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# Antecedents of innovation in industry

Antecedents of  
innovation in  
industry

## The impact of work environment factors on creative performance

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### Abstract

**Purpose** – Today, organizations must be able to create innovative strategies, and creative performance depends on knowing what hinders or stimulates creativity. This paper aims to determine which factors in the workplace environment positively or negatively affect creativity by analyzing individuals' perceptions in a sample of Brazilian industrial companies.

**Design/methodology/approach** – The discussion is based on the componential theory of creativity and the use of a recognized research instrument (KEYS). A regression analysis was carried out, using eight environmental factors related to creativity. The purpose of the collection is to observe the statistical relationships between the scales of the factors and the results related to creativity.

**Findings** – Among the eight factors of the original componential theory, only three were found to have a significant impact on the creative process: organizational incentives, challenging work and support from the work group.

**Research limitations/implications** – The sample in this study was relatively small, and a larger sample will be required to undertake factor analysis.

**Practical implications** – Possible implications for the management of innovation in the Brazilian context are discussed in light of these results.

**Originality/value** – This study contributed to the production of knowledge, still scarce in the country, about the search for creative solutions through the work environment by confirming which factors are significant and determinants of creative performance and challenging factors that had already been proven by other studies in non-Brazilian contexts.

**Keywords** Work environment

**Paper type** Research paper



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## Introduction

Ongoing uncertainty in the modern business environment requires managers to strive to find suitable alternatives for a business to survive and develop. Creativity and innovation are increasingly important in relation to developing skills in organizations, underscoring the critical role that fostering creativity plays in management for effective innovative performance.

The concepts of creativity and innovation have often been used interchangeably in the literature on management, but they are in fact distinct concepts. While creativity refers to the process of developing a new idea or invention, innovation refers to the process of implementing and marketing it (Amabile *et al.*, 1996).

Based on an extensive review of the literature on creativity, innovation and organizational change, Bruno-Faria (2003) argues that while innovation may have other sources, it is closely related to creativity. Resende *et al.* (2016) note that encouraging employees to be creative in search of new opportunities is among the main antecedents of innovation. In their recent study, Dul and Ceylan (2014) showed that companies whose work environments support creativity achieve better results in terms of new product sales and number of new products launched.

In the context of management, decision-making with regard to the organizational environment presents a constant challenge for management, and the complexity of this environment requires a search for broader knowledge about its aspects. In recent years, there has been a growing recognition of the importance of the impact that personal and contextual factors have on creativity. Therefore, Alencar (1998) recommends that attention should be given to the general tone of the work environment to dismantle possible barriers to creativity and maximize the opportunities for its expression. It is apparent, then, that one must consider the level of fomentation of creativity to be a critical aspect of effective organizational management.

This study explores the perceptions of individuals in industrial companies regarding the factors in their work environment that stimulate or inhibit the creativity of the organization's members. This is a topic that still intrigues researchers in the field of administration. Recent studies have sought to determine what factors influence creative performance in the business environment. For example, Gu *et al.* (2015) found that the leader's moral stance has a positive influence on the creative performance of a team. Muñoz-Pascual and Galende (2017) concluded that managers should promote and encourage practices related to the management of knowledge and intrinsic motivation to improve their teams' creativity, leading to improved performance by the company in terms of technological innovation. Jyoti and Dev (2015) found that transformational leadership, that is, leadership that promotes and manages the processes of change, substantially increases employees' creative performance. Jafri *et al.* (2016) concluded that the organizational climate moderates the effect of emotional intelligence on creative performance in terms of creativity. Jiang *et al.* (2017) suggested that employees who suffer bullying by their leaders show inferior creative performance. Rodríguez-Sánchez *et al.* (2017) observed how engagement with a group plays a mediating role between a work group's cohesion and its creative performance. Carmeli *et al.* (2007) studied how respectful relations among team members improve the processing of relational information, resulting in superior creative behavior.

Among these various studies, theories and models of the antecedents or determinants of creative performance among individuals or teams in organizations, Amabile's componential theory (Amabile, 1983, 1988, 1996) stands out. Although it is a seminal theory, the theory and tools it has generated have never been applied in studies in Brazil. The present study makes pioneering use of the instrument cited. This is an empirical study using the KEYS

research instrument (Amabile *et al.*, 1996), which is designed to explore peoples' perceptions of their work environment based on environmental factors related to creativity.

The scarcity of studies on how work environment factors influence creative performance in Brazilian companies (Bedani, 2012; Bruno-Faria *et al.*, 2008) gives rise to the following research question:

*RQ1.* Which work environment factors are perceived by individuals as stimulants or inhibitors of creativity?

