Environment. Technology. Resources. Rezekne, Latvia
Proceedings of the 14th International Scientific and Practical Conference. Volume 2, 73-79

Factor Analysis of Web-based Idea Management System Application Results

Elina Mikelsone
Postdoctoral research unit
Idea Innovation Institute
Jelgava, Latvia
mikelsone.elina@gmail.com

Janis Frisfelds
Research unit
Idea Innovation Institute
Jelgava, Latvia
jfrisfelds@gmail.com

Jean Pierre Segers
Faculty of Engineering Economics and Management
Riga Technical University
Riga, Latvia
jean-pierre.segers@rtu.lv

Abstract. **The aim of the study is to reveal the underlying factors from variable data collected on the results of the web-based ideas management systems related to management and tangible results in companies. The purpose of the factor analysis process is to collect the information contained in a large number of changes in such a way as to obtain latent factors with minimal data loss. Authors have conducted global survey for enterprises that apply these systems (n>500). The 8 variables that fit together reveal the latent factor "tangible" or tangible results and the remaining 6 variables that together reveal the latent factor "managerial" or the management results.**

Keywords: Idea Management Systems, Web-based, Factor Analysis, Results.

I. INTRODUCTION

Open innovations help organizations manage knowledge across boundaries as inflows and outflows [1], [2] of knowledge, and they are becoming an important part of the innovation ecosystem [3]-[5]. On the one hand, the growing popularity of open innovations, and on the other hand, the digitalization and distance work (especially during COVID-19) are leading organizations to the application of different virtual tools that help manage innovation ecosystems and open innovations."

Web-based idea management systems (IMS) are software applications that allow individuals or groups to submit, track, and manage ideas. The paper discusses the assumption that an IMS is a tool that provides idea management. Idea management is a systematic and manageable process of idea generation, evaluation, and repeated idea generation and evaluation if needed [6], [7]. These tools can be used for a variety of purposes, such as product development, problem solving, or marketing. There are many different web-based IMS available, and each has its own strengths and weaknesses. It is important to conduct a factor analysis of web-based IMS applications to determine which system is best suited for a company's needs. Overall, web-based IMS offer a number of benefits, including increased productivity, improved communication, easier collaboration, and greater creativity.

Web-based IMS are becoming increasingly popular for several reasons:

- Increased accessibility: Web-based IMS can be accessed from anywhere with an internet connection, making it easy for employees to submit, track, and manage ideas, regardless of location.
- Improved communication and collaboration: Web-based IMS allow for real-time communication and collaboration among team members, which can help to improve the quality and quantity of ideas generated.
- Increased productivity: Web-based IMS can automate and streamline the idea generation and management process, leading to increased productivity.
- Greater flexibility: Web-based IMS offer more flexibility than traditional, paper-based systems and can be easily customized to meet the specific needs of an organization.
- Cost-effective: Web-based IMS are typically less expensive to implement and maintain than traditional, on-premises systems.
- Data analytics capabilities: Web-based IMS can track and analyze ideas, providing valuable insights that can

Print ISSN 1691-5402
Online ISSN 2256-070X
https://doi.org/10.17770/etr2023vol2.7189

be used to improve the organization's processes and decision-making.

- Shift to remote work: Due to the COVID-19 pandemic, many organizations have shifted to remote work, and web-based IMS provide an easy way for employees to collaborate and share ideas when working from different locations.

Study problem: There is currently a large amount of variable data collected on the impact of the IMS on management and tangible results. It is not easy to interpret and use this data without further data processing.

Purpose of the study: Using research analysis to identify the relationship between large-scale variables and to obtain a reduced number of variables that will help to explain and interpret the results of the survey.

Main contribution: The purpose of the study is to identify the underlying factors that affect the success of web-based IMS in companies. The study will also explore the relationship between management and tangible results in companies that use these systems.

II. Materials and Methods

The study conducted a survey to obtain primary data on the use and results of web-based IMS among companies. The survey was conducted on the "QuestBack" platform set up by UNIPARK, which was chosen for its focus on academic surveys, its widespread use among world-class researchers, its data security, and its compliance with the EU General Data Protection Regulation. To reach the survey audience more precisely, 107 IMS representatives were asked to distribute it to their customers, only to companies that were currently using the system and the person responsible for IMS. The authors, through private communication with 107 IMS developers, estimated that IMS is used by around 120,000 companies. In total, the responses of 400 enterprises with web-based IMS experience were included in the analysis.

