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# MEASURE OF CREATIVITY AND INNOVATION: EVIDENCE OF VALIDITY IN THE BRAZILIAN CONTEXT*

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## ABSTRACT

The main objective of this article is to explore the validity of the Factors of Creativity and Organizational Innovation (FINO) Measure in a Brazilian sample and ascertain the predictive power of individual, group, and organizational factors in relation to the perceived innovation in the organization. Evidence of the validity of this measure was previously found with workers in the Basque Country and in Latin-American countries. A total of 265 workers from various organizations participated in this survey study. Confirmatory factor analysis (CFA) and linear regression analysis with observable variables were performed by means of structural equation modeling. The CFA results indicate that the model with the best fit has eight correlated factors. The regression analysis suggests that the factors Work Characteristics, Leadership, and Personal Traits for Creativity and Innovation predict the perception of innovation in the organization.

**KEYWORDS:** creativity, innovation, organization, measure validity.

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# RESUMO

*O artigo tem o objetivo de explorar as evidências de validade da Medida de Fatores de Criatividade e Inovação Organizacional (FINO) em uma amostra brasileira e averiguar o poder preditivo dos fatores individuais, grupais e organizacionais na percepção de inovação na organização. Evidências de validade do inventário foram encontradas em estudo anterior com trabalhadores do País Vasco e países Latino-americanos. Participaram do estudo tipo survey 265 trabalhadores de diversas organizações. Foram realizadas análise fatorial confirmatória (AFC) e análise de regressão linear com variáveis observáveis por modelagens de equações estruturais. Os resultados da AFC apontam que o modelo de melhor ajuste é o de oito fatores correlacionados. A regressão linear sugere que os fatores Características do Trabalho, Liderança e Traços Pessoais Pró-Criatividade e Inovação predizem a percepção de inovação na organização.*


***PALAVRAS-CHAVE:*** *criatividade, inovação, organização, validação de medida.*


# 1 INTRODUCTION

The article presents the results of a study that sought evidence of validity of the Factors of Creativity and Organizational Innovation (FINO) Measure, with a sample of Brazilian workers. The FINO (COSTA et al., 2014; DA COSTA et al., 2015; DA COSTA et al., 2016) is a measure based on meta-analysis reviews (HAMMOND; NEFF; FARR; SCHWALL; ZHAO, 2011, HÜLSHEGER; ANDERSON; SALGADO, 2009) that have indicated that work characteristics (WC), group processes (GP), leadership (L), emotional climate (EC), organizational structure and dynamics (OSD), creative personality (CP), emotional intelligence (EI), and motivation (M) are the best predictors of creativity and organizational innovation. The FINO is a measure that integrates creativity and innovation, following the tendency of other measures (e.g., AMABILE; GRYSKIEWICZ, 1989), and allows comparative testing of the role of individual factors (worker attributes) and organizational environment factors (work characteristics, group and organizational aspects) in the creation of a creative environment and in the perception of organizational innovation. The main contribution of the FINO is therefore to offer a diagnostic tool for the organizational environment and the characteristics of the workers, validated in the Brazilian context, aiming to assist work planning and management actions that favor creativity, with repercussions on organizational innovation.

# 2 CREATIVITY AND INNOVATION: CONCEPTUAL INTERRELATIONS

Contemporary capitalism, which is strongly competitive in the use of new technologies (e.g., BUENO; BALESTRIN, 2012; RODRIGUES; VELOSO, 2013), selects creativity and innovation as key characteristics for organizations to thrive in complex environments and develop new capabilities (ZHOU; HOEVER, 2014). Although the policies in this area are defined by the management team, the workers also prove to be principal actors in the generation of creativity and in the implementation of innovation processes. Hence the importance of better understanding how workers perceive and identify the main factors that contribute to creativity and innovation (GONDIM et al., 2015).

In the specialized literature on creativity and organizational innovation, the concepts are presented as correlated and complementary, although they have emerged from different theoretical traditions (GONDIM et al., 2015). In the nineteenth century, creativity was seen as something typical of geniuses and as a divine gift (RUNCO; JAGER, 2012). In the 1950s, psychology began to explore the construct, considering creativity as a process generating new ideas and products (ALENCAR; BRUNO-FARIA; FLEITH, 2010; HAMMOND et al. 2011; HÜLSHEGER; ANDERSON; SALGADO, 2009; RUNCO; JAGER, 2012). Humanist authors, such as Rogers (1959) and Maslow (1959), con-

ceived of creativity as the result of the interaction between the individual and the environment, highlighting the role of self-realization, autonomy, and resistance to social control.

Innovation, in turn, is more related to the economic, technological, and entrepreneurial approaches (CHESBROUGH, 2006; FREEMAN, 1987; OLIVEIRA BRASIL; GONDIM NOGUEIRA; ARRUDA CAVALCANTE, 2011; SANTOS; FAZION; MEROE, 2011; SCHUMPETER, 1988). The innovation phenomenon is multidimensional and complex (ISMAIL; ABDMAJID, 2007), involving the effective implementation of ideas (AMABILE, 1996; BRUNO-FARIA; FONSECA, 2014; HAMMOND et al., 2011; HÜLSHEGER; ANDERSON; SALGADO, 2009). The innovation literature, based mainly on Schumpeter (1988), describes innovation as a step beyond invention (idea generation). In innovation one glimpses how to produce a commercial transaction and generate wealth from invention. However, in being widely publicized and imitated, the object of innovation loses its innovative character, triggering the search for more innovations. Given that the invention process is related to the generation of ideas, being one of the key aspects of creativity, the argument can be made for creativity to be seen as one of the antecedents of innovation. The specialized literature of the area has been clearly indicating that creativity could be understood as a precondition of innovation in the organizational context (DEWES et al., 2012; MARKS; HUZZARD, 2008; RODRIGUES; VELOSO, 2013), since a large number of ideas increases the organization's innovative potential (CLARK; WHEELWRIGHT, 1993).

There are different types of measures of creativity and innovation. Creativity is commonly assessed through the use of psychological tests or inventories (ALENCAR; BRUNO-FARIA; FLEITH, 2010). Cognitive styles, fluency, flexibility, originality, and feasibility are evaluated (TORRANCE, 1966, 1974). The affective, attitudinal, and motivational domains are also considered, since moods can activate cognitive processes contributing to insights and mental associations (ALENCAR; BRUNO-FARIA; FLEITH, 2010; URBAN; JELLEN, 1996).