Innovative processes are multifaceted. They are affected by variations in institutions, cultures, organizations and the external environment (Ensor *et al.*, 2001; Sarooghi *et al.*, 2015). An analysis of the various recent studies mentioned above shows that management of work environment is essential to create characteristics favorable to the factors that impact the creative potential of groups in organizations. Following this line of argument, the general objective of the present study was to show that the work environment factors described by componential theory do not affect creativity as expected in the Brazilian context and to consider the possible consequences of this finding for the management of creativity in companies' innovation processes.

To achieve its overall objective, the study had the following specific objectives: to investigate individuals' perceptions of work environment factors and their influence on the creative process; and to suggest ways in which management of the work environment can be improved to foster innovation in the organization.

The study aims to confirm positive or negative influence of work environment factors on creativity in the Brazilian business environment. The following hypothesis will be tested:

*H1.* The factors described in componential theory's dimensions of the work environment impact creativity in organizations as expected, in accordance with the original theory.

The main benefit expected from this study, from the point of view of management practices, is the potential to guide managers in their search for organizational improvements by promoting the creative process and fostering an environment conducive to innovation. Work environment factors have an impact on innovative results and, by extension, can facilitate the conversion of individual creativity into innovation, thereby contributing to the achievement of organizational goals.

The study's main contribution to academia is the verification of the significance of the effect of eight environmental factors on creativity in the sample studied, as an initial effort at preliminary, partial and tentative validation of the KEYS instrument in the Brazilian context. Studies using larger samples will make a more complete validation possible by using confirmatory factor analysis.

## Review of the literature

This section presents a review of the research on which this study is based and is divided into three topics: determinants of creative performance in companies; the componential theory of creativity; and the KEYS research instrument. The aim of this review is first to present various studies, including the most recent, which establish a connection between practices and behaviors that promote creativity in the business environment at both the individual and working group levels. Next, the theory on which this study is based is presented in greater detail, followed by a description of the KEYS instrument. The componential theory of creativity underlines the KEYS instrument.

*Determinants of creative performance in companies*

The literature on determinants of creativity in the business environment is vast. [Table I](#) attempts to summarize the contributions of classic studies and recent studies on this topic, with the exception of componential theory, which is addressed in greater detail in the next subsection. We do not intend to present a comprehensive review but rather to highlight some of the most significant contributions and highlight some trends. Comprehensive reviews have been undertaken by [Nanda and Singh \(2009\)](#) and [Anderson et al. \(2014\)](#). As can be observed, some studies focus on management practices. Others focus on the individual behavior or characteristics of managers or team members. In other words, one can conclude that creativity depends not only on individual factors such as education and personality but also on work environment and society that stimulate and recognize creative capacity. Although many studies address factors that impact the creative performance of individuals, a number of studies also address the creativity of teams. The factors in [Table I](#) were divided into two categories: factors at the organizational or managerial level and factors at the individual/behavioral level.

*The componential theory of creativity*

Among the theoretical models based on situational factors that influence creativity, one of the most relevant is Amabile's componential model of creativity ([Amabile, 1983, 1996](#)), which shows that factors arising from the social context and the interaction of these elements with cognitive and personality elements are main drivers of creativity. This model is discussed below.

The componential theory of creativity was developed by [Amabile \(1983\)](#) and describes the creative process and various factors that influence its outcomes. The theory was adapted

| Determinants of creativity in the business environment           | Author(s)  |
|--|--|
| <i>1. Factors at the level of the organization and practices</i> |  |
| Organizational incentives to take risks                          | <a href="#">Ensor et al. (2001)</a>  |
| Participatory management   | <a href="#">Ensor et al. (2001)</a>  |
| Organizational support and consideration of ideas                | <a href="#">Ensor et al. (2001)</a>  |
| Rewards and bonuses  | <a href="#">Ensor et al. (2001)</a>  |
| Management of knowledge and management of intrinsic motivation   | <a href="#">Muñoz-Pascual and Galende (2017)</a>   |
| Collective engagement  | <a href="#">Rodríguez-Sánchez et al. (2017)</a>  |
| Team cohesion  | <a href="#">Rodríguez-Sánchez et al. (2017)</a>  |
| Culture of the country/region                                    | <a href="#">Erez and Nouri (2010)</a> ; <a href="#">Zhou and Su (2010)</a>   |
| <i>2. Factors at the individual/behavioral level</i>             |  |
| Leader's moral posture   | <a href="#">Gu et al. (2015)</a>   |
| Transformational leadership by the manager                       | <a href="#">Jyoti and Dev (2015)</a>   |
| Emotional intelligence   | <a href="#">Jafri et al. (2016)</a>  |
| Bullying by the leader (negative effect)                         | <a href="#">Jiang et al. (2017)</a>  |
| Mutual respect among team members                                | <a href="#">Carmeli et al. (2007)</a>  |
| Life experience  | <a href="#">Woodman et al. (1993)</a> ; <a href="#">Ford (1996)</a>  |
| Ambition/self-esteem   | <a href="#">Shalley et al. (2009)</a>  |
| Knowledge/education  | <a href="#">Zhou and Shalley (2010)</a> ; <a href="#">Ford (1996)</a>  |
| Personality, way of thinking/values, psychological state         | <a href="#">Raja and Johns (2010)</a> ; <a href="#">Shin and Zhou (2003)</a> ; <a href="#">Miron-Spektor et al. (2011)</a> |

