Assessing Measurement Quality: As A Unifying And Consistent

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Abstract

In this article, assessing measurement quality is closely reviewed. Aiming addressing the goals of the present work, quantitative method has been used. More specifically, the Likert scale questionnaire based on the existing scales was developed and the online survey has been conducted in order to collect the required data. As a part of the nomonological network validity check, three types of validity were tested. Namely, those were content, construct and criterion validity. Apart from that, *internal consistency reliability* method has been used for the present research. The SPSS software has been used for the analysis. And, the following reliability coefficients were tested: Confidence Interval, Cronbach's Alpha and Guttman's Lambdas.

Keywords: *Reliability, Validity, Measurement Quality, SPSS.*

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1. Theoretical and Empirical Background and Relevance

Countries overcoming economic outcomes caused by different types of crisis – political, social – as well as by a war – are reliant on their human resources and its productivity. If employees are motivated as well as resultative along with the proper strategic management practices being involved, a company may overcome crisis at a faster pace as well as outperform its competitors. Pfeffer (1994) earlier stated that "as other sources of competitive success have become less important, what remains as a crucial differentiating factor is the organization, its employees, and how they work" (p. 16) (see also Wright & McMahan, 1992)[1]. If extended, the same rule may be applied to the industries and countries overall. In other words, the level of entrepreneurial orientation of each individual has a cumulative effect on the overall economic development. From the theoretical perspective, Schumpeter (1942) was one of the pioneer at pointing at the

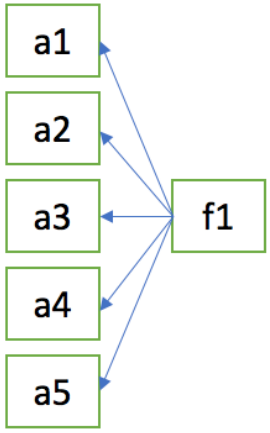
[1] Ulrich and Brockbank (2005) later supported this statement and pointed that more than half of total influence of total impact on business performance is related to human resources; and the way they are managed.

importance of entrepreneurs[2] and their activity for the overall economic development and creation of the new jobs and national wealth as a result. Developing this idea further, within this paper, it is argued that entrepreneurial orientation influenced by the human resource management practices and vice versa may result in boosting country's recovering from the various types of crisis. As HRM practices are seen by Huselid (1995) as a major factor influencing the firm-level outcomes (p. 636), it also helps sustain organization's competitive advantage (Becker and Gerhart, 1996, p. 781; Barney, 1986, 1991) and ensures organizational survival (Delery & Doty, 1996; Schuler & Jackson, 1987). As an example, Ukraine with its current situation has been chosen for the investigation and in order to investigate the most productive examples facing the crisis, the Ukrainian software engineering industry has been chosen for the investigation.

2. Research Objectives and Hypotheses

Although there are a lot of blank areas and central conceptual issues that are still present in the field of entrepreneurship, the term entrepreneurial orientation has received a substantial amount of researchers' attention (Covin et al., 2006; Nambisan, 2002).

Figure 1
Proposed Research Framework



Source: Lutsenko A., 2019

[2] Miller (1983) defined the term entrepreneurial orientation and concluded that it consists of the three following dimensions: proactiveness, innovativeness and risk-taking. Slightly after, Covin and Slevin (1989) modified the concept and Lumpkin and Dess (1996) have polished it further. As a result, the following identification of the entrepreneurial orientation has been framed by Lumpkin and Dess (1996) "The processes, practices, and decision-making activities that lead to new entry" and "represents the process aspect of entrepreneurship". Presently, entrepreneurial orientation consists of five dimensions – proactiveness, innovativeness, risk-taking (Miller, 1983), autonomy and competitive aggressiveness (Covin & Slevin, 1986, 1989; Lumpkin & Dess, 1996).