Innovation, on the other hand, can be classified as radical or incremental. In the first case, innovation is related to indicators of performance and achievement of goals, such as number of patents, new products launched in the market, percentage of revenues with new products, etc. In the second case, innovation is directed toward the continuous improvement of processes, such as those involving greater control of results, decision making, and the dissemination of values that affect management and work practices. This reveals a bit of the diversity of explanatory variables of innovation (BRUNO-FARIA; FONSECA, 2014; DE PAULA et al., 2015).

Although the importance of these two constructs is widely recognized and traditionally related to the context of organizational research, there are still few studies that attempt to investigate them in a joint manner (BINNEWIES; GROMER, 2012; WECHSLER, 2011). Recent research, however, indicates an increase in the number of methodological designs that integrate contextual, environmental, and cognitive factors, seeking to identify aspects that inhibit or favor creativity and organizational innovation. Bedani's (2012) study has provided evidence that organizational values that reconcile individual and collective goals such as autonomy, achievement, and concern for the group, are positively associated with support for new ideas, whereas the focus on tradition and on control, seen in the pressure for meeting goals and deadlines, inhibits the expression of creativity.

The research by Souza and Bruno-Faria (2013) identified 10 factors facilitating and 12 factors limiting the expression of creativity and innovation in organizations. Among the facilitators, the following stand out: the support of management and of work groups, the strategies for innovation, in addition to the interaction between the organizational sectors. Included among the limiters are social disintegration, lack of support, and resistance to innovation. In a review study on innovation capacity, Valladares, Vasconcellos, and Di Serio (2014) identified seven factors associated with innovation: leadership, pro-innovation people management, familiarity with the customer and the market, strategic technology management, flexible organizational struc-

ture, and investment in project management. In the study by Jiang, Gu, and Wang (2015), leadership and team knowledge sharing have a positive impact on the team performance in innovation. In addition, knowledge sharing by team members would have a mediating role in the effects of leadership on the innovation indicators attributed to the team.

Studying the relationships between organizational culture and innovation, Naranjo-Valencia, Jimenez-Jimenez, and Sanz-Valle (2016) concluded that an organizational culture based on flexibility and change generates a positive impact on innovation, while a hierarchical culture produces a negative effect. In addition to highlighting the importance of organizational-level factors, Esteves and Feldmann (2016) include contextual variables such as, for example, pro-innovation government policies, which would include investments in research and development, education, and in exporting high tech products.

The measure of the Factors of Creativity and Organizational Innovation (FINO) constructed by Da Costa et al. (2014) was developed with the objective of offering an organizational diagnostic tool that integrates diverse individual and contextual (group and organizational) factors strongly related to creativity and organizational innovation, aiming to offer assistance in the elaboration of policies on the subject (DA COSTA et al., 2014; DA COSTA et al., 2015; DA COSTA et al., 2016). It offers an additional contribution to the inventory developed by Amabile and Gryskiewicz (1989), which aims to identify factors that facilitate and impede creativity and organizational innovation. The FINO is strongly supported by recent meta-analysis reviews, as noted earlier. The organizational-level factors included in the FINO are: (i) work characteristics (WC) (or job role characteristics), (ii) organizational structure and dynamics (OSD), and (iii) emotional climate (EC). The WC include the activities, content, and responsibilities related to the work (PARKER, 2014), covering items about the complexity of the work, the challenges in doing the work, the autonomy, and the expectations of the roles of innovation. OSD is characterized by the design of the organization's structure (MINTZBERG, 2008; SANTOS et al., 2014), considering organizational integration, availability of resources, flexibility, and decentralization of communication. Finally, EC refers to the positive atmosphere of trust, respect, and safety within the work environment (DA COSTA et al., 2014).

The group-level factors included in the FINO are: (iv) group processes (GP) and (v) leadership (L). The GP refer to the dynamics and the relationships within the work group, such as cohesion between members and internal communication. Leadership is considered a process of social influence and was evaluated in two perspectives. The first is the positive, in which relations of mutual respect, trust, closeness, and support between leaders and subordinates are assumed, and the second, that of pro-innovation, which refers to actions or intermediations of leaders, together with those they lead, favoring creative and innovative processes (DA COSTA et al., 2014).

The individual-level factors included in the FINO are: (vi) creative personality (CP), (vii) emotional intelligence (EI), and (viii) motivation (M). Although the personality construct is large and complex, CP was measured based on the personal assessment of the generation of new ideas, products, and processes. EI, another complex concept, was assessed by the ability to handle emotions properly. M, a basic psychological process, was assessed by the personal tendency in performing a task and resolving problems (AMABILE, 2012; DA COSTA et al., 2014).

The study whose sample was of workers from the Basque Country and from Latin American countries (Argentina, Brazil, Chile, and Mexico) found evidence of the validity of the FINO (DA COSTA et al., 2016). The results of this validation study indicated that the factors called organizational structure and dynamics (OSD), work characteristics (WC), and leadership (L) were positively related to the perception of organizational innovation. Individual factors, such as creative personality (CP), emotional intelligence (EI), and motivation (M) marginally explained the

perception of innovation, while group processes (GP) and emotional climate (EC) did not present any significant relations. The findings indicate, therefore, that organizational factors and work characteristics are the best predictors of the workers' perception of organizational innovation, with leadership having a minor role. They also point to the need for actions both at the organizational structure level and in the design of the work.

The interest in testing the stability of the FINO factor structure in other samples meant enlarging the sample with Brazilian workers, which led to a new study, the results of which are being reported in this article. The intent was also to test whether organizational factors would prove to be better predictors than individual factors in the perception of organizational innovation.

# 3 METHOD

## 3.1 Participants

A total of 265 workers from various organizations participated, 61.5% being males. The mean age was 35.2 years (SD = 9.72). Most held postgraduate degrees (55.1%), followed by college graduates (26.9%), and those who only finished high school (17.1%). As for marital status, 48.3% were married / in a stable union, 42.3% were single, and 6.8% were separated. Most of the participants were from the northeast region (82.5%), followed by the southern region (13.3%), with the rest from other regions (3.9%) of Brazil. Of the total number of participants, 65.8% worked in private organizations and 21.4% in public institutions, being distributed between the service (65.8%), industrial (31.2%), and agriculture and livestock (3%) sectors. The majority had a permanent employment relationship (76.6%) and worked full time (70.6%). Of the total, 31.5% held management positions, 46.9% had already participated in innovation teams, 70.5% had received training in work teams and 54.9% in innovation teams.