**Table I.**  
Determinants of  
creativity in the  
business  
environment

**Source:** Prepared by the authors

in 1988 to include individual creativity and innovation in organizations. In 1996, it evolved further to incorporate the principle of intrinsic motivation. An additional modification was published in 2008, adding that the affective state, which can be influenced by the work environment, can have a significant impact on relevant creative processes (Amabile, 2012).

The theory rests on two important assumptions. The first is that there is a link between the low levels of creativity found in daily life and the high levels of creativity found in performances, inventions, scientific discoveries and historically significant works of art. The second is that there are degrees of creativity in the work of each individual, even within a single field. The level of creativity produced by a person in any given moment derives from a combination of the components in play at that moment, within and around the person.

By observing the role of a variety of social factors, Amabile (1983, 1996, 2012), together with other researchers, developed the componential model of creativity. The model describes the psychological and social components necessary for an individual to produce creative work, emphasizing the key role of intrinsic motivation and the impact of the organizational context on this type of motivation.

The theory refers to four components that interact to produce any creative response. Three of the components are inherent to the individual: skills and knowledge relevant to the field (or expertise), relevant creative talents and intrinsic motivation to work (specifically, the intrinsic motivation to engage in the activity out of curiosity for pleasure or from a sense of personal challenge). The fourth component is external: the social environment where the individual works (Amabile, 1996). The theory holds that creativity requires the confluence of all these components.

According to Amabile (2012), the external component of creativity, or the social environment in which the individual works, is made up of extrinsic sources of motivation that influence the person's intrinsic motivation and environmental factors that can serve as obstacles or stimuli to the person's intrinsic motivation and creativity. Amabile (1997, p. 46) recommends that "controlling extrinsic motivation is detrimental to creativity, but informational or enabling extrinsic motivation can be conducive, particularly if initial levels of intrinsic motivation are high".

In general, research in organizational settings has identified factors that block creativity, such as strict standards, internal policy, emphasis on one's position in the structure, conservative attitude of upper management and excessive time pressures. Other factors stimulate creativity, including meaningful, challenging work, collaborative work teams, the ability to work autonomously, support and recognition for new ideas and innovation, mechanisms for developing new ideas and policies of actively sharing ideas in the organization (Amabile, 2012).

Creativity is higher when a person with intrinsic motivation, relevant skills and creative thought processes works in an environment that is highly conducive to creativity (Amabile and Kramer, 2007). Figure 1 describes the impact of the external component on creativity.

The componential model has served as the basis for many empirical studies (Gagné and Deci, 2005; Oldham and Cummings, 1996; Shalley *et al.*, 2000; Woodman *et al.*, 1993) and as a partial foundation for other theories about creativity. Its importance lies in the fact that it covers multiple levels, addressing creativity at the levels of the individual, team and organization.

#### *The KEYS instrument: assessing the environment for creativity*

Drawing on the componential theory of creativity and the conceptual model, the KEYS quantitative research instrument was designed (Amabile *et al.*, 1996) based on environmental factors relevant to creativity. The factors are presented in Figure 2, which can be considered as the conceptual research model that guides this study.

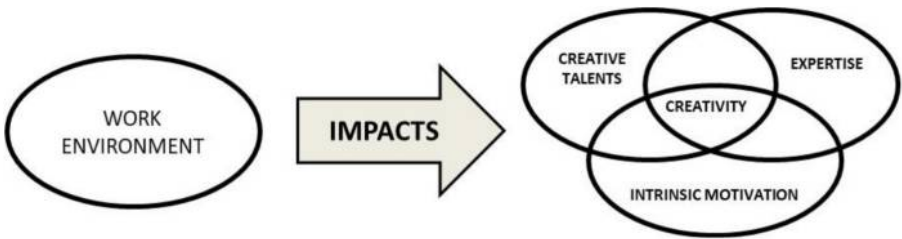


Ensor *et al.* (2001) report that a review of the literature on creative work environments shows that various studies were fragmented across different fields, but the concept of the KEYS research instrument classified them and categorized factors to measure environmental and results-related aspects.