However, only a small number of works has been written in order to understand the nature of entrepreneurial orientation under the influence of the HRM practices and vice versa in the software engineering industry in general and in Ukrainian context, in particular. Therefore, among the aims of the work, it is to develop a questionnaire scale to identify the relationship between the components mentioned above. In more detail, the nomonological network for the present research, includes HRM practices and entrepreneurial orientation is presented on the figure below, where HRM practices (a1-a5) are seen as items and risk-taking of the entrepreneurial orientation is seen as a factor (f1):

The relationship between HRM compensation practices and risk-taking representing entrepreneurial orientation is under investigation. Having the mentioned above in mind, the following two hypotheses were formulated:

$H1_o$: There is no significant relationship between the entrepreneurial orientation and HRM practices in the software engineering companies in Ukraine;
$H1_a$: There is a significant relationship between the entrepreneurial orientation and HRM practices in the software engineering companies in Ukraine.

3. Research Design

Within the present research, a quantitative method is to be implemented in order to address the aims of the study (Tashakkori and Teddlie, 2003). In more detail, the questionnaire is to be developed and the online survey will be conducted in order to collect the data needed. For the research purposes, the questionnaire was developed based on the existing Likert scale survey tools (the scale ranges from 1 to 5, where 1 meaning “strongly disagree” and 5 meaning “strongly agree”) previously developed Lumpkin and Dess (1996) and Sinkura (1997). In general, for the overall research, along with the introductory part, the questionnaire has five sections, namely: general information about the respondent and the company, entrepreneurial orientation, human resource management practices and learning orientation, business environment characteristics and business performance. For the present work, only two sub-sections have been used: HRM compensation practices and risk-taking representing entrepreneurial orientation (and the factor in the present framework).

As long as the existing scale has been used, the questionnaire has been initially developed in English. However, after the pre-test stage, when 11 industry representatives were offered to fill in the questionnaire, it was suggested by them that it needs to be translated into Russian language (not Ukrainian, although the language question is of utmost importance in Ukraine at the moment, it was generally agreed that the IT-industry is mainly a Russian-speaking environment). After being translated by two independent certified translators with the further comparison and development of the

final scale, it was proofread by the professional certified English-Russian-English translation editor and the requested corrections were made. After obtaining over 400 completed questionnaire forms, reliability and validity of the designed scale have been tested. The theoretical background of validity and reliability concepts and testing is provided in the next section.

4. Research Design

4.1. Validity

According to the classical model of test validity, there are three types of validity to be tested as a part of the nomonological network validity check. These are content, construct and criterion validity. Content validity, according to Raykov (2011) is “the degree to which test components represent adequately a performance domain or construct of interest” (p. 186). Criterion validity is “the extent to which one can predict subject scores on another variable or criterion of interest from the scores on that instrument” (p. 185), so a high criterion validity means small prediction error. In its turn, construct validity is “the degree to which a test measures what it claims, or purports, to be measuring.”

Moving forward with the definitions of the measures used in this work, as a part of the validity test, the following coefficients are to be calculated and checked:

1. *Standardized Root Mean Square Residual (SRMR)* is an absolute measure of fit and is defined as the standardized difference between the observed correlation and the predicted correlation. It is a positively biased measure and that bias is greater for small N and for a low degree of freedom studies, (SRMR ranges from 0 to 1, with a value of .08 or less being indicative of an acceptable model) (Hu and Bentler, 1999).
2. *The Root Mean Square Error of Approximation* is calculated to check the level of model fit and ranges from 0 to 1. The smaller RMSEA is, the better fit of the mode.
3. *The comparative fit index (CFI)* is calculated to analyse the model fit as well. In more detail, it is done by examining the discrepancy between the data and the hypothesized model. The values CFI fall into the interval from 0 to 1 and with the values gravitating to 1 indicating better fit (Hu & Bentler, 1999).
4. *The Tucker-Lewis index (TLI)* also known as the non-normed fit index, adjusts for model complexity, theoretically ranges from 0 to 1, where gravitation to 1 means better fit, considered satisfactory when > .90
5. *The statistical model Goodness Of Fit* describes how well the model fits a set of observations. Its measurement typically summarizes the discrepancy between observed values and the values expected under the model in question.