## 3.2 Data Collection Procedures

Participants were selected non-randomly based on contacts with various local companies. The study inclusion criteria were: currently working, over 18 years old, and accepting the free and informed consent agreement. The research instrument was presented electronically or in printed form.

## 3.3 Instrument

The Factors of Creativity and Organizational Innovation (FINO) Measure, developed (DA COSTA et al., 2014; DA COSTA et al., 2015) and validated by da Costa et al. (2016), is a self-report instrument organized into three parts. The first part contains two open questions for respondents to define their conception of creativity and innovation. The second part presents items referring to the eight factors that encompass individual, group, and organizational aspects. The third part includes questions regarding participation in work and innovation teams. The response scale for parts 2 and 3 is Likert type, with values ranging from 1 (strongly disagree / not applicable) to 7 (strongly agree / very applicable). In the case of the present validation study, only the eight-factor structure was used. Table 1 presents the description of the original instrument validated by da Costa et al. (2016).

**Table 1** - Description of the FINO factors including the dimensions and internal consistency indicators.

| Factor | Factor dimensions | Number of items | Alpha |
|---|---|---|---|
| Work (or job role) characteristics | Complexity and challenge of roles | 4 | 0.83 |
| | Autonomy | 2 | 0.60 |
| | Expectations of the role of innovation | 3 | 0.88 |
| Group Processes | Task orientation | 3 | 0.87 |
| | Group cohesion | 2 | 0.87 |
| | Vision or clarity of norms | 3 | 0.82 |
| | Internal communication | 3 | 0.82 |
| | Individual stimulation or task conflict | 2 | 0.55 |
| | Reward orientation | 4 | 0.88 |
| Leadership | Positive leadership | 4 | 0.91 |
| | Leadership in innovation | 4 | 0.92 |
| Emotional climate | Positive climate | 3 | 0.88 |
| Organizational structure and dynamics | Organizational integration | 3 | 0.89 |
| | Resources | 3 | 0.80 |
| | Flexibility | 1 | - |
| | Decentralization | 1 | - |
| Creative personality | Creative self-concept | 2 | 0.89 |
| Emotional intelligence | Emotional intelligence, alexithymia, and affective sensitivity | 3 | 0.86 |
| Motivation | Work self-efficacy | 2 | 0.85 |
| | Creative self-efficacy | 2 | 0.91 |
| | Intrinsic motivation | 2 | 0.78 |
| | Extrinsic motivation | 3 | 0.64 |

Source: da Costa et al. (2016).

As part of the validation process for the Brazilian context, a prediction model was developed that included the criterion variable (POI - Perception of Organizational Innovation) with two items: perception of the degree of innovation in the employer organization and perception of the recognized value of innovation in the employer organization, to be answered on a 7-point Likert scale.

### 3.4 Data Analysis Procedure

Considering that the instrument had already been applied initially with a sample of Brazilian workers, whose cases were included in the sample of workers from different countries (DA COSTA et al., 2016), in this study we opted for Confirmatory Factor Analysis (CFA) to test the structure of the measure. We sought to advance in the attempt to find a factor solution for the FINO that maintained a similar structure, but that was more parsimonious, clearly delimiting the factors of the individual, group, and organizational levels, disregarding the sub-dimensions, since some of them contained only one or two items. Therefore, for the purposes of the present study, the creative personality (2 items) and emotional intelligence (3 items) factors were joined into a single factor that came to be called personal traits for creativity and innovation (PT). In addition, the motivation factor was subdivided into two, separating self-efficacy (4 items) (SE) from more specific motivation items (5 items). The factor structure tested in this study, therefore, was composed of eight factors: work characteristics (WC) (8 items), group processes (GP) (18 items), leadership (L) (8 items), emotional climate (EC) (3 items), organizational structure and dynamics (OSD) (8 items), personal traits (PT) for creativity and innovation (combined items from creative personality and emotional intelligence - 5 items), self efficacy (SE) (4 items), and motivation (M) (5 items), totaling 59 items equal to the original measure.

To compose the variables of the prediction model that tested which of the eight factors would be the best predictors of perceived organizational innovation, meanwhile, an exploratory factor analysis (EFA) was performed. The objective was to identify the variables of greater factorial weight to be included in the design of the model to be tested using AMOS structural equation modeling. For each factor, three items with the highest factor loadings were chosen, except for the group processes factor, for which, due to the high number of subdimensions, we decided to include six items representative of each one them.

For the CFA, the Maximum Likelihood estimation method was adopted to test the measurement structure model 1, composed of eight correlated factors, and to compare it with the model 2 consisting of three second-order factors. The models were evaluated using the quality of fit indexes. The $\chi^2$ (chi-squared) evaluates the fit of the model to the data (the smaller the better; p>0.05). The ratio of the chi-square over degrees of freedom ($\chi^2/df$) indicates the quality of the model fit per se ([2; 5]: tolerable fit; [1; 2]: good fit). The Goodness-of-Fit Index (GFI) is an index that considers the quality of the model fit from the proportion of the covariances between the manifest variables ([0.80; 0,90]: tolerable fit; [0.90; 0.95]: good fit). The Comparative Fit Index (CFI) evaluates the quality of the model from the comparison with the worst and the best possible model ([0.80; 0,90]: tolerable fit; [0.90; 0.95]: good fit). The Root Mean Square Error of Approximation (RMSEA) is an index that compares the fit of the sample data model with what would be achieved with population data ([0.05; 0.10]: acceptable fit; ≤ 0.05 very good fit). The Akaike Information Criterion (AIC) is used to compare models, taking as the best model the one with the lowest values (MARÔCO, 2014).

The multivariate outliers were identified by means of the Mahalanobis Distance squared ($D^2$). Twenty extreme cases were removed based on the chi-square value. In consulting the distribution table available in Marôco (2014), it was found that with 27 variables in the model and a probability of p<0.001, the value of the chi-square limit would be 55.476. Higher values would be considered multivariate outliers. In addition, the skewness and kurtosis values of the variables were inspected, and there were no indications of violating the normality principle (FIELD, 2009), which confirmed the option for the Maximum Likelihood method.

