter et al., 2004). We approach climate factors as manifestations of the organizational culture (Martin, 2001) functioning as important predictors of innovation capabilities and outcomes at the team level (Hunter et al., 2007).

A systematic review of the literature made by Sethibe & Stein (2016) identified only seven articles investigating the causal path between organizational climate, innovation, and organizational performance, this represents the most important gap in the academic knowledge we address through this paper, given the importance of innovation in companies' long-term performance. This paper aims to describe and academically substantiate a theoretical model establishing relationships between organizational climate, a firm's innovative capabilities, and innovation's business performance, in the very specific context of the software industry. The academic background on the organizational climate factors contributing to innovativeness, novelty degree, and innovation's business performance in the software industry is still poor, immature, and fragmented (Fischer et al., 2014; Rose et al., 2016). Recent research partially covered this field, indicating that certain climate factors have a positive impact on certain dimensions of innovativeness as knowledge acquisition, dissemination, idea generation, and idea promotion (Huang & Li, 2021) on business creativity and profitability (Shahzad et al., 2017) or innovation performance (de Souza Bermejo et al., 2016).

At the same time, a solid body of academic literature has already validated Team Climate, Personal Initiative, and Psychological Safety as relevant composite factors for the organizational creative climate and has found direct and indirect correlations between these climate factors and organizational performance (Frese & Fay, 2001; Hirak et al, 2012; Soomro et al., 2016). However, the three composite climate factors have never been placed altogether in the same research, even though important research initiatives have paired TCI and PI (Fischer et al., 2014), respectively PI and PS (Baer & Frese, 2003) in studies aiming at finding correlations between organizational climate and performance in software or technology companies. We see a strong opportunity to cover this knowledge gap, by bringing together all three composite climate factors, demonstrated as highly relevant for the creative sectors of the economy, to be checked and validated in the same research model.

We see a strong opportunity to contribution to the knowledge in this field by introducing the innovative capability factors (Innovativeness and Degree of Novelty), already confirmed as relevant in the academic literature (Nirjar, 2008; Eveleens, 2010; Therrien et al., 2011), in the relationship between climate factors and firm's innovation performance to look for their correlations in the sector of digital technology (Pallas et al., 2013). We theorize that the parameters characterizing firms' innovation capabilities directly result from the organizational climate and significant premises of the innovation's business performance. Innovativeness is a composite parameter resulting from the employees' evaluation of several elements specific to the value-creating activities in the organization, while the Degree of Novelty differentiates organizations focused on incremental change from those interested in a high degree of novelty (i.e. radical and even disruptive innovations), this approach of business strategy and risk-taking imposing organizational climates adapted to each orientation (Duhamel & Santi, 2012). For the results of the organizational innovative activities specific to the software industry, we define a composite parameter called Innovation Performance, which

aggregates several items describing innovations' beneficial and measurable business impact, as assessed in management's perceptions.

Based on a wide body of literature (Amabile et al., 1996; 1999; Baer & Frese, 2003; Subramaniam & Youndt, 2005), the theoretical model we propose (presented in Figure 1) considers that the organizational climate has a direct impact on the innovative capabilities demonstrated in the value-creative activities and operational processes of the organization (Fischer et al., 2014; Sethibe & Stein, 2016). In their turn, these capabilities, through their quality and consistency, directly impact the business results generated by innovation (Subramanian, 1996; Romijn & Albaladejo, 2002; Hult et al., 2004; OECD, 2005; Gamal et al., 2011).

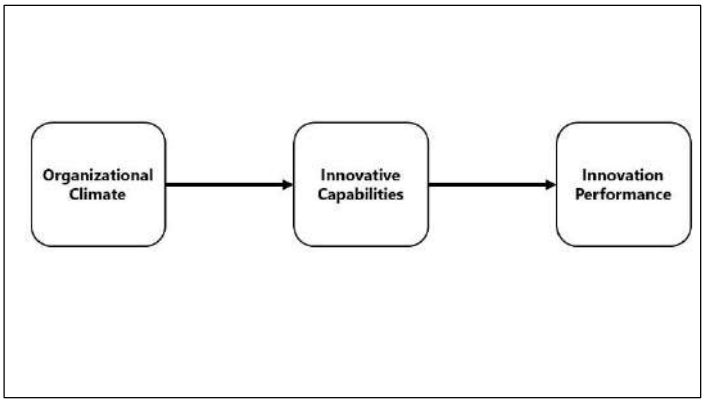

Figure 1. The Research Model – structural description

In this theoretical model, we separate three categories of factors: 1 - organizational climate factors validated by the academic literature as determinants for innovation (Team Climate, Personal Initiative, and Psychological Safety), 2 - innovation capability factors specific to the organization's value-creating processes (Innovativeness and Degree of Novelty), and 3 – innovation's outcome factors, illustrated by the novelty-related measurable results of the business (Innovation Performance).