4.2. Reliability

To begin with and as long as the instrument has been administered only once, the internal consistency test has been implemented. In order to test reliability for the present instrument, the following coefficients are tested: Confidence Interval, Cronbach's Alpha and Guttman's Lambdas. Where, the confidence interval is understood as "a range of values for a variable of interest constructed so that this range has a 95% probability of including the true value of the variable. It can also be expressed as "one can be 95% certain that the truth is somewhere inside a 95% confidence interval" (Attia, 2005). The Cronbach's alpha (also known as Guttman's Lambda 3) is a measure of internal consistency, that is, how closely related a set of items are as a group.

5. Data Collection Process

It has two stages and begins with the quantitative data collection followed by the quantitative data collection process. For the purpose of the reliability and validity tests, the quantitative data collection was organized via online self-administered structured survey after recruiting participants via a number of social and professional networks (e.g. LinkedIn, Facebook and from the researcher's personal professional network). The qualitative component is to be a set of personal interviews to be held based on the results gained though the first stage of data collection and is to be completed shortly after the quantitative part of the data collection is completed and analysed.

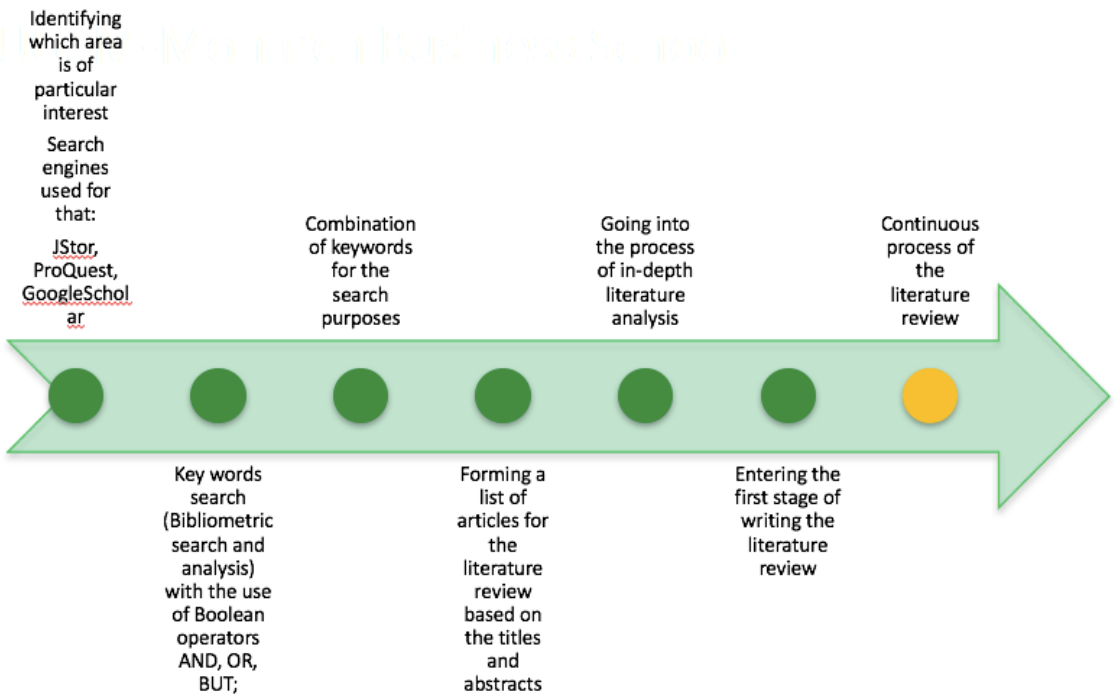
In order to minimize sampling error, before sending the questionnaire to a potential participant, he/she were asked to confirm their current working place and job position. Along with that, the link was not published anywhere in order to restrict unplanned access to the questionnaire form. In this way, the questionnaires were mostly not accessible for the non-target respondents. As a result of data collection, which took approximately 5 months, 400 participants have submitted completed questionnaires and 723 submitted partially completed questionnaires; 5otalling in 1123 responses. The response rate was fixed at the level of 36 percent and average response rate of 5.2 per day.