In order to obtain evidence of the internal validity of the measure, the composite reliability (CR), the convergent validity, and the discriminant validity among the eight factors were calculated. Composite reliability is attested by a value of 0.7 or greater for each of the factors. Convergent validity is verified when the Average Variance Extracted (AVE) is 0.5 or greater. Finally, discriminant validity is certified when the AVE of the factors are greater than or equal to the square of the correlations between the dimensions present in the analysis (MARÔCO, 2014).

For the prediction model test, a multiple linear regression analysis was performed in AMOS with observable variables. The predictors were the eight FINO factors: work characteristics, group processes, leadership, organizational structure and dynamics, emotional climate, personal traits for creativity and innovation, self-efficacy, and motivation. The variable to be predicted was the perception of organizational innovation (POI).

# 4 RESULTS

Presentation of the results is organized in two sections. The first presents the evidence of validity of the FINO through CFA, and the second describes the results of the eight-factor prediction model test regarding the perception of organizational innovation (POI) of the Brazilian workers participating in the study.

### 4.1 Evidence of validity of the FINO structure: Eight-factor model

The fit indicators of the model of the eight correlated factors (Model 1) confirmed a good fit (Table 2) with significant factor weights and standardized factor loadings over 0.5. However, the modification indexes (MI) indicated the existence of correlations not predicted in the initial model, which suggested exclusion or replacement by other items representative of the factor, as specified below. The error of item 21.a of the group processes (GP) factor was correlated with the emotional climate (EC) (MI = 30.533) and group processes (MI = 27.231) factors, and with the error of item 21.b (EC) (MI = 37.082). To improve the model, item 21.a was replaced by item 2.a in the re-specified model 1. The error of item 1.a (GP) was correlated with the error of item 1.c of the work characteristics (WC) factor (MI = 36.695) and was excluded. The error of item 3.b (GP) was correlated with the error of item 15.d of the leadership (L) factor (MI = 13.077) and was excluded. The error of item 17.b of the personal traits for creativity and innovation (PT) factor was correlated with the errors of items 17.c (PT) (MI = 75.263) and 1.h (GP) (MI = 12.500) and was replaced by item 17.a in the re-specified model 1.

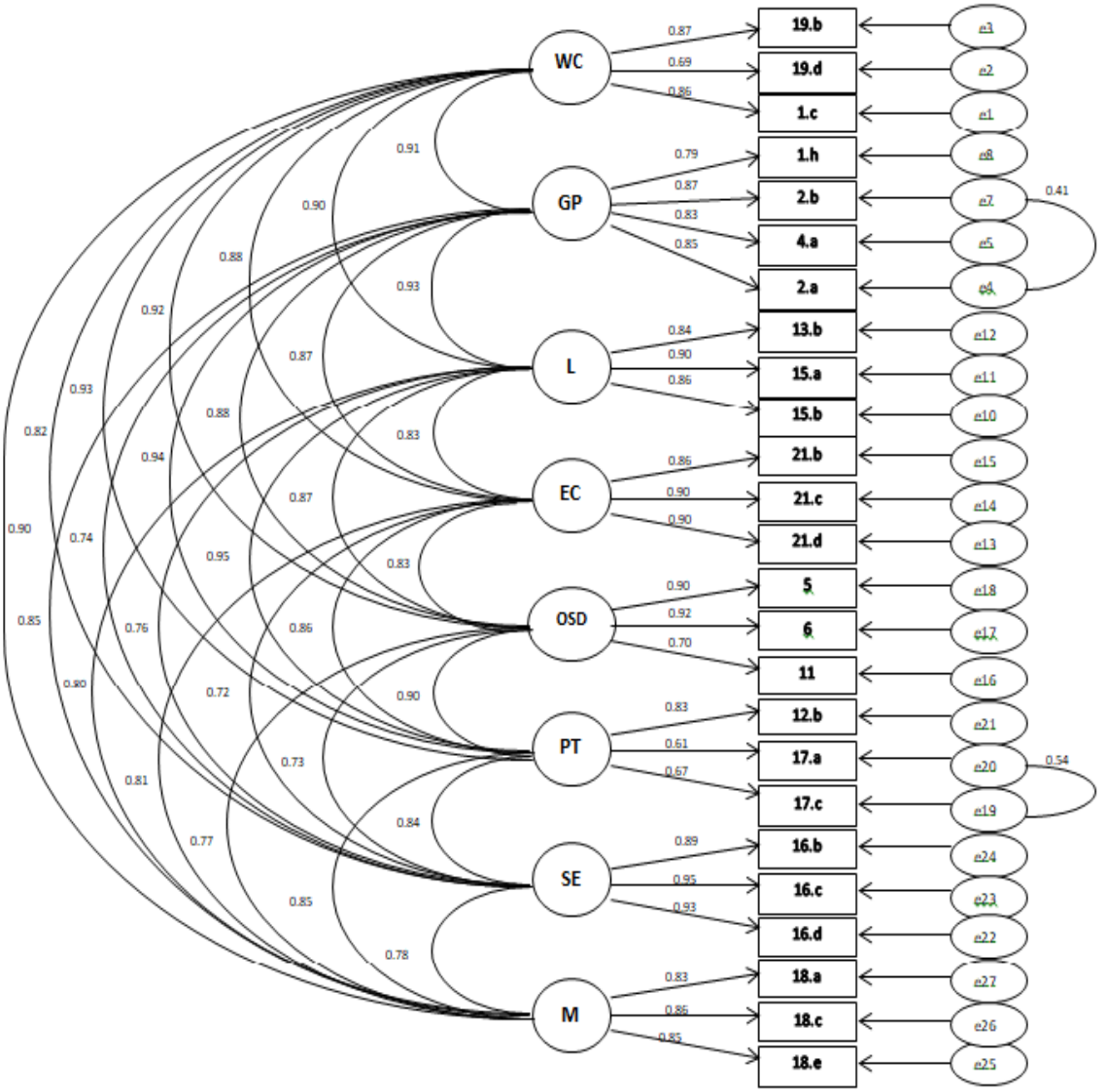
**Table 2** - Model Fit Indexes.

| Models | $\chi^2$ | $\chi^2$/df | GFI | CFI | RMSEA | AIC |
|---|---|---|---|---|---|---|
| Model 1 - initial | 775.712 | 2.621 | 0.812 | 0.926 | 0.081 | 939.712 |
| Model 1 - re-specified | 446.896 | 1.824 | 0.876 | 0.966 | 0.058 | 606.896 |
| Model 2 - initial | 583.093 | 2.209 | 0.840 | 0.946 | 0.070 | 705.093 |
| Model 2 - re-specified | 485.611 | 1.861 | 0.862 | 0.962 | 0.059 | 613.611 |