The theoretical novelty of the research originates from (a) the definition of a new research model focused on organizational innovation, specific to the software industry as a new and highly performing sector in the knowledge economy, which correlates organizational climate, firm's innovative capabilities and innovation; (b) the introduction of two industry-relevant composite factors: innovativeness and innovation performance, consistently supported by literature but customized for the software industry, a highly-growing, insufficiently explored but economically significant business sector; (c) the introduction in the same research framework of three major climate inventory assessment instruments that have been rarely used together and never altogether, with a special attention allocated to Personal Initiative and Psychological Safety, two composite factors of organizational climate demonstrated as strategically important for innovativeness and performance in technology companies, but investigated in a very small number of studies ; and (d) the presentation of a complex

validation research methodology including customized survey instruments, aggregated and based on a solid literature body.

2. Literature review

Innovation is seen as *"the successful exploitation of new ideas"* (Adams et al., 2006, p. 22), *"the successful implementation of creative ideas within an organization"* (Amabile et al., 1996, p. 2), or *"the first commercialization of a new idea."* (Fagerberg, 2004, p. 3). A holistic and universal framework to identify and evaluate the sources and engines of innovation performance at a firm's level is hard to construct and coherently apply. Companies generally focus on innovation inputs and output only, ignoring the complexity of the in-between processes. A systematic literature review by Said-Metwaly et al. (2017) reveals that existing instruments of innovation assessment suffer from conceptual and psychometric shortcomings, gaps in their validity, or omissions. Quantitative measures yet prevail, whereas qualitative research still needs more development, spectrum enlargement, standards, and common approaches, while evaluation instruments cannot cover the entire spectrum of problems and a unitary system of quantification is far from realization (Said-Metwaly et al., 2017).

Organizational Culture and Structure represent one of the seven major dimensions of innovation defined by Adams et al. (2006), together with Innovation Strategy, Innovations Commercialization, and the management of Inputs, Knowledge, Portfolio, and Projects. The firm's culture and structure act as strong differentiators for innovative organizations. Interactions, collaboration, processes, capabilities, autonomy, flexibility, resources availability, methods' novelty, multidisciplinary and diverse teams, qualifications and communication, freedom and motivation favor successful innovative projects. Scholars propose multiple different evaluation models and inventories, but this paper will strictly focus on the elements specific to the organizational climate, indicated by Adams et al. (2006) in the Organizational Culture and Structure category, and by Crossan & Apaydin (2010) as Managerial Lever.

2.1. Organizational climate factors impacting innovation

The organizational climate concept is based on *"shared perceptions of organizational policies, practices, and procedures"*, indicating the subjective but collectively agreed interpretation of the objective reality and interactions in the work environment (Schneider, 1990; Reichers & Schneider, 1990; Anderson & West 1998, p. 236). Subramaniam & Youndt (2005) indicate work climate is the bedrock of the organization's innovative capability, whereas different organizational climates are directly responsible for different types of innovation in companies (Hunter et al., 2007). West & Anderson (1996) prove that the overall quality of the innovation processes (in terms of radicalness, magnitude, or novelty) is primarily determined by the team's composition, while social interactions at the team level are essential to attain a high level of innovation. Team climate provides employees the context to reach their highest levels of creativity, and individual outcomes contribute further to collective results (Pirola-Merlo & Mann, 2004).

Various theoretical models of organizational climate have been developed identifying several dimensions relevant to creativity and innovation (Hunter et al., 2007; West & Sacramento, 2012). The principal alternative to TCI, KEYS (Amabile et al., 1996; 1999) is considered comprehensive and precise, reliable, and highly useful, though criticized for being more appropriate for creativity than innovation as process outputs (Mathisen

& Einarsen, 2004), this being the reason for choosing TCI instead of KEYS in the current research model. Other climate-related factors have a much narrower academic coverage, especially in the recent years, and are criticized by scholars for certain liabilities.

Even though the software industry dominates all value rankings in the global economy and consistently contributes to business development via incremental or radical innovation, this sector has rarely been the object of studies correlating climate, creativity-related capabilities, and innovation performance. Therefore, we bring together three of the most consecrated organizational climate research instruments: The Team Climate Inventory (TCI), the Personal Initiative (PI), and the Psychological Safety (PS) inventories, which assess the climate for innovation from three different but equally important perspectives for the software industry as part of the knowledge and creativity economy. Team Climate Inventory enjoys the highest research coverage in the academic literature and benefits from a wide range of statistical validations (Houston et al., 2020; Newman et al., 2020). We add two other climate parameters that cover relevant interactions, behaviors, attitudes, contributions, and manifestations with strong personal involvement within organizations in the knowledge economy: Personal Initiative describes individuals' capacity to initiate and impose new ideas, concepts, products, and projects (Frese & Fay, 2015; Khalili, 2018; Lisbona et al., 2018; 2020), while Psychological Safety covers the extremely important area of a climate of mental comfort and intellectual balance, both at individual and group level(Edmondson & Lei, 2014; Carmeli et al., 2009; 2010).