For analysis, the authors used a dataset gathered with a global enterprise survey (n>500) conducted in Q4 of 2022, on the topic of applying web-based IMS and their results in companies.

Number of observations: 505. Based on Tabachnick and Fidell [8], the number of 500+ observations is considered to be very good. Together, the analysis will include 14 variables, which means that there are approximately 35 observations per variable.

Variable data was collected using a survey based on a 7-point Likert Scale, where 1 represents "I certainly do not agree" (Strongly Disagree) and 7 represents "I certainly agree" (Strongly Agree). All variables correspond to the objective of the survey section to respond as the results of the web-based IMS relate to management and statistical results within the company.

The following data from a previously conducted survey on the use of web-based IMS is available for the current study.

The variable data was obtained by asking the following question: "Using the scale below, indicate to what extent each of the following items pertain to the outcomes of the web-based IMS related to management and tangible results in your enterprise."

The data were collected on the following variables, which were selected based on the literature review. See variables in Table 1.

TABLE 1 VARIABLES

Idea management system application has …
… Stimulated growth - turnover
… Improved customer satisfaction
… Improved quality
… resulted in income increase
… resulted in cost reduction
… resulted in growth of the market share
… Improved productivity
… resulted in growth of the number of new products
… Improved decision making
… helped to achieve goals
… Improved information management
… Improved overall management effectiveness
… helped to set the goals
… Improved ability to respond to change

Sources: created by the authors

The study utilizes factor analysis, a statistical technique, to identify the key factors that contribute to the variability in the results of a survey on the usage and outcomes of web-based IMS in companies. The factors are the underlying variables that explain the observed variability in the survey data. The goal of the analysis is to determine which variables, and to what extent, these variables jointly produce latent factors that explain the variability in the results of the survey. All variables in the sample align with this assumption, as they are based on latent factors that are measured.

III. Results and Discussion

The factor analysis begins by examining the correlation matrix. Based on the correlation matrix, all variables used for the factor analysis have a correlation with one another (see in Table 2).

TABLE 2 CORRELATION MATRIX

Code	Variable	v_101_q_5622770	v_94_q_5622770	v_95_q_5622770	v_96_q_5622770	v_98_q_5622770	v_99_q_5622770	v_100_q_5622770	v_193_q_5622770	v_103_q_5622770	v_133_q_5622770	v_134_q_5622770	v_135_q_5622770	v_136_q_5622770	v_102_q_5622770
v_101_q_5622770	Idea management system application has helped to achieve goals	1.000													
v_94_q_5622770	Idea management system application has improved decision making	0.838	1.000												
v_95_q_5622770	Idea management system application has improved productivity	0.492	0.510	1.000											
v_96_q_5622770	Idea management system application has improved information management	0.744	0.773	0.554	1.000										
v_98_q_5622770	Idea management system application has improved overall management effectiveness	0.680	0.726	0.532	0.716	1.000									
v_99_q_5622770	Idea management system application has improved quality	0.370	0.385	0.729	0.451	0.406	1.000								
v_100_q_5622770	Idea management system application has resulted in cost reduction	0.556	0.572	0.714	0.585	0.555	0.750	1.000							
v_193_q_5622770	Idea management system application has resulted in income increase	0.524	0.544	0.693	0.571	0.533	0.719	0.851	1.000						
v_103_q_5622770	Idea management system application has stimulated growth - turnover	0.482	0.516	0.684	0.535	0.488	0.707	0.816	0.822	1.000					
v_133_q_5622770	Idea management system application has improved costumer satisfaction	0.510	0.510	0.676	0.545	0.509	0.704	0.803	0.812	0.823	1.000				
v_134_q_5622770	Idea management system application has resulted in growth of the market share	0.530	0.525	0.679	0.546	0.517	0.692	0.810	0.796	0.802	0.835	1.000			
v_135_q_5622770	Idea management system application has resulted in growth of the number of new products	0.617	0.628	0.595	0.642	0.595	0.616	0.730	0.752	0.701	0.743	0.773	1.000		
v_136_q_5622770	Idea management system application has helped to set the goals	0.660	0.660	0.576	0.658	0.664	0.534	0.704	0.698	0.609	0.663	0.708	0.782	1.000	
v_102_q_5622770	Idea management system application has improved ability to respond to change	0.634	0.632	0.543	0.630	0.600	0.490	0.669	0.661	0.665	0.669	0.698	0.740	0.774	1.000
v_101_q_5622770	Idea management system application has helped to achieve goals														
v_94_q_5622770	Idea management system application has improved decision making	0.000													
v_95_q_5622770	Idea management system application has improved productivity	0.000	0.000												
v_96_q_5622770	Idea management system application has improved information management	0.000	0.000	0.000											
v_98_q_5622770	Idea management system application has improved overall management effectiveness	0.000	0.000	0.000	0.000										
v_99_q_5622770	Idea management system application has improved quality	0.000	0.000	0.000	0.000	0.000									
v_100_q_5622770	Idea management system application has resulted in cost reduction	0.000	0.000	0.000	0.000	0.000	0.000								
v_193_q_5622770	Idea management system application has resulted in income increase	0.000	0.000	0.000	0.000	0.000	0.000	0.000							
v_103_q_5622770	Idea management system application has stimulated growth - turnover	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000						
v_133_q_5622770	Idea management system application has improved costumer satisfaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
v_134_q_5622770	Idea management system application has resulted in growth of the market share	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
v_135_q_5622770	Idea management system application has resulted in growth of the number of new products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
v_136_q_5622770	Idea management system application has helped to set the goals	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
v_102_q_5622770	Idea management system application has improved ability to respond to change	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Sources: created by the author