6. Data Analysis: Quality Standards

6.1. Validity

For the purpose of the present research, construct validity, content validity and criterion validity has taken place.

Figure 2
Literature Review Process Stages



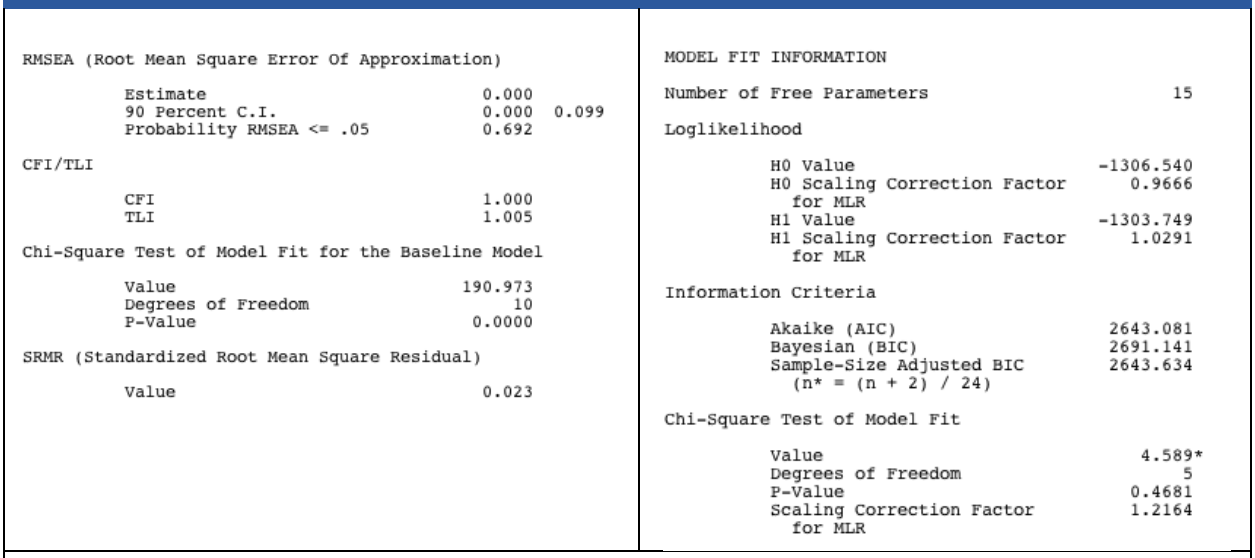
Source: Lutsenko A., 2019

Following the order below, the content validity has been established (scale construction): (1) Step 1: defining the universe of items; (2) Step 2: Drawing a systematic sample from the item universe, and; (3) Step 3: Assessing the adequacy of the scale in application (Rammstedt, 2010). For responding to the steps 1 and 2, an extensive literature review consisting of three stages in the domain studied has been performed. The literature review process is presented below.A part of the scale developed by Lumpkin and Dess (1996), namely of risk-taking scale, has been selected as a factor for the present research. And, HRM practices, namely compensation practices, have been chosen as items forming the construct placed under the influence.

After the literature review has been conducted and the scales were selected and modified according to the requirements of the industry (see above). More specifically, a set of the confirmatory interviews have taken place. For the interviews, CEOs of the companies and industry experts were involved. As a result of the interviews, the scales were confirmed as appropriate to be applied to the Ukrainian context. Apart from that, the questionnaire has been translated into the Russian language, as it was suggested that English version may be difficult for the respondents. For the translation, two independent certified interpreters were involved and their work has been compared afterward. Once the questionnaire was finalized, it has been reviewed by the

professionally qualified editor and further stylistic corrections took place. This allowed getting the final set of the feedback regarding its comprehensiveness. Once the questionnaire has been administered after that, a one-dimensional factor analysis has been performed using Mplus and as a result, the following results have been obtained and are outlined below.