Note: $\chi^2$ - Chi-square; $\chi^2$ / df - Chi-square over degrees of freedom; GFI - Goodness-of-Fit Index; CFI - Comparative Fit Index; RMSEA - Root Mean Square Error of Approximation; AIC - Akaike Information Criterion

Table 2 shows an improvement in the quality of fit indices in relation to the initially proposed model 1. The re-specified model 1 included two covariances between the errors of items 2.a and 2.b (MI = 14.247) and the errors of items 17.a and 17.c (MI = 61.297) (Figure 1). There are theoretical justifications for maintaining the correlation of these items in the re-specified model. The first items represent one of the facets of group processes associated with reward orientation. The two subsequent items represent one of the facets of personal traits for creativity and innovation related to emotional intelligence.

**Figure 1** - Re-Specified Model 1.




Source: Prepared by the authors.

For contrast purposes, a second-order model (Model 2) was proposed in order to determine if the eight FINO factors could be explained by three latent factors: the organizational-level, integrating the work characteristics (WC), organizational structure and dynamics (OSD), and emotional climate (EC) factors; the group-level, joining group processes (GP) and leadership (L); and the individual-level, combining the personal traits for creativity and innovation (PT), self-efficacy (SE), and motivation (M) factors.

Upon calculating the second-order model, it was found that it also presented good fit indicators (Table 2). This model showed all loadings as significant and with factor validity (≥0.5). However, the modification indexes confirmed correlations between errors of items from different dimensions. The error of item 19.b (WC) was related to the error of 1.h (GP) (MI = 11.313) and to the second-order factor, "individual" (MI = 11.937). The error of item 1.h (GP) was also correlated with the first-order factor, emotional climate (MI = 15.589). The error of item 2.a (GP) was related to the errors of items 2.b (GP) (MI = 14.478) and 5 (OSD) (MI = 12.658). The

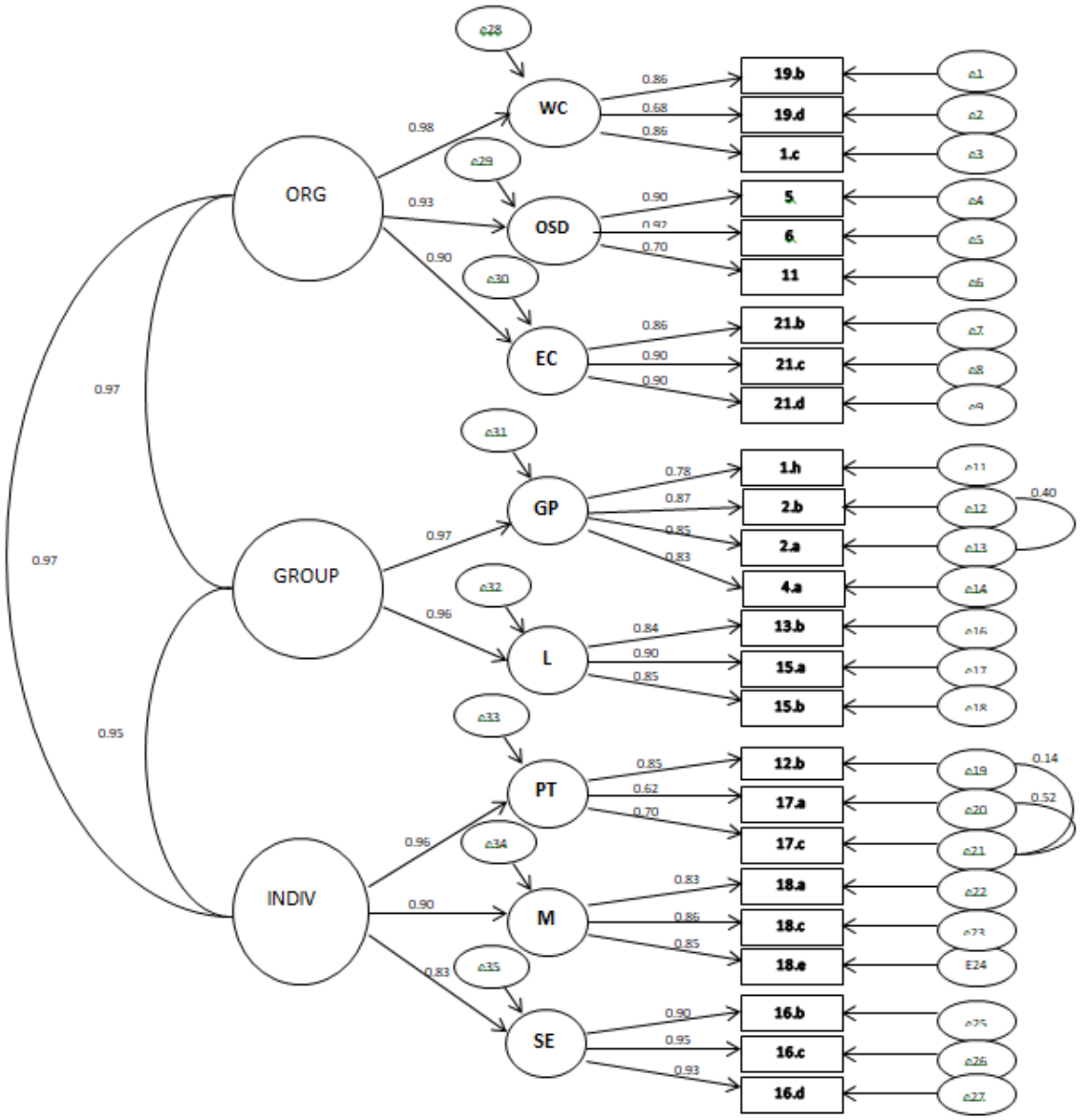
error of item 4.a (GP) (MI = 15.156) was correlated with the second-order factor, “group”. There were correlations between item 17.c and items 17.a (MI = 61.417) and 12.b (MI = 11.401). These last items belong to the same dimension.