KEYS is a well-recognized, psychometrically sound instrument developed by Amabile *et al.* (1996) to quantitatively assess perceptions of the creative work environment. The instrument portrays a work environment, not an individual. The work environment is seen as the result of personalities, styles, policies and interactions among a large number of people, from upper management to individual employees in work groups.

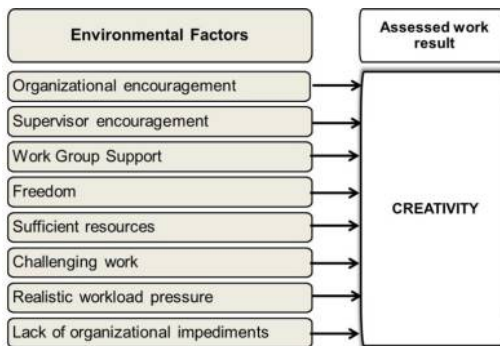
The instrument consists of a questionnaire with 78 items, organized into ten work environment factors that classify the relevant environmental factors and results. Four factors describe management practices, two describe organizational motivation for creativity and two describe organizational resources. The other two factors on the scale describe perceptions of results in terms of creativity and productivity of the work currently carried out by the organization (Amabile *et al.*, 2010). This study does not analyze the productivity scale, as it falls outside the study's scope. Description of the dimensions and factors of the KEYS instrument is provided.

**Figure 1.**  
Components that favor a creative response: impacts of an organization's work environment on creativity



Source: Adapted from Amabile (1997)

**Figure 2.**  
Environmental factors of KEYS



Source: Adapted from Amabile *et al.* (1996)

Work environment:

- (1) Management practices:
  - *Freedom*: It is the ability to decide what work to do or how to do it; perception of control over one's own work.
  - *Challenging work*: It is the perception that one must work hard on challenging tasks and significant projects.
  - *Supervisor encouragement*: It is a manager who serves as a good reference point at work, who tries to set appropriate goals, supports the work group, values individual contributions and shows confidence in the group.
  - *Work group support*: It is a group whose members possess a wide range of skills, communicate well, are open to new ideas, challenge each other's work constructively, trust and help each other and feel committed to the work they are doing.
- (2) Organizational motivation:
  - *Organizational encouragement*: It is an organizational culture that encourages creativity through fair and constructive assessment of ideas, rewards and recognition for creative work, mechanisms for the development of new ideas, an active flow of ideas and a shared vision.
  - *Absence of organizational impediments*: It is an organizational culture that does not hinder creativity through internal political problems, harsh criticism of new ideas, destructive internal competition, aversion to risk or an exaggerated emphasis on the status quo.
- (3) Resources:
  - *Sufficient resources*: It means access to appropriate resources, including funds, materials, facilities and information.
  - *Realistic workload pressure*: It includes no extreme time pressures, unrealistic productivity expectations and distractions from creative work.
- (4) Results:
  - *Creativity*: It is an organization or creative unit in which a great deal of creativity is required and in which people believe that they really produce creative work.
  - *Productivity*: It is an efficient, effective and productive organization or unit [Source: Adapted from [Amabile et al. \(2010\)](#), p. 34].

The aforementioned list shows and classifies the dimensions and factors of the KEYS instrument related to the work environment and organizational results.

KEYS is the measurement instrument chosen for this study, and it was used with the permission of the Center for Creative Leadership, current holder of the license and the author's representative. As this is the first occasion on which the instrument has been used for academic research in Brazil, the instrument was translated and back-translated by an academic team, and a pretest was subsequently performed with seven volunteers to make final revisions and adjustments.

## Method

To answer the questions posed by the study, an exploratory study was undertaken, which nevertheless included a test of the hypothesis. The research consisted of a field study designed to explore individuals' perceptions about their work environment at a particular



moment (Amabile *et al.*, 2010). In light of the limited information about organizations that actually foster creativity in Brazil, the sample was chosen for heterogeneity and is based on openness to participation in the study.

The research method used adopts quantitative aspects and seeks an explanation for the phenomenon investigated. In organizational studies, quantitative research makes it possible to measure social phenomena in a universe through a statistically representative sample, examining and corroborating theories about the phenomena based on the results of hypotheses tested (Prodanov and Freitas, 2013).