Importantly, as this survey measures both tangible and management results through web-based IMS it is possible that both tangible and management results are positively affected by these systems. Therefore, the correlation between all variables is expected and the latent factors themselves may also be correlated. The analysis of the factors will continue using this data. The first factor analysis test is a validity test used to confirm the extent to which measurements effectively measured the true significance of each structure to which the measurement belongs [9], [10]. When investigating the design's validity, it may be used to further reduce the total observed number of non-adequate variables. At first, each design was tested using the Kaiser-Meyer-Olkin (KMO) test and the Barlett spherical test. KMO is a measure used to determine the conformity of sampling or whether the sample size is large enough to be used for further factor analysis [10]. The Barlett spherical test is used as an indicator of the strength of the ratio of different measurements [10]. The match measure for the sample of KMO is 0.958 with a significant Barletta spherical test (Sig. $P < 0.05$). These values indicate that the data are sufficient to be used for further factor analysis [10], [11]. All variables can be used for factor analysis. See in Table 3.

TABLE 3 KMO AND BARTETT'S TEST

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0,958
Bartlett's Test of Sphericity	Approx. Chi-Square	7369,826
	DF	91
	Sig.	0,000

Sources: created by the authors

In addition, the use of Anti-image correlation and Measures of Sampling Adequacy (MSA) determines that all variables have a MSA value above 0.9. All variables can be included in the factor analysis. The selection of the number of factors will be based on the principal component analysis by which eigenvalue and scree plots are obtained. Based on this analysis, 2 components have an eigenvalue above 1.0 which indicates that none of the components has negative credibility. Overall, these 2 components explain the dispersion of 77.68%. See in Table 4.

TABLE 4 TOTAL VARIANCE EXPLAINED

Component	**Initial Eigenvalues**			**Extraction Sum of Squared Loadings**			**Rotation Sums of Squared Loadings**		
	Total	% of Variance	Cumulative%	Total	% of Variance	Cumulative%	Total	% of Variance	Cumulative%
1	9,389	67,061	67,061	9,389	67,061	67,061	6,166	44,041	44,041
2	1,512	10,801	77,862	1,512	10,801	77,862	4,735	33,822	77,862
3	0,604	4,313	82,175						
4	0,378	2,698	84,873						
5	0,319	2,278	87,151						
6	0,291	2,076	89,227						
7	0,263	1,878	91,105						
8	0,239	1,709	92,814						
9	0,222	1,586	94,400						
10	0,194	1,386	95,786						
11	0,163	1,167	96,953						
12	0,154	1,101	98,055						
13	0,140	1,002	99,057						
14	0,132	0,943	100,000						
Extraction Method: Principal Component Analysis.									

