DETERMINANTS OF INNOVATION POTENTIAL AT UNIVERSITIES OF THE CZECH REPUBLIC*

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Scientific research in the sphere of education confirms the fact that the key elements of success are innovation and education. Through the influence of continuous changes, it is necessary to define innovation within the scope of the organization culture and education, which have a significant share on the efficient expression of thoughts leading to the overall development of the organization. The article builds on the research of social network, trust, and innovation and validates the relationship between the 'Trust at the workplace' and 'Innovation climate' in the environment of Czech universities. In connection with the research of determinants of Innovation climate, the article further examines the moderating effect of 'Seniority' on the relationship between the factors of 'Trust' and 'Innovation climate'. Primary data was collected using an electronic survey. An exploratory factor analysis was used for the extraction of factors. Based on the extracted factors the moderation effect was calculated. Conjoint effect of the 'Trust at the workplace' and 'Seniority' has greater impact on the level of Innovation climate than the simple sum of separate effects of individual constructs which can be interpreted as a synergistic effect.

trust; innovation; innovation climate; seniority

INTRODUCTION

Innovation can be considered a major factor in creating a competitive advantage that strongly influences the innovation potential of individuals. Innovation in education can be perceived as introducing new elements that improve the quality of the institution's education system. Innovation efforts come from the ranks of individuals that are a part of the education institution, thereby providing the impulse for changes. The place of instruction and education in the innovation process is affected by the Innovation climate. The main condition for the Innovation climate of an educational institution are human resources, which are adapted to branches or activities in which creative individuals and individuals open to change are supported.

Innovation

The Oslo Manual – Guidelines for Collecting and Interpreting Innovation Data (O E C D , 2005) defines the concept framework for the analysis and implementation of empiric work in the area of innovation as 'implementation of a new, or significantly improved product, service or new marketing method or a new method of management used for the first time at, minimally, the company level'. One of the most accurate definitions of innovation is that by B a r r e t t et al. (2008): 'Successful innovation is defined as effective creation and implementation of new thoughts, which increase the overall output of the organization'. S c h u m p e t e r (1935) was one of the first to define innovative activity. He defined innovation as 'a new path in doing things that are done better through a unique combination of production factors'.

Organization culture and innovation

Studies focused on the examination of the organization culture confirm the dependence of organizational factors and innovative behaviour of employees (W e s t , 1990; K i n g , A n d e r s o n , 1995). The organization

climate of the company is affected by a number of internal and external factors, which indirectly create the Innovation climate of companies. To be successful, it is necessary for a company to create an environment that supports employee creativity (I s a k s e n, L a u e r, 1999). Research shows that companies must react quickly to the changing requirements of the market by creating the right innovative environment, which will support flexibility (O r c h a r d, 1998; P a r k e r, B r a d l e y, 2000). The innovation potential is a sum of activities that provide the opportunities for innovation activities (S k a r z y n s k i, G i b s o n, 2008; H r o n et al., 2012). For institutions of higher education, these are primarily educational, research, infrastructure, legal, financial, socio-cultural activities (A p i a k u n, K h a t s k e v i c h, 2008). The potential of an individual means a set of traits and assumptions oriented towards the performance of such activities, enabling the organization to shift from the quantitative towards qualitative. It is a way for a person to produce thoughts in the course of which he/she reinvents himself/herself. From the perspective of an individual, potential contains an element of dynamics and relates to the future (S l a b b e r t, 1996). In the study conducted by Z i g a r m i, E d e b u r n (1980) the Innovation climate and its effect on employee development was evaluated. The assessment criteria included: communication, innovation, ability to promote oneself, ability to make a decision, self-evaluation, and stance towards other individuals. M o o l e n a a r, S l e e g e r s (2010) demonstrated the influence of trust on the Innovation climate in education. They examined the relationship between social network characteristics (density, reciprocity, and centralization) and Innovation climate in 53 schools in a large educational system in the Netherlands. They also explored the role of teacher trust as a potential mechanism that may explain the relationship between social network characteristics and Innovation climate at schools. Research findings confirm that seniority goes hand in hand with remuneration and capacity to influence the nature of organizational culture and innovation in the company (M c M u r r a y et al., 2010). The findings show strong positive relationships between employee ratings of their immediate supervisor's transformational leadership and employee ratings of organizational climate, wellbeing, employee commitment, and psychological capital. Additional analyses which explored the impact of demographic variables revealed that older employees recorded significantly higher scores on psychological capital than younger employees. These findings support organizational sustainability where the principles of socially responsible management practices form the heart of responsible stewardship.