Together with TCI, the inventories for Personal Initiative and Psychological Safety are preferred for this study because they have already been used and validated in innovation performance studies, applied together (Baer & Frese, 2003), or in combination with PI and TCI (Fischer et al., 2014) on samples of companies from software or technology sector. Baer & Frese (2003) proved that Personal Initiative and Psychological Safety positively influence organizations' business outcomes and moderate the relationship between innovation and business performance in technology companies. PI generates intensive team knowledge sharing, enhancing trust and PS, which ultimately leads to increased team creativity (Gong et al., 2012; Liu et al., 2021).

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The Team Climate Inventory (TCI). An instrument initially defined by West (1990; West & Farr, 1990) and further developed and consolidated by Anderson & West (1996; 1998) assesses the specific group processes and climate creation to encourage, enhance, and structure organizational innovation. This instrument had multiple versions in time, all focused on four major dimensions of work-group innovation: **vision, participative safety, task orientation,** and **support for innovation** (West, 1990; Anderson & West, 1998). Vision quantifies how clear, shared, attainable, and valuable the team's objectives and vision are within the group members and has four dimensions: clarity, visionary nature, attainability, and sharedness. Participative Safety refers to the level of implication in decision-making and the safety perceived when proposing changes and engaging in novel activities. Task Orientation expresses the team's commitment to achieving the highest work standards, indicating the group's engagement for excellence. Support for Innovation evaluates the degree of declared and practically confirmed support, autonomy, authority, and resources from the organization's management structures (Anderson & West, 1994; 1996). Many studies proved that team evaluations

with TCI significantly predict practical levels of innovation in the studied teams. Hülsheger et al. (2009) demonstrated that TCI predicts innovativeness, as the relationships of climate factors with team innovativeness is r=0,30 and higher. TCI benefits many validations in healthcare and education but was rarely used in technology-related areas. In software companies, Team Climate is proven as significantly related to superior team cognition (Açıkgöz et al., 2014), and teams' performance (Sudhakar et al., 2011), having as consequence better software and better quality (Acuña et al., 2008; 2015).

The instrument was initially built on 116 items/questions, later limited to only 44, extended to 61, and further reduced to 38 items, the most cited team climate research instrument. The number of scales varied from four to five in different interpretations. Antino et al. (2014) validated the Spanish version of TCI in both four- and five-factor versions in the software sector. The four-factor version gets the most academic credits, being validated as a team-level consensus model of team climate for innovation by Agrell & Gustafson (1994) and Mathisen et al. (2006), and as a predictor of the speed of innovation and innovation performance by Pirola-Merlo (2010). A shorter version with only 14 items addressing only the four-factor structure was also developed by Anderson & West (1998), applied and validated by studies in various sectors and countries (Kivimäki & Elovainio, 1999; Loo & Loewen, 2002; Loewen & Loo, 2004). Recently, the 14-item version of TCI was validated in Spain by Boada-Grau et al. (2011) and in Norway by Kaiser et al. (2016), confirming its validity, consistency, and reliability. This research model uses the 14 items and 4 factors version presented and validated by Strating & Nieboer (2009).

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Personal Initiative. Frese et al. (1997) introduced the concept of Personal Initiative as a self-starting, goal-oriented, and proactive work behavior that overcomes barriers to achieve an objective and enables people to deal with job difficulties more actively. The construct of personal initiative (Frese et al., 1996, 1997) is built on the concept of "taking charge" (Morrison & Phelps, 1999): employees engage in proactive extra-role behavior when they feel a climate of responsibility, self-efficacy, top management openness, and support. At the personal and team levels, initiative has a bearing on key outcomes such as productivity and radical innovation (Las-Hayas et al., 2018; Lisbona et al., 2020; 2021). Lisbona et al. (2018) use the model Frese & Fay (2001) developed and confirm that Personal Initiative is an antecedent of performance and a direct result of work engagement and self-efficacy. PI leads to new ideas implementation (Binnewies & Gromer, 2012), influences both creative activities at work and the degree of creativity of the new ideas (Binnewies et al., 2007), and brings a quantitative impact, by spending additional energy at work and demonstrating perseverance in overcoming challenges (Rank et al., 2004).

Personal Initiative is recently been demonstrated as a source of innovation and business outgrowth: mediates the increase of creative approaches in business and entrepreneurial success (Glaub et al., 2014), leads to innovative results when assisted by planning and social networking (Rooks et al., 2016), whereas training focused on PI increases firm's profits by 30% (Campos et al., 2017). In its current modern format, utilized in the current study as well, the research instrument related to Personal Initiative and Psychological Safety was first developed and applied by Baer & Frese

(2003) with two separate sections and 14 items (seven for PI, seven for PS), partially inspired by a model developed by Frese et al. (1997).