Sources: created by the authors

The study used VARIMAX with Kaiser normalization as the rotation method to produce the results. This method was chosen because it minimizes the number of variables with large weights that match the factor. The study identified (latent) 2 factors after 3 rotations. The highlighted factors have a pronounced compatibility together, as shown in Table 5.

TABLE 5 ROTATED COMPONENT MATRIX

	Component	
Variable Idea management system application has …	1	2
… stimulated growth - turnover	0,853	0,302
… improved quality	0,847	
… resulted in income increase	0,840	0,362
… resulted in cost reduction	0,834	0,387
… resulted in growth of the market share	0,833	0,362
… Improved productivity	0,733	0,344
… resulted in growth of the number of new products	0,668	0,556
… improved decision making		0,882
… helped to achieve goals		0,870
… Improved information management	0,328	0,817
… Improved overall management effectiveness		0,801
… helped to set the goals	0,550	0,664
… Improved ability to respond to change	0,551	0,624

Sources: created by the authors

The extracted components have a correlation above above 0.65, with the majority between 0.7 and 0.8. The relationship is of sufficient importance to be kept in the factor analysis (see highlighted parts in Table 6).

TABLE 6 COMMUNALITIES

Variable Idea management system application has …	**Initial**	**Extraction**
… helped to achieve goals	1,000	0,817
… Improved decision making	1,000	0,844
… Improved productivity	1,000	0,656
… Improved information management	1,000	0,775
… Improved overall management effectiveness	1,000	0,726
… Improved quality	1,000	0,741
… resulted in cost reduction	1,000	0,845
… resulted in income increase	1,000	0,836
… Stimulated growth - turnover	1,000	0,818
… Improved costumer satisfaction	1,000	0,827
… resulted in growth of the market share	1,000	0,825
… resulted in growth of the number of new products	1,000	0,756
… helped to set the goals	1,000	0,743
… Improved ability to respond to change	1,000	0,693

Sources: created by the authors

Both 2 extracted component factor loads are greater than 0.5, which exceeds sufficient factor load, and together with 2 extracted components explain 77.86% of the variation [10]. It shows that the 2 extracted components are well-suited. See in Table 7.

TABLE 7 TOTAL VARIANCE EXPLAINED

Component	Initial Eigenvalues			Extraction Sum of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative%	Total	% of Variance	Cumulative%	Total	% of Variance	Cumulative%
1	9,389	67,061	67,061	9,389	67,061	67,061	6,166	44,041	44,041
2	1,512	10,801	77,862	1,512	10,801	77,862	4,735	33,822	77,862
3	0,604	4,313	82,175						
4	0,378	2,698	84,873						
5	0,319	2,278	87,151						
6	0,291	2,076	89,227						
7	0,263	1,878	91,105						
8	0,239	1,709	92,814						
9	0,222	1,586	94,400						
10	0,194	1,386	95,786						
11	0,163	1,167	96,953						
12	0,154	1,101	98,055						
13	0,140	1,002	99,057						
14	0,132	0,943	100,000						
Extraction Method: Principal Component Analysis.									

Sources: created by the authors

The highlighted factors must be interpreted. The 8 variables that fit together reveal the latent factor "tangible" or tangible results and the remaining 6 variables that together reveal the latent factor "managerial" or the management results. See in Table 8.

The results match the expected outcomes. The survey questions that resulted in the variables were based on the inclusion of two types of web-based IMS on results, specifically management and tangible results. When examining variables grouped only in each structure, they correspond to the purpose of the question on which they were designed. The aim of the analysis has been achieved by identifying the underlying factors through factor analysis. It is also likely that all variables are correlated with each other, and that the two identified factors are also correlated with each other. This is expected, as the use of web-based IMS would likely have a similar impact on both tangible and management results in practice.