In the re-specified second-order model, the covariance paths were included between the error of item 17.c and the errors of items 12.b and 17.a, representative of the “personal traits for creativity and innovation” factor, and between items 2.a and 2.b, representative of the “group processes” factor (Figure 2). There was an improvement in the quality of fit indices in relation to the initially proposed second-order model (Table 2), but the modification indexes again confirmed correlations between items of different dimensions and between first and second order items and dimensions, not representative of these items. According to Marôco (2014), correlations between errors may characterize some kind of fragility in the content of the instrument’s items.

Table 2 presents the quality of fit indices obtained in models 1 and 2. The AIC indicates, as the best model, the one with the lowest value, in this case the first order model (606.896) in comparison to the second order model (613.611). Thus, the model chosen was the one with eight correlated factors, justified by attaining a better fit to the data from the sample of Brazilian workers.

Considering that the best structure of the measure would be that of eight factors, we proceeded to calculate the composite reliability, and the convergent and discriminant validity of the FINO. The composite reliability indicators (CR) were satisfactory in all dimensions (CR_WC = 0.84, CR_GP = 0.89, CR_L = 0.90, CR_EC = 0.91, CR_OSD = 0.88, CR_PT = 0.75 ; CR_SE = 0.94, CR_M = 0.88). The convergent validity indicators were also adequate in all dimensions (AVE_WC = 0.65; AVE_GP = 0.69; AVE_L = 0.75; AVE_EC = 0.78; AVE_OSD = 0.71; AVE_PT = 0.50; AVE_SE = 0.85, AVE_M = 0.71).

**Figure 2** - Re-Specified Model 2.




Source: Prepared by the authors.

Discriminant validity was confirmed only between the dimensions that obeyed the condition that the AVE of the factors should be greater than or equal to the square of the correlations between the factors present in the analysis (MARÔCO, 2014). Thus, discriminant validity was observed only between the factors: group processes and self-efficacy ($r^2$=0.54); leadership and self-efficacy ($r^2$=0.57); leadership and motivation ($r^2$=0.64); emotional climate and self-efficacy ($r^2$=0.51); organizational structure and dynamics and self-efficacy ($r^2$=0.53); organizational structure and dynamics and motivation ($r^2$=0.58), and self-efficacy and motivation ($r^2$=0.60).

No discriminant validity was found between (a) work characteristics and leadership, emotional climate, organizational structure and dynamics, personal traits for creativity and innovation, self-efficacy, and motivation; (b) group processes and leadership, emotional climate, personal traits for creativity and innovation, and motivation; (c) leadership and emotional climate, organizational structure and dynamics, leadership and personal traits for creativity and innova-

tion; (d) emotional climate and organizational structure and dynamics, personal traits for creativity and innovation, and motivation; (e) organizational structure and dynamics and personal traits for creativity and innovation; (f) personal traits for creativity and innovation and self-efficacy and motivation.

### 4.2 Factors predicting the perception of organizational innovation

Table 3 presents the correlations between the factors favorable to creativity and innovation and the perception of innovation in the organization. Significant correlations ($p<0.01$) were found between factors favorable to creativity and innovation and the Perception of Organizational Innovation (POI).

**Table 3** - Correlation between factors favorable to creativity and innovation and the perceived innovation in the organization in a Brazilian sample.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | M | SD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WC | 1 | | | | | | | | | 4.55 | 1.30 |
| GP | 0.84** | 1 | | | | | | | | 4.76 | 1.31 |
| L | 0.82** | 0.86** | 1 | | | | | | | 4.79 | 1.48 |
| EC | 0.79** | 0.80** | 0.77** | 1 | | | | | | 4.77 | 1.48 |
| OSD | 0.80** | 0.82** | 0.79** | 0.69** | 1 | | | | | 4.30 | 1.34 |
| PT | 0.71** | 0.71** | 0.71** | 0.66** | 0.66** | 1 | | | | 4.69 | 1.34 |
| SE | 0.66** | 0.63** | 0.61** | 0.61** | 0.56** | 0.61** | 1 | | | 5.03 | 1.33 |
| M | 0.72** | 0.71** | 0.71** | 0.69** | 0.64** | 0.62** | 0.56** | 1 | | 4.71 | 1.23 |
| POI | 0.76** | 0.70** | 0.72** | 0.61** | 0.69** | 0.65** | 0.56** | 0.61** | 1 | 4.56 | 1.57 |

Note: WC (Work Characteristics), GP (Group Processes), L (Leadership), EC (Emotional Climate), OSD (Organizational Structure and Dynamics), PT (Personal Traits for Creativity and Innovation), SE (Self-efficacy), M (motivation), POI (Perceived Organizational Innovation).

** $p<0.01$.

The results of the multiple regression are shown in Table 4. The model accounts for 63% of the observed variance. Only three factors appeared as predictors of POI: CT ($\beta=0.401$; $p<0.001$), L ($\beta=0.229$, $p<0.05$), and PT ($\beta=0.141$; $p<0.05$), with first being organizational, the second being group-related, and the third individual.

**Table 4** - Predictors of perceived innovation in the organization.

| | Perceived Innovation in the Organization | | |
|---|---|---|---|
| Predictors | B | $SE_b$ | ß |
| Constant | -0.148 | 0.286 | |
| WC | 0.484 | 0.109 | 0.401*** |
| GP | -0.033 | 0.117 | -0.028 |
| L | 0.242 | 0.094 | 0.229* |
| EC | -0.112 | 0.078 | -0.106 |
| OSD | 0.164 | 0.091 | 0.139 |
| PT | 0.166 | 0.075 | 0.141* |
| SE | 0.044 | 0.068 | 0.038 |
| M | 0.069 | 0.080 | 0.054 |

Note: b = non-standardized regression coefficient; $SE_b$ = Standard error; ß = Standardized regression coefficient.

*** $p<0.001$; *$p<0.05$

# 5 DISCUSSION

Evidence of validity of the FINO factor structure was investigated in a sample of Brazilian workers through CFA. Two models were tested: model 1 with eight correlated factors and model 2 with second-order factors.