In addition, according to H a n s e n, C r e s p e l l (2006) seniority is positively correlated with people's perception of innovativeness and creative climate. The degree of innovativeness shown by a company is related to the dominant climate at the workplace. Creative climate is characterized by high levels of supervisor encouragement, team cohesion, autonomy, and openness to innovation. More opportunities for employee participation can be pursued. Companies must go beyond the classical suggestion box. Systems in which open communication is the norm yield better outcomes and result in higher morale than more formal systems. Monetary incentive programs may be useful in companies where organizational commitment is not the highest. Companies with higher organizational commitment may be better off by relying on intrinsically motivated incentive systems.

Trust and research focused on higher education

Trust can be perceived as an individual or group value, in which individuals or groups are mutually open and honest (H o y, T s c h a n n e n - M o r a n, 2003). It is the basic unit of joint effort being important for the creation of relationships and bonds (C o s t i g a n et al., 1998). In this phase of realization, individuals appreciate mutual values that support creativity, cooperation, innovation, sharing, and openness of individuals towards each other (R u n c o, 2007). Trust along with active listening, avoidance of arbitrary conduct, and admitting the vulnerability of others, play a key role in the development of individuals in an organization. All of this leads to mutual trust between individuals and strengthens the ability to manage everyday issues in the work environment (B r y k, S c h n e i d e r, 2003).

The aim of the article is to validate the positive relationship between the factors of 'Trust at the workplace' and 'Innovation climate' in the environment of Czech universities. A secondary goal is to measure moderating effect of 'Seniority' on the factors of 'Trust at the workplace' and 'Innovation climate'.

MATERIAL AND METHODS

The primary data was collected by the survey method, using an electronic survey form (so-called CAMI). Teaching staff at nineteen economically oriented departments at Czech public and private colleges/universities were interviewed. The sample is based on publicly available e-mail addresses, which are provided on the websites of individual schools. The questionnaire is composed of three areas: (1) social climate at the workplace, (2) climate of innovation in the organization, (3) identification questions. Social and Innovation climate at the workplace are determined with the aid of a 5-degree Likert scale (in the range of 'definitely agree' to 'definitely disagree') and expresses the personal stance of the respondent. The scale of aspects of the social climate is derived from H o y, T s c h a n n e n - M o r a n (2003) ('Trust in colleagues' including four factors). The aspects of

Table 1. Fit indices

Index	Setpoint value	Source
GFI	> 0.9	G a r s o n, 2006
RMSEA	< 0.08	G a r s o n, 2006
NFI	> 0.9	G a r s o n, 2006
TLI	> 0.9	G a r s o n, 2006
CFI	> 0.9	G a r s o n, 2006
IFI	> 0.9	G a r s o n, 2006
CMID/DF	< 0.3	H a i r et al., 2006

GFI = Goodness-of-Fit Index, RMSEA = Root Mean Square Error of Approximation, NFI = Normed Fit Index, TLI = Tucker-Lewis Index, CFI = Comparative Fit Index, IFI = Incremental Fix Index, CMID/DF = Relative Chi-square

the Innovation climate are taken from the questionnaire of the C o n s o r t i u m o n C h i c a g o S c h o o l R e s e a r c h (2004) and were further adapted to the environment of Czech institutions of higher education. The aspects of the Innovation climate are expressed in five factors. From the demographic and organization factors, the gender, age and length of scientific-pedagogic activity in the organization were determined. The questionnaire was sent out on the public e-mail addresses of 861 academic employees and the return rate was 21%. The questionnaire was completed by 185 respondents out of which 61.60% were female (38.40% male); 68.80% working full time (31.20% part-time employees); 33.60% up to 30 years (other age groups were represented as follows: 31.20% 31–40, 12.00% 41–50, 9.60% 51–60, and 13.60% of respondents were over 60 years old).