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Psychological Safety. Teams' psychological safety is a construct defined by Edmondson (1999) indicating a shared belief held by the team members that their working group is safe for interpersonal risk-taking. PS is a critical factor in understanding workgroup phenomena such as voice, teamwork, information sharing, interpersonal trust, mutual respect, caring about each other, and team and organizational learning which, combined with trust and confidence, are prerequisites for group creativity and team performance (Edmondson & Lei, 2014). A systematic literature review indicates that PS correlates with performance, team effectiveness, innovation, team creativity, efficiency, and positive work attitudes (engagement, commitment, and empowerment) at the dyadic level (Newman et al., 2017; 2020). A longitudinal study applied by Baer & Frese (2003) on 47 mid-sized German technology companies demonstrates the direct contribution of PS to the success of organizational innovation and firms' business results, moderating the relation between process innovations and firms' profitable growth. PS is positively associated with SMEs' innovation outcomes, and positively related to innovation capabilities related to products, activities, services, and business models (Andersson et al., 2020) and enhances the chances of success for teams at the front end of new product development, even in conditions of uncertainty in work structure or lack of clarity (Nienaber et al., 2015).

In this study, the research instrument related to the climate of Psychological Safety is applied by Baer & Frese (2003), built by using the seven items developed by Edmondson (1999).

2.2. Connecting innovative capabilities and innovation performance

Adams et al. (2006) observed that quantification of innovation results does not appear to take place routinely within management practice in organizations, but this field has received increasing attention within the last two decades and tends to be more structured (Bititci et al., 2012). Despite their importance, organizations' innovativeness and innovation performance do not yet benefit from a solid, clear, and objective evaluation method, as it is difficult to choose suitable and precise indicators (Rogers & Rogers, 1998; Romijn & Albaladejo, 2002; Bloch, 2007). Involving a complex system with multiple dimensions is recommended, to provide a meaningful, clear, and comprehensive representation of reality (Mairesse & Mohnen, 2002; Lanjouw & Schankerman, 2004; Gault, 2018).

Innovation assessment should be adapted to the specific business sector and the organizational context (Richtnér et al., 2017). The software industry is one of the best performing but also one of the most recently developed areas, so it has not yet built a comprehensive and coherent methodology to help management assess innovation capabilities and benefits. Edison et al. (2013) identified 13 existing innovation measurement frameworks reported in the literature, but only one, the index of innovativeness (Nirjar, 2008) was focused at the time on software firms, being based on six metrics adapted from the Oslo Manual (OECD, 2005), aggregated in a calculated index of innovativeness.

Literature separates inputs (resources for innovation - personnel, funds, equipment, ideas), processes (activities, time, cost, quality, and project's progress), outputs (new products, services, knowledge, or new flows), and outcomes (market results and business success: revenue, profit, market share, customer satisfaction) as major factors describing innovation (Janssen et al., 2011; Saunila, 2017). For two reasons, we separate input, process, and output factors as dimensions of the innovative capability of outcomes as innovation's tangible contribution to business growth. First, the relationship between organizational capabilities and business results is not always positive and proportional (Bengtsson et al., 2013; Pallas et al., 2013; Quandt et al., 2015). Second, we capitalize on the diversity of information sources, to get accuracy, relevance, and representativity: while business outcomes (innovation performance) can be effectively evaluated by the organization's top managers by interpreting financially-calculated factors, innovativeness, and novelty degree would be more precisely and representatively evaluated by the employees, who also provide data inputs for the climate factors (OECD, 2005; Prajogo & Suhal, 2006; Fischer et al., 2014). For both types of respondents and for the aggregated evaluation parameters, a superior level of objectivity and credibility would be reached by asking respondents to apply multiple scales of evaluation (Kraft, 1990; Prajogo & Ahmed, 2006), by looking at results in absolute numbers, by comparing their perceived outcomes to the results of their market rivals or by comparing their concrete results against the organization's objectives (Judge & Douglas, 1998; Prajogo & Sohal, 2006; De Luca & Atuahene-Gima, 2007).

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Innovativeness. The variety and complexity of instruments assessing organizational innovativeness are increased by the specific differences between industries and research approaches. Hung et al. (2011) adapt concepts of previous research (Baker & Sinkula, 1999; Prajogo et al., 2004) and inspire this study by proposing 11 items relevant for innovativeness: speed of R&D; the speed of production improvement; the speed of logistic innovation; the impact of R&D in production; production customization; products innovativeness; use of latest technologies; use of modern HR practices; job design innovation; organizational structure flexibility; patent registrations). One of the most cited and structured frameworks is the "Oslo Manual", developed by OECD (2005), which includes a large part of the previously-mentioned parameters, and sets international standards for measuring innovativeness and innovation performance (Evangelista et al., 2001; Erdil et al., 2004; Roszko-Wójtowicz & Białek, 2016).