In the initially proposed model 1, unpredicted correlations were observed, pointing to the need to review some items. Items 1.a (*objectives are clearly defined*) and 3.b (*collaboration among workers is the norm*) of the group processes factor (GP) were excluded because there were correlations between their errors and the errors of items in other dimensions. This indicates the need for these items to be reformulated so that they can adequately represent the GP factor and its respective sub-dimensions: clarity of goals, sharing of objectives within the group, and group cohesion. Items 21.a (*exchange of ideas about the work, even if they are in opposition*) (GP) and 17.b (*talk with their coworkers about their emotions*) (PT) were replaced in model 1 by items 2.a (*promote the search/identification of new concepts for the organization*) (GP) and 17.a (*express their emotions*) (PT), respectively. Analyzing these results, the relevance of item 21.a in the GP factor and its reallocation to the EC (emotional climate) factor should be re-evaluated for two reasons: due to the correlation and the semantic similarity between this item and one of this factor's representative items, and also because a correlation was found between the error of 21.a and the emotional climate factor. Regarding item 17.b, it should be reformulated to represent the PT factor more clearly.

Upon re-specifying model 1, there were still correlations between the errors of the items. However, there is theoretical justification for fixing the path between the errors in the model, since the correlated items belong to the same factor. Thus, the paths between the errors of items 2.a (*promote the search/identification of new concepts for the organization*) and 2.b (*promote the exchange of ideas and opinions between the members of their work group*), and of items 17.a (*express their emotions*) and 17.c (*are sensitive to the feelings or emotions of their coworkers, putting themselves in the other's place and responding appropriately to their emotional reactions*) are included in the re-specified model 1. Although maintaining the correlation paths between these items is justifiable, the results indicate that it would be advisable to revise them for future confirmatory tests. The correlation between errors suggests that there is an underlying factor with greater explanatory power or a problem in measuring the observable variables (similar items), as pointed out by da Costa et al. (2016). A semantic evaluation of items 2.a. and 2.b may suggest there is a redundancy between search / identification of new concepts and promotion of exchange of ideas. That is, the new concepts seem to be identified by the exchange. In turn, items 17.a. and 17.c refer to the emotional intelligence (IE) dimension, differing from the creative personality items, dimensions separated in the initial FINO structure proposal. However, in this validation study of the FINO with another sample of Brazilian workers, the proposal of joining the items from the two dimensions to compose a general factor of Personal traits for creativity and innovation was precisely due to the sub-representativeness of the EI and Creative Personality dimensions in the original measure, which imposed limits in being treated as separate factors. The suggestion to include new items to better represent EI and Creative Personality could be an alternative for recomposing the measure, to be tested in future samples.

The modification indices of model 2 (with second-order factors) were even more critical for the FINO. In addition to finding correlations between items of different dimensions, correlations between first and second order items and factors could be seen. Therefore, the model was re-specified with correlations between items that could be theoretically justified, as in the case of

correlations between items of the same factor. Thus, paths were created for the correlations between the errors of item 17c (*are sensitive to the feelings or emotions of their coworkers, putting themselves in the other's place and responding appropriately to their emotional reactions*) and the errors of 12.b (*the implementation of products, procedures, or processes in an innovative way in their work*) and 17.a (*express their emotions*), representative of the personal traits for creativity and innovation factor, and between the errors of items 2.a (*promote the search/identification of new concepts for the organization*) and 2.b (*promote the exchange of ideas and opinions between the members of their work group*), representative of the group processes factor. The need to revise such items, especially 17.c, is thus reiterated because a single formulation containing various ideas makes it difficult to know what is being measured.

It is also worth highlighting the problem of the representativeness of the sub-dimension "decentralization of decision-making and communication flow" of the organizational structure and dynamics factor. This sub-dimension was measured only by item 10, which strictly measures the level of centralization of the organization ("*it has a centralized structure, with emphasis on vertical communication and decision-making*"). In the EFA this item had a factor loading below 0.5 and was not included in the test of the models. The suggestion is that the item be reformulated to better conceptualize the sub-dimension or be excluded from the factor.

In comparing the two models using the AIC, it was found that model 1 was the one that best fit the data, indicating that there is empirical support for the multidimensional structure of the FINO composed of eight correlated factors. However, it should be noted that model 2, the second-order model, also presented good indexes. This result suggests that a factor structure formed by second order factors (organizational, group, and individual) could also represent the FINO. But for this it will be necessary to revise and improve the items that presented problems related to the representation of their respective dimensions, such as the cases already pointed out in this discussion.

Another result that indicates the need for FINO enhancements is that of discriminant validity. Independently from the satisfactory indicators of composite reliability and convergent validity present in all the factors, discriminant validity was observed among few pairs of factors. In this case, only the self-efficacy (SE) factor presented adequate indices of discriminant validity with the group processes, leadership, organizational structure and dynamics, and motivation dimensions. This result points again to the need to revise the FINO in order to improve discrimination between its factors, given that the measure presumes a structure of eight factors that supposedly have correlations, but measure distinct aspects related to creativity and organizational innovation.

In comparing the results of the FINO structure in this sample with that obtained in the study with samples from several countries, including Brazil (DA COSTA et al., 2016), it was verified that there is equivalence between them, as can be seen in Table 5. In the present study it was made clear that the arrangement of the items in eight factors represents the FINO in a more parsimonious way, eliminating the need for sub-dimensions, in some cases with only two items.