Figure 3
Main Results of the Vality Test Using SPSS



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RMSEA (Root Mean Square Error Of Approximation)

          Estimate                            0.000
          90 Percent C.I.                     0.000  0.099
          Probability RMSEA <= .05            0.692

CFI/TLI

          CFI                                 1.000
          TLI                                 1.005

Chi-Square Test of Model Fit for the Baseline Model

          Value                             190.973
          Degrees of Freedom                    10
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value                               0.023
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MODEL FIT INFORMATION

Number of Free Parameters                       15

Loglikelihood

          H0 Value                       -1306.540
          H0 Scaling Correction Factor       0.9666
            for MLR
          H1 Value                       -1303.749
          H1 Scaling Correction Factor       1.0291
            for MLR

Information Criteria

          Akaike (AIC)                    2643.081
          Bayesian (BIC)                  2691.141
          Sample-Size Adjusted BIC        2643.634
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                              4.589*
          Degrees of Freedom                      5
          P-Value                           0.4681
          Scaling Correction Factor         1.2164
            for MLR
```

Source: Lutsenko A., 2019

The Root Mean Square Error of Approximation (RMSEA) ranging from 0 to 1 (where smaller values indicate better fit), for the present research has a value of 0.000. For the present research, CFI is 1.000, which confirm perfect fit of the model and Tucker-Lewis index (TLI) is 1.005 Chi-Square Test of Model Fit for the Baseline Model is 190.973, Degrees of Freedom is 10 and P-Value is 0.0000. As well as, Chi-Square Test of Model Fit has value of 11.524 and p-value is 0.0419. And, SRMR is 0.023, pointing at the acceptability of the proposed model for further use. Standardized model results can be seen in the figure below.

In general, all items have similar factor loadings and the model can be interpreted as suitable for further use. And, there are no significant outliers which need to be excluded from the scale in order harmonize it.

Figure 4
Standardized Model Results

STANDARDIZED MODEL RESULTS

STDYX Standardization

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
F BY				
A1	0.444	0.080	5.548	0.000
A2	0.780	0.055	14.232	0.000
A3	0.768	0.038	20.335	0.000
A4	0.597	0.069	8.703	0.000
A5	0.675	0.055	12.217	0.000
Intercepts				
A1	2.776	0.156	17.791	0.000
A2	2.562	0.136	18.806	0.000
A3	2.112	0.094	22.477	0.000
A4	2.384	0.119	19.949	0.000
A5	2.270	0.105	21.718	0.000
Variances				
F	1.000	0.000	999.000	999.000
Residual Variances				
A1	0.803	0.071	11.275	0.000
A2	0.392	0.085	4.587	0.000
A3	0.410	0.058	7.065	0.000
A4	0.644	0.082	7.861	0.000
A5	0.544	0.075	7.296	0.000

R-SQUARE

Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
A1	0.197	0.071	2.774	0.006
A2	0.608	0.085	7.116	0.000
A3	0.590	0.058	10.167	0.000
A4	0.356	0.082	4.351	0.000
A5	0.456	0.075	6.108	0.000

Source: Lutsenko A., 2019

6.2. Reliability

Based on that fact, that the instrument has been administered only once, *internal consistency reliability* method has been selected for the present research. It has been conducted with the use of SPSS. Being a mean of all possible split-half correlations and the correlation of the observed scale with all possible other scales measuring the same thing and using the same number of items, both *Cronbach's Alpha and Guttman's lambda* λ has been selected for the present task. As a result of the model fit and unidimensionality test, Cronbach's Alpha (and Guttman's lambda λ, L3) for the items of the scale are spotted at the level of close to the lower threshold of 0.706, which is considered as small but still acceptable. The low coefficient can be explained by a small number of items representing the scale. The Guttman's Lambda 2 is .756 (please see