Data were collected to enable the performance of a regression analysis relating to the eight environmental factors to creativity and testing the hypothesis proposed. The purpose of the data collection was to observe the statistical relationships among measures of stimuli and obstacles to creativity in the work environment and their results in terms of creativity. Although items on the KEYS instrument are rated on a Likert scale, which is categorical, the factors that make up a creative climate are continuous variables (arithmetic means), requiring the use of ordered non-logistic and linear regressions (Gelman and Hill, 2007).

Much research has been done in recent decades on topics related to creativity and innovation, and various studies have applied regression analysis using factors calculated from questionnaires that use the Likert scale (Blauth *et al.*, 2014; Eisenbeiss *et al.*, 2008; Ferizovic, 2015; Hamidi *et al.*, 2008; Im *et al.*, 2013; Kalyar, 2011; King *et al.*, 2007; Oldham and Cummings, 1996; Pörzse *et al.*, 2012; Rice, 2006; Schepers and Van Den Berg, 2007; Shin *et al.*, 2012; Sierra *et al.*, 2017; Sousa *et al.*, 2016; Stokols *et al.*, 2002; Tierney and Farmer, 2002).

#### *Sample and empirical space*

Data were collected from 128 participants in 57 companies. The criteria used to select the study's subjects were that they should be employed in organizations of various sizes located in Brazil and that preferably they have been working in their current position for at least a year to be able to answer the questions with greater authority. Following these criteria, the sample was defined by the researchers who selected participants according to their accessibility (Vergara, 2013).

The empirical space was the working environments of 57 small, medium and large industrial organizations in various sectors: processing, chemicals, food, plastics, vehicle manufacturing, energy, furniture, construction, metalworking, hospitality and assorted manufacturing industries.

It is important to emphasize that the approach chosen for the sample aimed to increase the explanatory power of the conclusions, and hence, a regression analysis with a larger sample was used rather than a case study, which is not amenable to generalization (Yin, 2011). Moreover, the presence of sufficient variation in the sample (a direct consequence of a greater number of companies included in the sample) is essential to ensure the validity of the results of the regressions, as variables that exhibit little variation within the sample collected must be excluded (Neter *et al.*, 1996). Therefore, a wider range of companies is preferable for a given sample size. Of course, a larger sample is always desirable, but the scope of this study made it impossible to obtain a larger number of participants, which is one of its limitations.

#### *The instrument*

The goal of the KEYS instrument is to assess employees' collective perception of their company's climate in terms of creativity. The original format of the KEYS questionnaire was used, which requires respondents to rank their level of agreement with affirmations on a four-point Likert psychometric scale to avoid neutral responses. The anchors were "never,"

“sometimes,” “frequently” and “always” (Amabile *et al.*, 2010). Although the instrument has not been formally validated in the Portuguese language, which is one of the objectives that prompted the present research project, the careful validation performed in English is a preliminary indicator of the instrument’s validity (Amabile *et al.*, 1996).

### Procedure

Before the questionnaire was administered, each participant received the informed consent form (IC) and gave written consent to participate in the study. The form explained the purpose of the study and informed participants that their participation was voluntary and that their responses during the interview were anonymous and confidential. The study’s results do not identify individuals or companies. This study was reviewed and approved by the Human Subjects Research Ethics Committee of IFBA-Brazil (Opinion No. 1.533.915).

In accordance with the guidelines established in the KEYS instrument, the factors related to the organizational environment were treated as independent variables and grouped into scales. Multivariate statistical techniques are necessary for studies that aim to explain complex problems (Hair *et al.*, 2011).

### Reliability

The Cronbach’s alphas of the factors, which provide a measure of the instrument’s internal consistency and reliability, are shown in Table II. All the factors had acceptable values (above 0.7), except the factors of freedom and realistic work pressures, as shown in Table II. The unsatisfactory results of these two factors indicate that factor analysis with a large sample is necessary for a complete validation of the KEYS instrument in the Brazilian business environment.

### Results

In light of the goal of assessing the impact of various measures of the work environment on creativity, a multiple regression analysis was used to estimate a model. The values for the work environment dimensions were examined and the behavior of the dependent variable creativity was observed and compared using the regression formula.