Other academic frameworks offer multiple diverse perspectives but appear unreliable, inappropriate, or irrelevant to the software industry and the context of this paper.

The six variables aggregated in the innovativeness factor are: focus on innovation (Pallas et al., 2013); the speed of R&D processes as compared against major competitors; the novelty of the used technologies and methodologies; speed to the market of new products, as compared against major competitors (Prajogo & Ahmed, 2006; Prajogo & Suhal, 2006); encouragement of initiative to implement ideas (OECD, 2005; Fischer et al., 2014); effective adoption of new ideas (Ferraresi et al., 2012; Parida et al., 2017).

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Innovation's Degree of Novelty. Innovative activities and business outcomes depend on the radicalness, magnitude, and novelty of the implemented new ideas (West & Anderson, 1996), scholars separating incremental from radical innovations (Eveleens,

2010). Innovation is incremental when changes sustain or improve efficiency to existing flows for current markets and customers, whereas radical innovation is market-creating and often disruptive, activates latent needs or desires of non-consuming segments, and bring products or services new to the company, new to the market or even new to the industry (Christensen et al., 2019). Management practices differ: radical innovation asks for a totally different mindset (McDermott & O'Connor, 2002), new principles and rules (Veryzer, 1998; Hill & Rothaermel, 2003), develops a totally new organizational paradigm (McLaughlin et al., 2008), involves high-risk of failure (Duhamel & Santi, 2012) and potentially high-return.

The novelty of innovation can be expressed on a scale where change is *"associated with the creation and adaptation of ideas that are new-to-world, new to nation/region, new-to-industry or new-to-firm"* (Patterson et al., 2009, p. 5). Romijn & Albaladejo (2002) improved the model created at Cambridge by Cosh et al. (2002) affirming that the degree of novelty is strongly relevant, qualitative, and subjective, being expressed in surveys, on 5-degrees scales, as a score of the newness of the firm's products launched within the last three years. Similar approaches are presented by other studies (Baer & Frese, 2003); Prajogo & Ahmed, 2006; Prajogo & Suhal, 2006; Carayannis & Provance, 2008). To quantify innovation's newness, this research proposes a six-degree scale defined by Fischer et al. (2014), inspired by Romijn & Albaladejo (2002) and later validated by Lisbona et al. (2020). Six levels of radical innovation (based on consistency and market impact) specifically distinguish the degree of newness: no major innovation at all (score of 0); same or very similar innovation adopted by competitors (score of 1); similar innovation to the ones adopted by other firms in the same industry but the firm's innovation differs in identifiable ways from innovations of other firms. (score of 2); similar innovation to the ones adopted in other industries (score of 3); innovation fundamentally new to the firm (score of 4); innovation fundamentally new to the market (score of 5).

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Innovation Performance. The evaluation of innovation outcomes received high attention and coverage in the literature, with with multiple frameworks addressing the topic and generally based on top managers' Likert scale evaluations.

Based on a rich academic background, the ten factors established in this study to assess the innovative performance of the organizations are: new products turnover in total turnover; new products turnover in total turnover, as compared against competitors (OECD, 2005; Carlsson et al., 2011; Alegre et al., 2013; Arundel et al., 2019); new products turnover in total turnover, per employee, as compared against major competitors (Kafouros et al., 2008); increase of competitive advantage in the market due to innovation (Hung et al., 2011); increase of profitability due to innovation (Pallas et al., 2013); increase of turnover due to innovation (OECD, 2005; Hung et al., 2011); achievement of market share objectives by new products; achievement of sales revenue objectives; achievement of Return On Investment objectives; achievement of profitability objectives (Baer & Frese, 2003, Pallas et al., 2013).

To resume, we propose a Research Model split into three phase-related composite factors (climate, capabilities, and performance). We expect to identify significant correlations between climate factors in software-creating organizations and firms' innovative capabilities (innovativeness and innovations' degree of novelty), which, in

their turn, have direct relationships with innovation-based business results. Our literature-based theory states that Personal Initiative, Psychological Safety, and Team Climate (with their four components – Vision, Participative Safety, Task Orientation, and Support for Innovation) each significantly influence software organizations' capabilities of producing valuable creative novelty.