TABLE 8 HIGLIGTED FACTOTS

Variable - Idea management system application has …	
… Stimulated growth - turnover	**1 Tangible outcome**
… Improved costumer satisfaction	
… Improved quality	
… resulted in income increase	
… resulted in cost reduction	
… resulted in growth of the market share	
… Improved productivity	
… resulted in growth of the number of new products	
… Improved decision making	**2 Management results (Managerial outcome)**
… helped to achieve goals	
… Improved information management	
… Improved overall management effectiveness	
… helped to set the goals	
… Improved ability to respond to change	

Sources: created by the authors

The confidence test shall be used to confirm whether the values measured in the design are internally consistent and reflect the same design. For this purpose, Cronbach Alpha is used, which measures the degree to which the items measured in the design are of the same or similar type or nature to be used in the design [10]. Cronbach Alpha is often used as an indicator to test the reliability of the aggregated rating scales [12]. The value of Cronbach Alpha can be any value from 0 to 1, and according to Cronbach [13] the value must be at least 0,7 or more for the measurement to be reliable. However, there is evidence that Cronbach Alpha value of 0.6 or higher remains a good indicator of internal consistency [10], [11].

In addition to the use of Cronbach Alpha to measure reliability, the adjusted total correlation of items is also considered to check whether a measurement in the design is not consistent and should therefore be removed from the structure. According to J. Glus [14], if the adjusted total of units is less than 0,4, the variables should be excluded from the analysis. In the conclusions, both structures have a value of Cronbach Alpha of 0.7 or higher. See in Table 9.

TABLE 9 RELIABILITY STATISTICS

	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
1	0,959	0,959	8
2	0,927	0,931	6

Sources: created by the authors

The adjusted unit total for correlation is also above 0.7. Both results lead to the conclusion that variables contained in constructions are internally consistent and reflective of the same design that is measured. See in Table 10.

TABLE 10 ITEM-TOTAL STATISTICS

Variable	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Idea management system application has improved productivity	33.19	83.973	0.762	0.615	0.958
Idea management system application has improved quality	33.26	82.806	0.788	0.656	0.956
Idea management system application has resulted in cost reduction	33.05	80.595	0.892	0.806	0.950
Idea management system application has resulted in income increase	33.09	79.522	0.886	0.803	0.951
Idea management system application has stimulated growth - turnover	33.14	78.944	0.870	0.775	0.952
Idea management system application has improved costumer satisfaction	33.13	79.458	0.879	0.790	0.951
Idea management system application has resulted in growth of the market share	33.09	78.156	0.876	0.788	0.951
Idea management system application has resulted in growth of the number of new products	32.78	83.640	0.790	0.658	0.956
Idea management system application has helped to achieve goals	27.32	32.525	0.817	0.738	0.912
Idea management system application has improved decision making	27.44	31.651	0.834	0.771	0.909
Idea management system application has improved information management	27.54	31.713	0.808	0.679	0.912
Idea management system application has improved overall management effectiveness	27.66	31.570	0.773	0.620	0.916
Idea management system application has helped to set the goals	27.84	29.884	0.793	0.677	0.914
Idea management system application has improved ability to respond to change	27.70	29.546	0.751	0.634	0.922

IV. CONCLUSIONS

In summary, the study aims to uncover underlying factors from a large amount of data collected on the results of a web-based IMS in relation to management and tangible results in companies. The researchers used factor analysis to identify latent factors and conducted a global survey of more than 500 enterprises that use these systems. They found that 8 variables fit together to reveal the latent factor "tangible results," and the remaining 6 variables fit together to reveal the latent factor "managerial results."

The purpose of the factor analysis was to identify the important factors that account for the variability in the results of the survey. The results of the factor analysis revealed that there are two important factors that account for the variability in the results of the survey. These two factors are the "tangible results" and the "management results." The tangible results are the underlying variables that explain the variability in the tangible outcomes of the survey. The management results are the underlying variables that explain the variability in the management outcomes of the survey.