results for both below). The correlation matrix shows no significant outliers within the HRM scale. The standardized Cronbach's alpha is .695, which is slightly lower than the Cronbach's alpha being at the level of .706.

Figure 5
Cronbach's Alpha and Guttman's Lambda Results - SPSS Output

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	327	83,0
	Excluded[a]	67	17,0
	Total	394	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,706	7

Reliability

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	327	83,0
	Excluded[a]	67	17,0
	Total	394	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Lambda	1	,605
	2	,756
	3	,706
	4	,629
	5	,739
	6	,747
N of Items		7

Source: Lutsenko A., 2019

The correlation matrix shows no significantly high or low correlations. The only outlying item is the one which does not belong to the HRM scale (see the SPSS output for more details). Following, this inter-item correlation is .246, range [-.259; .569].

Figure 6
Summary Item Statistics - SPSS Output

Summary Item Statistics

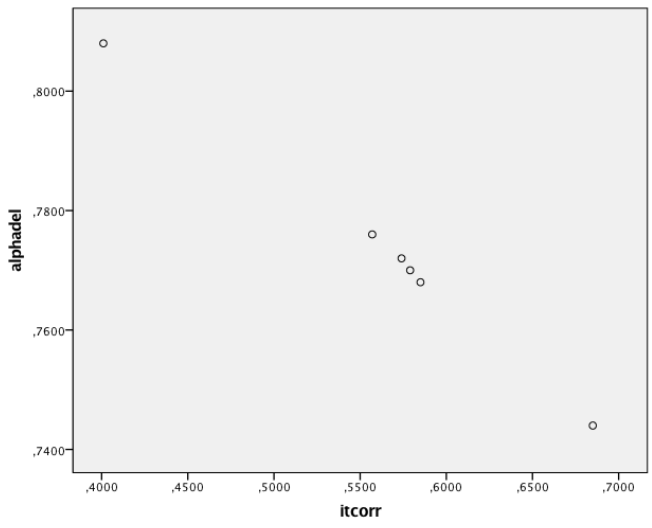
	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	2,982	2,602	3,297	,694	1,267	,075	7
Item Variances	1,277	,995	1,607	,612	1,615	,042	7
Inter-Item Correlations	,246	-,259	,569	,828	-2,196	,079	7

Source: Lutsenko A., 2019

Even though, the maximum is above the threshold (.20 and .40). The MIC is .246 which points at the homogeneity of the scale items (please see the SPSS output above).

In more detail, Cronbach's Alpha has been calculated for both: for all seven items and for six representing HRM compensation practices items only. If to calculate Cronbach's Alpha for all seven items of the of the present scale, where there are six questions on entrepreneurial orientation and one on human resource management practices, Cronbach's Alpha is calculated at the level of 0.706 (the same for Guttman's Lambda 3). If to calculate for the items of the entrepreneurial orientation only, the coefficient is 0.804, which in both cases means that the scale has an acceptable level of reliability and the scale can be used for further research. The precision of alpha is .063 (for 7 items) and .022 (for six items). As long as there is a limitation of the Mplus (the trial version is used) only six out of nine items of the scale are used in this test. Therefore, the precision of alpha is a little bit higher than the cut-off of .01. However, this serves as an indicator of a poor precision and that it can be an indicator of non-unidimensional scale. So, further CFA is suggested. Five out of six items have SMC coefficients higher than .30 and range between .357 and .498, which means good representation of each item for all other items. Only one item is SMC at the level of .280, which is slightly lower than 30%. The scatterplot below shows the correlation between the item-total correlation and Cronbach's alpha. The higher the item-total correlation, the less becomes alpha if the item is not part of the scale (please see the graph below).

Figure 7
Scatterplot For Correlation – SPSS Output



Source: Lutsenko A., 2019

Regarding obtaining confidence interval, the following results have been achieved.

Figure 8
Model Results – Mplus Output

MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
F1 BY				
A1	0.389	0.074	5.292	0.000
A2	0.886	0.057	15.419	0.000
A3	0.917	0.056	16.417	0.000
A4	0.781	0.062	12.600	0.000
A5	0.787	0.052	15.158	0.000
Intercepts				
A1	3.309	0.059	56.210	0.000
A2	3.168	0.062	50.701	0.000
A3	2.714	0.067	40.440	0.000
A4	2.993	0.063	47.530	0.000
A5	2.566	0.059	43.465	0.000