The length of respondents' time working at the workplace was not included in the explorative factor analysis and was defined as Seniority for the reason of subsequent use in the moderation analysis. The exploratory factor analysis in the IBM SPSS Statistics

(Version 19, 2012) program was used for the extraction of factors through the Varimax method – orthogonal rotation for minimizing the number of variables. The extracted factors, 'Trust at the workplace' and 'Innovation climate', were input into the IBM SPSS AMOS (Version 20, 2012) program for the purpose of calculation of non-standardized regressive coefficients. The moderation effect was examined by entering the non-standardized regressive coefficients onto the worksheet – Plots Two-Way Interaction Effects for Non-Standardized Variables (D a w s o n, R i c h t e r, 2006). Variables were transformed using the 'item parcelling' technique (B a g o z z i, E d w a r d s, 1998).

In the IBM SPSS Statistics (Version 19, 2012) program, the factors were reduced on the basis of exploratory factor analysis – Varimax rotation method – orthogonal rotation of the original factors. The graphic method for setting the number of factors is the Scree plot. The structure of the factors was verified on the basis of confirmatory factor analysis in the IBM SPSS AMOS (Version 20, 2012) program. For evaluation of the factor load of the individual factor variables and the overall acceptability of the model, the following indices were used: Goodness-of-Fit Index, Root Mean Square Error of Approximation, Normed Fit Index, Tucker-Lewis Index, Comparative Fit Index, Incremental Fix Index, and Normed Chi-Square (Table 1). For confirmation of discriminatory validity of the model, correlation coefficients between individual factors with a critical value of 0.85 (K l i n e, 2005) were monitored.

The value of the Kaiser-Mayer-Olkin level is high (0.89) and indicates the appropriateness of the use of the factor analysis. In the case of the Bartlett test of sphericity, a level of significance less than that entered (0.00 < 0.01) is observed, and thereby the basic assumption for the use of the factor analysis is fulfilled. Complex factors with their own number greater than 1 were included in further calculations. The factor in-

Table 2. Descriptive statistics (*n* valid = 185, *n* missing = 0; minimum = 1, maximum = 5)

	Mean	SD	Variance
Openness*	2.42	1.008	1.016
Reliability*	2.45	1.010	1.020
Honesty*	2.55	1.026	1.054
Safety*	2.44	0.988	.976
Sharing of personal information*	3.03	1.158	1.342
Acceptance of new ideas*	2.37	1.056	1.116
Knowledge development in the field*	2.41	0.934	.873
Regular innovations of school subjects*	2.41	0.911	.830
Support for using potential	2.78	1.082	1.170
Proactive approach to work*	2.51	0.945	.892

*source: author's survey

Table 3. Rotation sums of squared loadings

Factor	Rotation sums of squared loadings		
	total	variance (%)	cumulative (%)
FA1 – Trust at the workplace	3.790	37.897	37.897
FA2 – Innovation climate	3.341	33.415	71.311

source: author's survey

cluded complex factors with an absolute value of factor load coefficient value over 0.5.

The internal consistency of the factors was evaluated based on Cronbach's alpha reliability coefficients on the basis of the following criteria: > 0.9 – Excellent; > 0.8 – Good; > 0.7 – Acceptable; > 0.6 – Questionable; > 0.5 – Poor; and < 0.5 – Unacceptable (G e o r g e , M a l l e r y , 2003). The correlations were calculated and tests of the proposed moderator (Seniority) were conducted using the common procedures of regression analysis (D a w s o n , R i c h t e r , 2006).

RESULTS AND DISCUSSION

The overall number of answered questionnaires is 185. Table 2 presents the answers of respondents with values ranging from 1 (definitely agree) to 5 (definitely disagree). The averages of individual answers are within the interval 2.37–3.03. Respondents were mainly in agreement in areas open to new ideas (2.37), development of knowledge in the field (2.41), and regular innovation of objects (2.41). The lowest rate of respondents' agreement was in areas of shared personal information (3.03) and support in the full use of potential (2.78). An indicative deviation and spread of answers was in the intervals 0.911–1.158 and 0.83–1.342. The greatest agreement among re-

spondents concerned the opinion on regular innovation training (0.830) and knowledge development in the field (0.873). The least agreement was in the area of sharing personal information with colleagues (1.342).