As seen in Table III, the multiple regression model using the eight predictor variables and the dependent variable creativity was shown to be statistically significant,  $F(8,235) = 13.24$ ,  $p < 0.001$ , with an adjusted  $R^2$  of 0.435.

| Factor                                | Cronbach’s alpha |
|---------------------------------------|------------------|
| Organizational encouragement          | 0.887            |
| Supervisor encouragement              | 0.919            |
| Work group support                    | 0.826            |
| Freedom                               | 0.174            |
| Sufficient resources                  | 0.79             |
| Challenging work                      | 0.697            |
| Absence of organizational impediments | 0.812            |
| Realistic workload pressure           | 0.552            |
| Creativity                            | 0.729            |

Source: Data obtained in the study

**Table II.**  
Cronbach’s alphas of  
the factors

| <i>R</i>  | <i>R</i> <sup>2</sup>         | Adjusted <i>R</i> <sup>2</sup> | Standard error of estimate |          | Durbin-Watson |
|---|-------------------------------|--------------------------------|----------------------------|----------|---------------|
| <i>Summary of the regression model – Dependent variable: Creativity</i> |                               |                                |                            |          |               |
| 0.686   | 0.471                         | 0.435                          | 0.38068                    |          | 1.852         |
| <i>ANOVA – Dependent variable: Creativity</i>                           |                               |                                |                            |          |               |
|   | Sum of Squares                | df                             | Mean Square                | <i>F</i> | Sig.          |
| Regression  | 15.354                        | 8                              | 1.919                      | 13.243   | 0.000         |
| Residuals   | 17.245                        | 119                            | 0.145                      |          |               |
| Total   | 32.599                        | 127                            |                            |          |               |
| <i>Statistics of collinearity – dependent variable: creativity</i>      |                               |                                |                            |          |               |
| Variables   | Tolerance                     |                                |                            | VIF      |               |
| Organizational encouragement  | 0.336                         |                                |                            | 2.981    |               |
| Supervisor encouragement  | 0.611                         |                                |                            | 1.637    |               |
| Work group support  | 0.779                         |                                |                            | 1.284    |               |
| Freedom   | 0.849                         |                                |                            | 1.178    |               |
| Sufficient resources  | 0.453                         |                                |                            | 2.208    |               |
| Challenging work  | 0.644                         |                                |                            | 1.554    |               |
| Absence of organizational impediments                                   | 0.633                         |                                |                            | 1.581    |               |
| Realistic workload pressure   | 0.676                         |                                |                            | 1.479    |               |
| Independent variables   | Non-standardized coefficients |                                | Standardized coefficients  | <i>t</i> | Sig.          |
|   | <i>B</i>                      | Standard model                 | Beta                       |          |               |
| <i>Correlations and coefficients – variable dependent: creativity</i>   |                               |                                |                            |          |               |
| Organizational encouragement  | 0.340                         | 0.113                          | 0.347                      | 3.011    | 0.003         |
| Challenging work  | 0.334                         | 0.081                          | 0.341                      | 4.102    | 0.000         |
| Work group support  | 0.204                         | 0.078                          | 0.198                      | 2.620    | 0.010         |
| Freedom   | 0.157                         | 0.083                          | 0.137                      | 1.896    | 0.060         |
| Absence of organizational impediments                                   | -0.161                        | 0.086                          | -0.157                     | -1.875   | 0.063         |
| Realistic workload pressure   | 0.072                         | 0.082                          | 0.071                      | 0.874    | 0.384         |
| Supervisor encouragement  | -0.031                        | 0.063                          | -0.042                     | -0.493   | 0.623         |
| Sufficient resources  | -0.003                        | 0.089                          | -0.004                     | -0.039   | 0.969         |

**Table III.**  
Statistical results

**Source:** Data obtained in the study

The results suggest that at least some variables have an impact on organizational creativity. Before the statistical analysis was performed, the data were cleaned and their precision was verified. Any items left blank were treated as missing data.

Because a probabilistic model requires the establishment of assumptions under which the model should work, the absence of collinearity was tested as the basic assumption for the regression model.

In addition to testing assumptions, sample size is another important consideration for the reliability of the regression. To ensure such reliability, the sample size was based on the calculation adopted for determining the minimum recommended size, which is  $50 + 8K$ , where  $K$  is the number of independent variables (Green, 1991). As there were eight independent variables in this study, the minimum recommended size was determined to be 114 respondents, and the sample included 128 people.

The variance inflation factor (VIF) method was used to diagnose collinearity. As shown in Table III, the VIF values calculated were below 2.981 for all variables, showing no collinearity ( $VIF > 10$ ).

Table III also shows the correlations of each independent variable in the model. The factors with the greatest contribution to the model were organizational incentives, with a coefficient of 0.340, challenging work, with a coefficient of 0.334 and work group support, with a coefficient of 0.204. The factor with the lowest coefficient was sufficient resources, with 0.003.