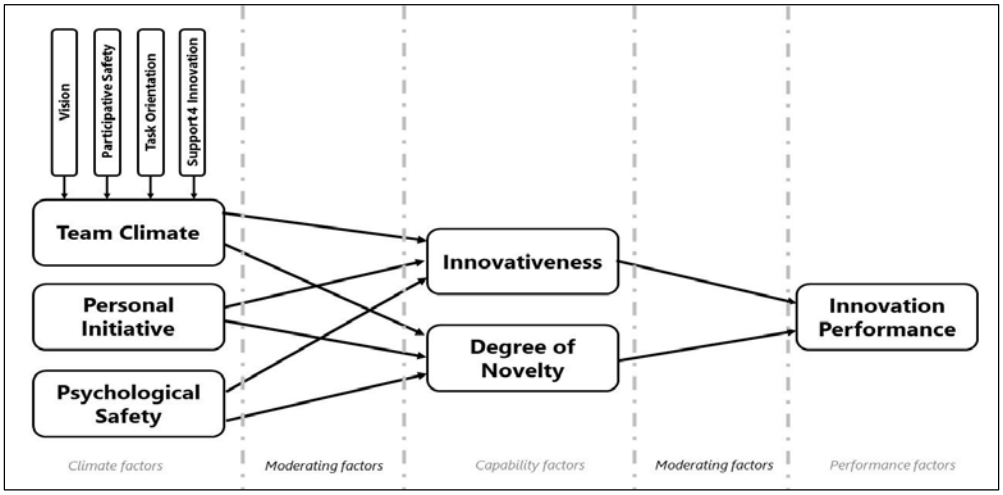

Figure 2. The Research Model – detailed description

To collect relevant and consistent organizational climate data, we combine for the first time three consecrated organizational climate research instruments: The Team Climate Inventory (TCI), the Personal Initiative (PI), and the Psychological Safety (PS) surveys. In the field of organizational innovative capability, we select Innovativeness and Degree of Novelty, already developed and validated by literature, as the most important results of an innovation-oriented climate and assume these two factors as prerequisites for the significant business outcomes generated by innovations, aggregated in a composite factor, Innovation Performance. Two new formulas of composite factors aggregated from domain-relevant variables are proposed for Innovativeness, respectively Innovation Performance.

3. Proposed research design and instruments to test the model

Based on the literature, we believe the best approach to test this research model is quantitative, based on surveys applied on a statistically relevant number of software companies of various types, sizes, market coverages, product strategies, and business models, to provide diversity and cover a sufficiently large spectrum of firms for each of the three moderating factors. A pair of surveys (one for the employees and one for the top manager of each company) should be applied. To correspond to the innovation performance criteria, only companies with at least three years of activity and already profitable should be selected in the final sample, as scholars consider that the research-relevant new products generated through innovation are those launched and sold within the last three years of activity of the firm (Judge & Douglas, 1998; Cassiman & Veugelers, 2006; Fosfuri & Tribó, 2008; Zeng et al., 2010).

The climate-related questionnaire addressed to employees includes 28 items: 14 items for the Team Climate Inventory, using the model presented and validated by Strating &

Nieboer (2009); 7 items for Personal Initiative, as defined by Baer & Frese (2003) and validated by Fischer et al. (2014) or Lisbona et al. (2018); and 7 items for Psychological Safety, as defined by Edmondson (1999), presented and validated by Baer & Frese (2003) and multiple other recent studies. All 28 items use a 5-degree Likert scale with values from 1 – Strongly disagree; 2 – Disagree; 3 – Neither disagree or agree; 4 – Agree; 5 – Strongly agree. The items are presented in the following Table (star-marked manifest variables indicate negative situations or climate behaviours):

#Item formulation	**Manifest variable, code**	**Latent variable**
#1 - I completely agree with our organization's objectives.	TC11_Sharedness	TCI Vision
#2 - I believe that our team's objectives are clearly understood by the other members of the team.	TC12_Clarity	TCI Vision
#3 - I think our team's objectives can actually be achieved.	TC13_Attainability	TCI Vision
#4 - I believe these objectives are worthwhile to the organization.	TC14_PerceivedValue	TCI Vision
#5 - We have a "we are in it together" attitude in our team.	TC21_Influence	TCI Participative Safety
#6 - People keep each other informed about work-related issues in the team.	TC22_InteractionFrequency	TCI Participative Safety
#7 - People feel understood and accepted by each other, in our team.	TC23_Safety	TCI Participative Safety
#8 - There are real attempts to share information throughout the team.	TC24_InfoSharing	TCI Participative Safety
#9 - Our team members are prepared to question the basis of what the team is doing.	TC31_Ideation	TCI Task Orientation
#10 - Our team members critically appraise potential weaknesses in what we are doing, in order to achieve the best possible outcome.	TC32_Appraisal	TCI Task Orientation
#11 - The members of our team build on each other's ideas in order to achieve the best possible outcome.	TC33_Excellence	TCI Task Orientation
#12 - People in our team are always searching for fresh, new ways of looking at problems.	TC41_ArticulatedSupport	TCI Support for Innovation
#13 - In this team we take the time needed to develop new ideas.	TC42_Time4Creativity	TCI Support for Innovation
#14 - People in our team cooperate in order to help develop and apply new ideas.	TC43_EnactedSupport	TCI Support for Innovation
#15 - People in our company actively attack	PIE1_Focus	Personal Initiative