Through exploratory factor analysis, the original 10 variables were reduced to 2 independent factors, which describe 71.31% variability in the output set (Table 3). Number of factors was set with the aid of the graphic method of the Scree plot.

The latent factor FA1 explains 37.90% of the total variability of sets of variables. The factor characterizes the load (0.549–0.906) and is composed of 5 variables (Table 4). This factor can be interpreted as 'Trust at the workplace'. The latent factor FA2 explains 33.42% of the total variability of sets of variables. The factor characterizes the load (0.545–0.855) and is composed of 5 variables (Table 4). This factor can be interpreted as 'Innovation climate'. The highest factor loading at the Trust at the workplace achieves Honesty (factor loading (0.906) and Openness (factor loading 0.882).

Confirmatory factor analysis

The IBM SPSS AMOS (Version 20, 2012) program was used for Confirmatory factor analysis. The procedure of balancing the model was based on recommended methodology (H a i r et al., 2006). The structure of the model was constructed on the basis of exploratory factor analysis (Table 4). The internal consistency of the factors was evaluated based on Cronbach's alpha reliability coefficients (Table 5). For the evaluation of factor loads of individual variables and the overall acceptability of the model, the following indices were used: Goodness-of-Fit Index (GFI), Root Mean Square Error of Approximation (RMSEA), Normed Fit Index (NFI), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Incremental Fix Index (IFI), and Normed Chi-Square. For the confirmation of the discrimination validity of the model, correlation coefficients between individual factors cannot exceed the value of 0.85 (K l i n e , 2005). Table 6 shows the

Table 4. Rotated component matrix

	Component	
	Trust at the workplace	Innovation climate
Openness	0.882	
Reliability	0.787	
Honesty	0.906	
Security	0.830	
Sharing of personal information	0.549	
Acceptance of new ideas		0.721
Knowledge development in the field		0.855
Innovation training		0.823
Support for using potential		0.545
Proactive approach to work		0.724

For clarity, only values with a load factor > 0.5 are shown

source: author's survey

Table 5. Reliability coefficient

Factor	Cronbach's alfa	Evaluation
Trust at the workplace	0.911	excellent
Innovation climate	0.865	good

source: author's survey

Table 6. Fit indices for the confirmatory analyses and structural equation models

Index	Value of the model	Set point values	Acceptability	Source
GFI	.942	> 0.9	Yes	Garson, 2006
RMSEA	.073	< 0.08	Yes	Garson, 2006
NFI	.957	> 0.9	Yes	Garson, 2006
TLI	.968	> 0.9	Yes	Garson, 2006
CFI	.993	> 0.9	Yes	Garson, 2006
IFI	.978	> 0.9	Yes	Garson, 2006
CMID/DF	1.974	< 0.3	Yes	Hair et al., 2006

GFI = Goodness-of-Fit Index, RMSEA = Root Mean Square Error of Approximation, NFI = Normed Fit Index, TLI = Tucker-Lewis Index, CFI = Comparative Fit Index, IFI = Incremental Fix Index, CMID/DF = Relative Chi-square

source: author's survey

Table 7. Factor loading from confirmatory factory analysis

	Factor loading	CR	P	R^2
Trust at the workplace				
Openness	0.855	8.813	*	0.731
Reliability	0.905	9.169	*	0.819
Honesty	0.858	8.892	*	0.736
Security	0.920	9.280	*	0.846
Sharing of personal information	0.596	f. p.		0.355
Innovation climate				
Acceptance of new ideas	0.841	f. p.		0.707
Knowledge development in the field	0.748	11.130	*	0.560
Innovation training	0.712	10.408	*	0.507
Support for using potential	0.622	8.854	*	0.387
Proactive approach to work	0.796	12.164	*	0.634

CR = critical ratio, f. p. = fixed parameter; *P < 0.001
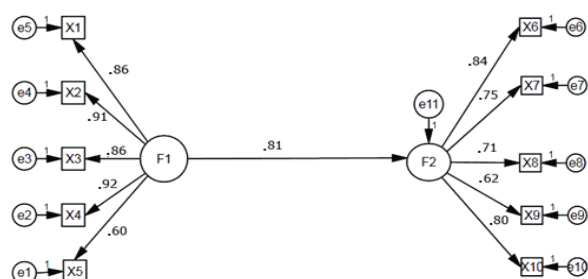
source: author's survey