Variances				
F1	1.000	0.000	999.000	999.000
Residual Variances				
A1	1.073	0.076	14.063	0.000
A2	0.601	0.078	7.715	0.000
A3	0.766	0.081	9.424	0.000
A4	0.788	0.083	9.478	0.000
A5	0.626	0.064	9.832	0.000
New/Additional Parameters				
R	0.600	0.000	0.000	1.000
SE	0.004	0.000	0.000	1.000
L	0.405	0.000	0.000	1.000
SEL	0.017	0.000	0.000	1.000
CI_L_LO	0.373	0.000	0.000	1.000
CI_L_UP	0.438	0.000	0.000	1.000
CI_R_LO	0.592	0.000	0.000	1.000
CI_R_UP	0.608	0.000	0.000	1.000

Source: Lutsenko A., 2019

With the 95% Confidence interval CI (LL, UL) is [0.592, 0.608], the factor loading is relatively similar by all the items. However, item a1 could be suggested to be removed from the scale.

Having all the coefficients calculated and tests performed, testing proposed hypotheses with the use of the correlation has been performed. For this, having in mind that for HRM practices there are six items and for the EO there is only one, in order to calculate overall correlation, a mean coefficient for the HRM items has been calculated. Using this coefficient, bivariate correlation coefficient has been obtained and is 0.209. Which

illustrates positively directed correlation between the tested variables. Which, in turn, means that the higher X the higher Y.

7. Results and Expected Contribution

This set of methods can be used for ordinal scales of various types of samples, and for the research questions formulated in a way when one needs to test the hypotheses. In terms of theoretical contribution, it is centred around the insight that, based on the extensive literature review and according to the Lumpkin and Dess (2011, p. 856), the area of entrepreneurial orientation and its conceptualization remains fragmented as well as elements to be associated with the entrepreneurial orientation are still to be defined. Therefore, as a part of the theoretical contribution, the following gap is planned to be filled in:

> *The nature of relationship between HRM compensation practices and risk-taking representing entrepreneurial orientation for the Ukrainian software engineering industry.*

Concerning the practical contribution, based on the works of Miller (1983) entrepreneurial minds are found to be a driving force for the economies and the source for creating new workplaces and overall welfare of the countries. However, most of the research has been conducted for the developed and well established economies. While, emerging economies have received significantly less attention. Therefore, present research is aiming to contribute the creation of the wealth via implementing the gained knowledge in emerging economies. In other words, this may allow to boost the research in this direction for other developing, unstable and countries overcoming crisis and other industries, in particular.

7. Limitations

At the present research, there are a number of limitations to be addressed. To begin with, there are: (1) Sampling issues, as although the background of the survey participants has been verified in each particular case, self-reported information from people registered online may be questionable (Dillman, 2000; Stanton, 1998); (2) possible limitations at the interviewing stage are the following: (a) lack of time, which might cause respondents to postpone participation; (b) rejection of the participant to participate in the survey; (c) inability or unwillingness of the interviewee to provide interviewer with the honest answers during the face-to-face interactions, etc. (3) the risk-taking indicator of the HRM factor has only one item and may not be considered as a reliable scale itself and may need further scale development, and; (4) as a trial version of the Mplus8 has been used, not all items of the HRM practices were included into the analysis (only six out of nine)

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