The standardized regression coefficients of the variables organizational incentives, challenging work and working group support were 0.347, 0.341 and 0.198, respectively, confirming them as significant factors ( $p < 0.05$ ) with the greatest impact on the variable creativity. This partially confirms the study's hypothesis in that three of the eight factors were significant.

This result is unexpected, as it does not validate the expectation that all or almost all the work environment factors would have a significant impact. The Brazilian context certainly differs from the American context, where all eight original factors were confirmed, but even so, the fact that only three factors proved significant challenges the findings of various studies of the componential theory that had used the KEYS instrument. Although the results challenge what is known about the topic, it is important to emphasize that they are based on a relatively small sample and thus cannot warrant drawing generalizations with confidence. The study's most important conclusion and greatest usefulness is the finding that three factors were most important for obtaining more creative performance in companies, and that managers should therefore prioritize practices and conditions that specifically promote these factors. Strategies to accomplish this are addressed below.

The organizational incentives factor was the most influential of the variables examined, which is corroborated by various studies on the subject. Kuazaqui (2006) states that it is vital to create mechanisms and environments that rekindle the flame of discovery and creation. Organizational incentives stimulate the creative process when they are perceived by staff members in the form of openness to new ideas, recognition and rewards.

Ederer and Manso (2013) report that an appropriate reward model is effective in providing the motivation to create. Isaksen *et al.* (2001) claim that when staff members are encouraged by the company to develop ideas, and when there is ongoing concern with training and development, this becomes one of the main factors for stimulating creativity. Creative contributions promote change, as they are more easily introduced by individuals who have the expertise needed to identify differences and push the envelope (Csikszentmihalyi, 1996).

Carayannis and Gonzalez (2003) suggest that as an incentive, organizations should focus their policies on facilitating communication, multidisciplinary work, autonomy and mutual support to avoid barriers to creativity.

The second most significant factor in influencing creativity was having challenging work. This suggests that working on challenging projects and tasks tends to spark peoples' intrinsic motivation and result in more creative work.

This report corroborates statements by Carmeli *et al.* (2007), who claim that challenge is a primary factor in improving the creative performance of team members, causing them to strive harder in the performance of their tasks and give greater meaning to their work and the organization.

Other authors also mention challenging work. Mumford (2000) states that exposure to new and challenging experiences develops individuals' skills and boosts their creativity and innovation. Motivation generated by intellectual challenges is strongly and positively related to innovative results (Sauermaun and Cohen, 2010).

Support from the work group is the third variable that makes the greatest contribution to the model. Corroborating this result, Meredith and Mantel (2011) hold that the basic

premises of group work also need to be observed to define techniques for problem-solving through group creativity.

Amabile (1996) and Woodman *et al.* (1993) suggest that innovative behavior in organizations is attributable to two types of input in the work environment, the characteristics of the group and the characteristics of the organization, reinforcing the emphasis given to work group support by these results.

Group support requires the participation of people who communicate well, and according to Robbins (2009), communication has several functions in an organization, including facilitating motivation and providing information to guide actions. The social system of an organization can present a barrier to communication, and organizational policies should encourage the use of appropriate language, feedback, relationships of trust and effective listening (Vecchio, 2012).

### Discussion

The theoretical foundations presented and the results obtained show that companies should be organized in a manner that strengthens the dimensions that foster a creative social work environment (Amabile *et al.*, 1996; Ensor *et al.*, 2001). This study is based on the guidelines of the componential theory of creativity and the KEYS instrument, and the use of this instrument along with accepted premises and solidity contributed to the data obtained.

The study made it possible to highlight aspects that may serve as guidelines for managers in terms of the work environment. The study did not attempt to assess the creative products but rather to analyze employees' perceptions of the factors that influence the creative processes of the organizations in the sample, thereby boosting the development of a variety of strategies. The results indicated that only some of the variables analyzed had an impact on organizational creativity, and thus, the study's hypothesis was only partially confirmed.

Organizational encouragement proved to be the primary factor affecting creativity in the sample of Brazilian industrial businesses. The identification and understanding of this factor are important to guide revisions to management styles and to the policies governing industrial organizations. This observation corroborates the findings of authors who claim that staff performance is influenced by the encouragement they receive (Robbins, 2009; Vecchio, 2012).

Because of the importance of organizational encouragement, one can see that it is necessary to establish policies that recognize and reward creative results, valuing and trusting individuals and groups. Such policies should be prioritized in dealing with issues of the work environment. Pressure and a controlled environment are typically associated with low levels of intrinsic motivation, but there is evidence that under certain conditions, external incentives can have a positive effect on an individual's creativity (Paulus and Nijstad, 2003).