**Table 5** - Distribution of the inventory items in the original FINO and in the one adapted to the Brazilian context.

| FINO – Original | | | | FINO – Adapted to the Brazilian context | | |
|---|---|---|---|---|---|---|
| Factor | Dimensions | Items | Total Items | Factor | Items | Total Items |
| Characteristics of the work role | Complexity and challenge of roles | 19.a; 19.b; 19.c; 19.f | 8 | Work (or job role) characteristics | 1.b; 1.c; 19.a; 19.b; 19.c; 19.d; 19.f; 19.h | 8 |
| | Autonomy | 19.d; 19.h | | | | |
| | Expectations of the role of innovation | 1.b; 1.c | | | | |
| Group Processes | Task orientation | 4.a; 4.b; 4.c | 18 | Group Processes | 1.a; 1.d; 1.e; 1.f; 1.g; 1.h; 1.i; 2.a; 2.b; 2.c; 2.d; 3.a; 3.b; 3.c; 4.a; 4.b; 4.c; 21.a | 18 |
| | Group cohesion | 3.a; 3.b | | | | |
| | Vision or clarity of norms | 1.a; 1.d; 1.e | | | | |
| | Internal communication | 1.f; 1.g; 1.h | | | | |
| | Individual stimulation or task conflict | 21.a; 3.c | | | | |
| | Reward orientation | 2.a; 2.b; 2.c; 2.d; 1.i | | | | |
| Leadership | Positive Leadership | 13.a; 13.b; 14.a; 14. b | 8 | Leadership | 13.a; 13.b; 14.a; 14.b; 15.a; 15.b; 15.c; 15.d | 8 |
| | Leadership in innovation | 15.a; 15.b; 15.c; 15.d | | | | |
| Emotional climate | Positive climate | 21.b; 21.c; 21.d | 3 | Emotional climate | 21.b; 21.c; 21.d | 3 |
| Organizational Structure and Dynamics | Organizational integration | 6; 7; 8; | 8 | Organizational Structure and Dynamics | 5; 6; 7; 8; 9; 10; 11; 19.g | 8 |
| | Resources | 5; 9; 19.g | | | | |
| | Flexibility | 11 | | | | |
| | Decentralization | 10 | | | | |
| Creative personality | Creative self-concept | 12.a; 12.b | 2 | Personal traits for creativity and innovation | 12.a; 12.b; 17.a; 17.b; 17.c | 5 |
| Emotional intelligence | Emotional intelligence, alexithymia, and affective sensitivity | 17.a; 17.b; 17.c | 3 | | | |
| Motivation | Work self-efficacy | 16.a; 16.b | 9 | Self-efficacy | 16.a; 16.b; 16.c; 16.d | 4 |
| | Creative self-efficacy | 16.c; 16.d | | | | |
| | Intrinsic motivation | 18.a; 18.c | | Motivation | 18.a; 18.b; 18.c; 18.d; 18.e | 5 |
| | Extrinsic motivation | 18.b; 18.d; 18.e | | | | |

Note: Original FINO (DA COSTA et al., 2014), FINO for this study.

Considering that the eight FINO factors are strongly associated with the perception of organizational innovation (POI) (ranging from 0.56 to 0.84) (Table 3), its predictive value was evaluated using linear regression with observed variables in AMOS (Table 4). Based on the observation of the standardized regression coefficients, only three of the eight factors were identified as predictors of POI. They are: work characteristics - WC (β=0.401), leadership - L (β=0.229), and personal traits for creativity and innovation - PT (β=0.141). The first is at the organizational level, the second at the group, and the third at the individual level. The model managed to explain 63% of the observed variance.

The results are similar to those of the previous validation study of the factor structure of the FINO and its predictive power (DA COSTA et al., 2016), although the organizational structure and dynamics (OSD) factor was not indicated as a predictor of POI in the present study. The results found in the study by da Costa et al. (2016) indicated that organizational structure and dynamics (OSD) (organizational integration, resources, flexibility, and decentralization), work characteristics (WC) (complexity and challenge at work, autonomy, and expectations of the roles of innovation), and leadership (L) (positive leadership and leadership for innovation) factors were positively associated with POI, and, to a lesser extent, individual factors such as creative personality, emotional intelligence, and motivation.

The results also converge with the study by Valladares et al. (2014) and Jiang et al. (2015), which concluded that leadership is one of the best predictors of organizational innovation. This diverges a bit from studies that indicate the greater importance of organizational and group factors such as those by Bedani (2012), Naranjo-Valencia et al. (2016), and Souza and Bruno-Faria (2013). The studies by Han, Jung and Joo (2015) observed that motivation and autonomy (work characteristics) have a positively significant effect on organizational innovation. However, there was no sign of a significant effect of leadership on organizational innovation, as found in the present study.

# 6 CONCLUSIONS

The study reported here provided evidence of validity of the FINO for the Brazilian context, although it clearly signals that some items need to be reformulated, in agreement with what has already been pointed out by da Costa et al. (2016). The improvement of the measure would allow us to differentiate the factors, improving intra-measure discriminant validity, and would probably have positive impacts on the fit indices, which would make it possible to confirm the structure with three higher-order factors (organizational, group, and individual).

The findings corroborate previous studies that indicate that context variables such as work characteristics (WC) and leadership (L) are among the best predictors of the perception of organizational innovation. They also affirm that personal traits (attitudes favoring creativity and innovation), although important, appear to have less predictive power. The practical implication of these results is in the elaboration of work management policies that invest in the design of the work and in leadership training, which could probably have impacts on the formation of attitudes that are more conducive to creativity and innovation.

Challenging work stimulates self-realization. Work situations that favor worker autonomy are more motivating and increase the perception of self-efficacy. Providing resources allows the worker to carry out quality work. As far as leadership is concerned, leadership training actions can help enable leaders to be better supporters and promoters of a favorable climate by cultivating mutual respect and intragroup trust. Finally, although individual factors have had a marginal importance in the prediction of innovation, suggesting that actions should focus on other levels, it should be emphasized that the attitude of personal recognition of the value of products and ideas, as well

as the handling of emotions by the workers, can help to create a group and emotional climate that assists in the implementation of management policies for creativity and innovation.

Finally, it should be noted that one of the main limitations of the study lies in the fact that innovation has been measured through workers' perceptions. No objective indicators of innovation were included. Therefore, generalizations of the results for other samples should be made with caution. Another limitation was the methodological design of the research. This is a cross-sectional study that presumed only one phase of data collection. This limits an understanding of the change of the phenomenon over time, not allowing for assessment of one of the most important dimensions of creativity and innovation, its dynamic nature. A final limitation pertains to the sample of workers, which was not segmented by sectors. It is recognized that there are sectors of the economy that are under more pressure to invest in creativity and innovation as the single alternative for survival in the market, which forces them to rely on workers who are already better aligned with the organizational creativity and innovation profile desired.

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|---|---|---|---|---|---|---|---|---|
| **1.** Definition of research problem | √ | | | | | | | |
| **2.** Development of hypotheses or research questions (empirical studies) | √ | | | | | | | |
| **3.** Development of theoretical propositions (theoretical work) | √ | √ | | | | | | |
| **4.** Theoretical foundation / Literature review | √ | √ | √ | √ | √ | | | |
| **5.** Definition of methodological procedures | √ | √ | | √ | √ | | | |
| **6.** Data collection | √ | √ | | √ | √ | | | |
| **7.** Statistical analysis | √ | √ | | √ | √ | | | |
| **8.** Analysis and interpretation of data | √ | √ | √ | √ | √ | √ | √ | √ |
| **9.** Critical revision of the manuscript | √ | √ | √ | √ | √ | √ | √ | √ |
| **10.** Manuscript writing | √ | √ | √ | √ | √ | √ | √ | √ |
| **11.** Other (please specify) | | | | | | | | |