Fig. 1. SEM relationship between Trust in workplace and Innovation climate
F1 – Trust in workplace; F2 - Innovation climate; X1 - Openness; X2 - Reliability; X3 - Honesty; X4 - Security; X5 - Sharing of personal information; X6 - Acceptance of new ideas; X7 - Knowledge development in the field; X8 - Innovation training; X9 - Support for using potential; X10 - Proactive approach to work; e1 – e10: Residual variance estimates
Source: author's survey

acceptability of the model in relation to modification to achieve its acceptability.

The values of R^2 are over 0.5 (Table 7), with the exception of the variables Sharing of personal information (0.355) and Support for the use of potential (0.387). These values did not affect the stability of the model (Table 6).

On the basis of the results of the Structural Equation Modelling in the IBM SPSS AMOS (Version 20, 2012) program, a high dependency of Trust at the workplace was determined for the Innovation climate (R = 0.809; R^2 = 0.654) (Fig. 1). From the results of the regressive analysis it follows that 65.40% of the Innovation climate can be predicted on the basis of Trust at the workplace. These results open space for further analysis of determinants of the Innovation climate.

Moderation effect

Moderation occurs when the relationship between two variables (Trust at the workplace and Innovation climate) depends on a third variable (Seniority) (Fig. 2). The Moderation effect was measured using the statisti-

Table 8. Moderation effect

Trust at the workplace	Seniority	Innovation climate (IC)	Absolute change of Innovation climate*	Change of Innovation climate** (%)
Low (LT)	low (LS)	2.11	0	0
Low (LT)	high (HS)	2.49	0.38	18.01
High (HT)	low (LS)	3.19	1.08	48.34

*IC − (LS + LT); *IC − (LS + LT)/(LS + LT) × 100

source: author's survey

cal worksheet plots of two-way interaction effects for non-standardized variables (D a w s o n, R i c h t e r, 2006). Input information for analysis was modelled in the IBM SPSS AMOS (Version 20, 2012) program, using the Structural Equation Modelling method (Fig. 3). All the model variables were parcelled to represent their respective factor, using the 'item parcelling' technique (H a i r et al., 2006).

In context of previous research (M o o l e n a a r, S l e e g e r s, 2010) the model of Innovation climate was extended by the influence of Seniority. Our conclusions identified the Seniority determinant as a strengthening element, acting on the level of Innovation climate, through Trust at the workplace. These results show the necessity of expanding the analysis to include indirect influences of other variables, which explain (mediating effect) or influence (moderating effect) the resulting level of Innovation climate at the workplace.

In the case of this research, with a low level of Trust at the workplace, Seniority increases the level of the Innovation climate by 18% and with a high level of Trust at the workplace, Seniority increases the level of the Innovation climate by 51% (Table 8).

From the results of the moderation analysis, the positive moderating effect of seniority on the relationship between the constructs, 'Trust at the workplace' and 'Innovation climate', is evident. The level of Innovation climate increases with the increasing level of Trust at the workplace and together with the growing level of Seniority, it creates a synergistic effect. Non-standardized values were standardized by the Plots Two-Way Interaction Effects for Non-Standardized Variables (D a w s o n, R i c h t e r, 2006).
Equation 1:
IC (LT, HS) − IC (LT, LS) < IC (HT, HS) − IC (HT, LS)
2.49 − 2.11 < 4.21 − 3.19
0.38 < 1.02
IC − Innovation climate; LT − Low trust; HT − High trust; HS − High seniority; LS − Low seniority

This difference is evident from the gradient lines of high and low Seniority [αLS (16°) < αHS (24°)] (see Fig. 3).

With a low level of Trust at the workplace, Seniority increases the level of the Innovation climate by 18% (Table 8). With a high level of Trust at the workplace, Seniority increases the level of the Innovation climate by 51% (= 99 − 48) (see Table 8). The total possible effect of Seniority on the Innovation climate occurs in the change of the situation from low to high Trust at the workplace. During the simultaneous increase of Trust at the workplace and Seniority, maximum increase of the level of the Innovation climate occurs at the level of 99.52%. These results confirm the theory of the influence of Seniority on the Innovation climate (S a r r o s et al., 2001; H a n s e n, C r e s p e l l, 2006) and further expand it through the effects of synergy.