As the incentives relate to a company's culture, the literature review showed that for workers' perceptions to spark their intrinsic motivation, the work environment must stimulate it through fair and constructive consideration of ideas (Amabile, 2012; Amabile and Kramer, 2007; Ryan and Deci, 2000). Procedures for performance evaluation should not only note weaknesses but also be open to recognizing creative work and stimulating the development of new ideas.

With regard to challenges, it is emphasized that intrinsic motivation tied to engaging in activity out of curiosity, pleasure or challenge (Ryan and Deci, 2000) is one of the main lessons highlighted by componential theory (Amabile, 2012). It is apparent, then, that managers need to address the routines and tasks that make up work in organizations and

from there look for alternatives to create challenging tasks that do not inhibit the workers' intrinsic motivation. The participants' answers indicated that they think it is important to feel challenged and understand the broader purpose of their tasks.

## Conclusions

In this study, the factors that were shown to have a significant impact on the creative process in the sample were organizational encouragement, challenging work and work group support. The analyses performed made it possible to select these variables as having the greatest impact on creativity. Factors such as freedom, supervisor encouragement, sufficient resources, realistic workload pressure and absence of organizational impediments were not significant. The reasons for this counter-intuitive result are unknown, and only additional studies can shed light on the problem. The data collected do not allow one to draw conclusions about the reasons for the results, which is one of this study's limitations. The complete absence of Brazilian studies based on componential theory makes the search for an explanation even more difficult. It is possible, however, to speculate that the cultural factor certainly must have contributed to the results (Zhou and Su, 2010). A follow-up study with a new questionnaire aimed at further analysis of a qualitative nature focusing on the cultural aspect and differences between the USA and Brazil could shed new light on the results. An alternative explanation for the counter-intuitive result is that the sample may have had too little variety, so a confirmatory factorial analysis based on a large sample of Brazilian individuals and companies could find more broad-based support for the factorial structure proposed in Amabile's model.

This study is based on a specific theory, the componential theory of creativity (Amabile, 1997), so its greatest contribution is specifically to confirm the determinants of creativity in the work environment, as derived from this theory, in the Brazilian context. The study is, however, part of a larger inquiry into the main theories and models of creativity, among which the following stand out: the interactionist perspective of organizational creativity (Woodman *et al.*, 1993), which focuses on the interaction of the individual with the work environment; Ford's model of individual creative action (Ford, 1996), which focuses on processes of giving meaning, motivation, knowledge and skills and the theory of four factors of the team climate for innovation; and especially, theoretical studies about cultural differences and their impact on creativity (Morris and Leung, 2010; Zhou and Su, 2010), although their contribution in this last field is of a preliminary nature.

Based on the classification of factors that was carried out, it is possible to recommend ways to improve management of the environment for innovation in organizations. Technological competition challenges organizations and researchers, and research should lead to better decisions. Thus, alternatives to strategies and practices are sought. The results make it possible to obtain information that can enable managers to make more accurate diagnoses and make decisions based on relevant factors in the work environment.

Because of the characteristics of the nationality of the sample, this study allows a better understanding of the characteristics of Brazilian industrial businesses, starting from the basic perspective of workers' perceptions. Moreover, identifying work environment factors that influence the creative ability of workers is extremely valuable for innovative results in companies.

The creativity of an organization's individuals and groups is the driving force of innovation and change. Innovation also appears to be closely related to the environment and requires new ideas to be developed and transformed into products, services or processes in the company. The context of ongoing and constant changes in which industrial companies operate demands of them a permanent ability to make organizational changes.



Organizations should use actions that stimulate creativity and thereby provide greater potential for change and effective innovation. The results presented showed that it is essential to establish policies that encourage and recognize creativity at various levels of organization and management.

This study contributed to the production of knowledge, still scarce in the country, about the search for creative solutions through the work environment, by confirming which factors are significant and determinants of creative performance and challenging factors that had already been proven by other studies in non-Brazilian contexts. The use of a small, purposive sample does not permit generalizing from the obtained results to all industrial organizations. It should also be noted that the analyses were based on participants' perceptions, without considering other measures of creative performance. Further studies could broaden the sample or even include the measurement of individual creativity. Other suggestions for future studies include the aforementioned study to validate the theory through combinatorial factor analysis, and a study that uses the assessment presented here to recommend interventions in the organizational environment and examine changes in culture and their impact on creativity and innovation in industrial sector companies. Both studies are in the planning stages.

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