problems.		
#16 - Whenever something goes wrong, people in our company search for a solution immediately.	PIE2_Solutioning	Personal Initiative
#17 - Whenever there is a chance to get actively involved, people in our company take it.	PIE3_Involvement	Personal Initiative
#18 - People in our company take initiative immediately – more often than in other companies.	PIE4_Initiative	Personal Initiative
#19 - People in our company use opportunities quickly in order to reach our goals.	PIE5_Opportunism	Personal Initiative
#20 - People in our company usually do more than they are asked to do.	PIE6_ExtraEffort	Personal Initiative
#21 - People in our company are particularly good at practically implementing new ideas.	PIE7_Implementation	Personal Initiative
#22 - In our company some employees are rejected for being different.	PSE1_Intolerance*	Psychological Safety
#23 - When someone in our company makes a mistake, it is often held against them.	PSE2_Blame*	Psychological Safety
#24 - No one in our company would deliberately act in a way that undermines others' efforts.	PSE3_Cohesion	Psychological Safety
#25 - It is difficult to ask others for help in our company.	PSE4_Unavailability*	Psychological Safety
#26 - In our company one is free to take risks.	PSE5_RiskTaking	Psychological Safety
#27 - The people in our company value others' unique skills and talents.	PSE6_Recognition	Psychological Safety
#28 - As an employee in our company one is able to bring up problems and tough issues.	PSE7_SpeakingUp	Psychological Safety

Table 1 – The items addressing the organizational climate. Sources: Anderson & West (1996; 1998), Baer & Frese (2003), Strating & Nieboer (2009), Fischer et al. (2014)

The questionnaire addressing the evaluation of the organizational innovative capabilities is addressed to employees and includes 6 items for the composite factor Innovativeness and one item for Degree of Innovation. All 6 items related to Innovativeness use a 5-degree Likert scale with values from 1 – Strongly disagree; 2 – Disagree; 3 – Neither disagree or agree; 4 – Agree; 5 – Strongly agree. The six factors taken into consideration to evaluate the organizations' innovativeness are: focus on innovation (Pallas et al., 2013); the speed of R&D processes as compared against major competitors; the novelty of the used technologies and methodologies; speed to the

market of new products, as compared against major competitors (Prajogo & Ahmed, 2006; Prajogo & Suhal, 2006); encouragement of initiative to implement ideas (OECD, 2005; Fischer et al., 2014); effective adoption of new ideas (Ferraresi et al., 2012; Parida et al., 2017). The items are presented in the following Table:

#Item formulation	Latent variable	Academic reference
The company I work for is seriously focused on innovation	Focus on innovation;	Pallas et al., 2013
The speed of the Research & Development processes of our company is faster than our competitors	Speed of R&D compared against major competitors	Prajogo & Ahmed, 2006; Prajogo & Suhal, 2006
We use the latest technological innovations and methodologies in our new product development activities	Novelty of the technologies and methodologies used	Prajogo & Ahmed, 2006; Prajogo & Suhal, 2006
The new products and services delivered by our company arrive to the market faster than our competitors	Speed to the market of NP, as compared to competitors	Prajogo & Ahmed, 2006; Prajogo & Suhal, 2006
In our company, the initiative for implementing new ideas is actively encouraged and supported.	Encouragement of initiative for new ideas	OECD, 2005; Fischer et al., 2014
A large proportion of the new ideas generated in the company is practically implemented in our work and products.	Effective adoption of new ideas	Ferraresi et al., 2012; Parida et al., 2017

Table 2 – The items addressing the organizational innovativeness

The degree of novelty will be assessed on a six-degree scale as defined by Fischer et al. (2014) and later validated by Lisbona et al. (2020). The item formulation is: *"Please evaluate the level of innovation of your organization. Select the option that best describes the innovative value of your products and services:"*, and the answering options are: 1 - No major innovation at all; 2 - Same or very similar innovation applied by our competitors; 3 - Similar innovation to the ones applied by other firms in the same industry, but the firm's innovation differs in identifiable ways from innovations of other firms; 4 - Similar innovation to the ones applied in other industries; 5 - The innovation we realize is fundamentally new to the firm; 6 - The innovation we generate is fundamentally new to the market.

The questionnaire targeting Innovation Performance is designated to organizations' managers and includes 10 items. The first item (new products' turnover in total firm's turnover) asks "What is the proportion of annual turnover from New Products in total annual turnover?" and is expressed on a 5-degree Likert scale with the following options: 1 – 0%; 2 – Between 0% – 15%; 3 – Between 15% – 30%, 4 – between 30% – 50%; 5 – Over 50%. The other 9 items related to Innovation Performance use a 5-degree Likert scale (1 – Strongly disagree; 2 – Disagree; 3 – Neither disagree or agree; 4 – Agree; 5 – Strongly agree) and are: new products turnover in total turnover, as compared against competitors (OECD, 2005; Carlsson et al., 2011; Alegre et al., 2013; Arundel et al., 2019); new products turnover in total turnover, per employee, as compared against

major competitors (Kafouros et al., 2008); increase of competitive advantage in the market due to innovation (Hung et al., 2011); increase of profitability due to innovation (Pallas et al., 2013); increase of turnover due to innovation (OECD, 2005; Hung et al., 2011); achievement of market share objectives by new products (De Luca & Atuahene-Gima, 2007; Ferraresi et al., 2012); achievement of sales revenue objectives; achievement of Return On Investment objectives; achievement of profitability objectives (Baer & Frese, 2003; De Luca & Atuahene-Gima, 2007; Pallas et al., 2013). The items are presented in the following Table:

#Item formulation	Latent variable	Academic reference
What is the proportion of annual turnover from New Products in total annual turnover?	New products' turnover in total turnover	OECD, 2005; Carlsson et al., 2011;
The proportion of annual turnover of New Products in total annual turnover is higher compared to our competitors.	New products' turnover in total turnover, compared to competitors	OECD, 2005; Alegre et al., 2013; Arundel et al., 2019
The Sales revenue from New Products in total turnover, calculated per employee, is higher compared to our competitors.	New products' turnover in total turnover, per employee	Kafouros et al., 2008
During the last three years, the comparative advantage of our company in the market has significantly improved due to innovation.	Increase of competitive advantage due to innovation	Hung et al., 2011
During the last three years, our company profitability has improved due to innovation.	Increase of profitability due to innovation	Pallas et al., 2013
During the last three years, the turnover of our organization has been improved significantly due to innovation.	Increase of turnover due to innovation	OECD, 2005; Hung et al., 2011
The new products and services developed by our firm have achieved MARKET SHARE according to our previously-stated objectives.	Achievement of market share stated objectives by new products	Baer & Frese, 2003; De Luca & Atuahene-Gima, 2007; Ferraresi et al., 2012; Pallas et al., 2013
The new products and services developed by our firm have achieved SALES REVENUE according to our previously-stated objectives.	Achievement of sales revenue stated objectives	Baer & Frese, 2003; De Luca & Atuahene-Gima, 2007; Pallas et al., 2013
The new products and services developed by our firm have achieved RETURN ON INVESTMENT according to our previously-stated objectives.	Achievement of ROI stated objectives	Baer & Frese, 2003; De Luca & Atuahene-Gima, 2007; Pallas et al., 2013
The new products and services developed by our firm have achieved PROFITABILITY according to our previously-stated objectives.	Achievement of profitability stated objectives	Baer & Frese, 2003; De Luca & Atuahene-Gima, 2007; Pallas et al., 2013

Table 3 – The items addressing the Innovation Performance

After data collection, data filtering, and entries validation, a mix of statistical research tools could be applied to validate the model.

4. Conclusions, limitations and further research

Summary. Based on the literature, we presume that organizational climate directly impacts organizations' innovative capabilities, which, in their turn, are correlated with innovation-based business results. We select Personal Initiative, Psychological Safety, and Team Climate (with their four latent variables – Vision, Participative Safety, Task Orientation, and Support for Innovation) as the most significant climate factors for the software organizations' capabilities (Innovativeness and Degree of Novelty) in generating profitable impactful novelty (Innovation Performance). Three established research instruments on organizational climate (TCI, PI, and PS) are combined for the first time in the methodology. Founded in literature, two industry-adapted aggregation formulas for Innovativeness and Innovation Performance as composite factors are presented.

Relevance. This research model should provide valuable insights for academics and managers about the characteristics and principles of organizational climate in software organizations, which can generate innovative capabilities and further remarkable innovative outputs. A comprehensive set of hypotheses may be formulated based on the research model and researchers' areas of interest, to cover and explore all the relationships between the factors in the proposed structure. By testing the consistency and validity of the two newly-constructed composite factors, a better understanding of innovativeness and innovation performance, adapted to the software industry, can be reached and further expanded to other creative sectors.

Further research. Testing the proposed model in various contexts, organizations and countries is a natural future research step. Based on the model testing, an opportunity for developing optimized versions appears, by including further variables, relationships, and potential moderating factors. Further research results are expected to produce innovation- and industry-related knowledge and support practical ideas related to how to engage and manage employees and teams to continuously generate new ideas and initiatives that prove to enhance the performance of software-producing organizations, no matter if oriented towards incremental, radical or mixed product strategies.

Limitations. The novelty of the research model involves certain vulnerabilities and limitations. In this format, the factors of innovativeness and innovation performance are based on a new composition framework, supported by a wide academic literature but not yet validated by other studies. The research model could not fully represent the global software industry and should be adapted to further research contexts, as local business strategies, cultural biases, and influence of the national culture, as defined by Hofstede (1980) are able to impact research results. Further research conclusions and managerial applications could be limited to the IT software-producing industry and should be adapted for other knowledge economy sectors.

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