CONCLUSION

On the basis of exploratory factor analysis, the input variables were reduced to two latent factors describing a 71.31% variability in the basic set: Trust
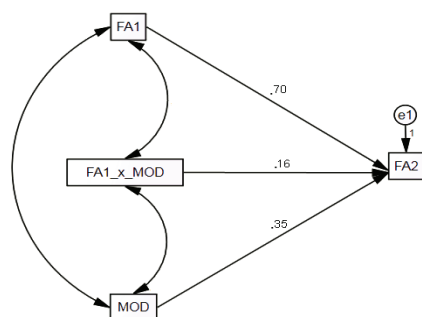

Fig 2 Structural Equation Modeling
*FA1 – Trust in workplace; FA2 - Innovation climate; MOD – Seniority
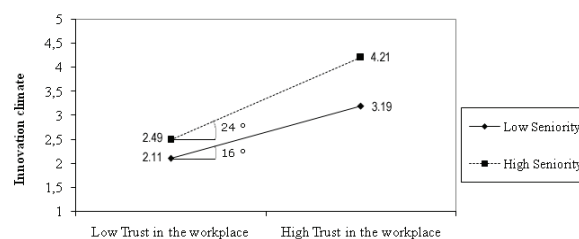Source: author's survey

Fig. 3. Moderation effect
*Standardized values
Source: author's survey

at the workplace explains 37.90% and Innovation climate explains 33.42% of the total variability of the set of variables.

Based on Structural Equation Modelling, the positive relationship between the constructs Trust at the workplace and Innovation climate were confirmed. The results of the analysis showed that the Trust at the workplace predicts an Innovation climate of 65.61%. This result opens the possibility of searching for and analyzing additional variables, which positively or negatively influence the Innovation climate for the purpose of increasing business performance. In this context we can recommend for further research to extend the input variables with TCI-38 (tool for measuring the level of Innovation climate) which consists of: Team Vision, Support for Innovation, Participation Safety, and Task Orientation (A n d e r s o n ,   W e s t, 1994). This tool has already been validated in Italy, Greece, Norway, and China.

The moderation effect demonstrated the positive influence on the relationship of Trust at the workplace and the Innovation climate. In cases of low level of Trust at the workplace, high Seniority increases the Innovation climate by 18% and in cases of a high level of Trust at the workplace, high Seniority increases the Innovation climate by 32%. Total effect of the Trust at the Workplace and Seniority (jointly) has greater impact on the level of Innovation climate than the simple sum of separate effects of individual constructs which can be interpreted as a synergistic effect, expressed by the value 0.38 (single impact of High Seniority in the case of Low Trust at the workplace) < 1.02 (synergystic effect of High Seniority in case of High Trust at the workplace).

These results confirmed the positive influence of Seniority on the relationship of Trust at the workplace and the Innovation climate. With increasing teacher´s Seniority the Trust at the workplace is becoming more efficient in relation to the level of Innovation climate. These results support the theory of the positive effect of Seniority on the Innovation climate (S a r r o s et al., 2001; H a n s e n ,   C r e s p e l l, 2006). It is necessary to state that Seniority which has positive effect on the Innovation climate is only the part of all determinants of the Innovation climate. The influence of Seniority alone does not guarantee a high level of Innovation climate. According to the results, personnel policies should concentrate on stabilizing and retaining staff to achieve higher levels of Seniority within the research teams.

If a company wants to increase the level of Innovation climate, it is necessary to support Openness, Reliability, Honesty, Safety, Sharing of personnel and information. The influence of these factors can be strengthened by the Seniority of employees. It cannot be said that high Seniority guarantees a high-level Innovation climate. It is only a determinant strengthening the influence of trust on the overall level of the Innovation climate. Support of Seniority on its own would not lead to increase in the level of Innovation climate. It is evident that the Innovation climate can be strengthened by supporting social interaction at the workplace and creating an environment without fear of failure or ridicule.

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