The study likely has some limitations, as all research studies do. Some potential limitations of this study include:

- Self-selection bias: The survey participants were self-selected, meaning that they chose to participate in the survey. This means that the results may not be representative of the population of companies using web-based IMS.
- Limited sample size: The sample size of 500 enterprises is relatively small when considering the estimated number of companies using IMS is >120000. Therefore, the results may not be generalizable to the entire population of IMS users.
- Reliance on self-reported data: The survey relied on self-reported data from participants, which is subject to bias and inaccuracies.
- Lack of control group: The study did not include a control group of companies that do not use web-based IMS, which would have helped to better understand the specific benefits of IMS.

- Limited geographic scope: The survey was conducted globally, but it is not clear the distribution of the sample by country. Therefore, the results may not be generalizable to all geographic regions.
- Limited time frame: The survey data is a snapshot in time, and the results may not be generalizable to other time periods.
- The survey was distributed by IMS representatives, which may bias the results as well.
- The survey was designed to obtain a general view.

Future research in this area could focus on several key areas:

- Replication and extension of the study: The study could be replicated and extended to other industries and organizations to see if the results generalize to other settings.
- Comparison of different web-based IMS: The study could also compare different web-based IMS to see which one is most effective in terms of management and tangible results. And it should be researched also in different sizes of the companies [15;16].
- Examination of the effect of different organizational characteristics: The study could investigate how different organizational characteristics (e.g. size, industry, culture, etc.) impact the effectiveness of web-based IMS.
- Longitudinal studies: The study could conduct longitudinal research to understand how web-based IMS impact the organization over time.
- The effect of COVID-19 on the use of web-based IMS: The study could also investigate how the shift to remote work during the COVID-19 pandemic has affected the use of web-based IMS and the results they produce.
- The effect of artificial intelligence on the web-based IMS: Future research could investigate the integration of artificial intelligence into web-based IMS, and the impact that it has on the results they produce.

V. ACKNOWLEADGMENTS

This work has been supported by the European Regional Development Fund within the Activity 1.1.1.2 “Postdoctoral Research Aid” of the Specific Aid Objective 1.1.1 “To increase the research and innovative capacity of scientific institutions of Latvia and the ability to attract external financing, investing in human resources and infrastructure” of the Operational Programme “Growth and Employment” (N-1.1.1.2/VIAA/4/20/670).

REFERENCES

[1] R. Adner, “Ecosystem as structure: An actionable construct for strategy”, Journal of Management, vol. 43, no.1, pp.39-58. 2017.
[2] O. Granstrand and M. Holgersson, “Innovation ecosystems: A conceptual review and a new definition”, Technovation, 2020, pp.90-91, https://doi.org/ 102098.
[3] H. Chesbrough and B. Marcel, “Explicating open innovation: Clarifying an emerging paradigm for understanding innovation”, In Henry Chesbrough, Wim Vanhaverbeke and Joel West (Eds.), New Frontiers in Open Innovation, Oxford: Oxford University Press, 2014, pp.3-28.
[4] M. Bagherzadeh, S. Markovic, J. Cheng, W. Vanhaverbeke, “How does outside-in open innovation influence innovation performance? Analyzing the mediating roles of knowledge sharing and innovation strategy”, IEEE Transactions on Engineering Management, vol. 67, no.3, pp.740-753, 2020.
[5] A.K. Zobel, “Benefiting from open innovation: A multidimensional model of absorptive capacity”, Journal of Product Innovation Management, vol. 34, no. 3, pp.269-288, 2017.
[6] T. Herrmann, D. Roth, H. Binz, “Framework Of An Ambidextrous Process Of Idea Management Supporting The Downstream Product Development Process”, Proceedings of the Design Society: DESIGN Conference, Editor D. Marjanović, M. Štorga, S. Škec, Martinec, vol.1, pp.587 – 596, 2020.
[7] E. Mikelsone and E. Liela, “Discussion on the Terms of Idea Management and Idea Management Systems”, Journal of Regional Formation and Development Studies, vol. 3, no.17, pp. 97-110. 2015.
[8] B.G. Tabachnick and L.S. Fidell, Using Multivariate Statistics, Third edition, HarperCollins College Publishers, 1996.
[9] Maat et al., “Confirmatory factor analysis of the mathematics teachers' teaching practical instrument”, World Applied Sciences Journal Vol. 12, no. 11, pp. 2092-2096, 2011.
[10] L. L. Chan, and N. Idris, “Validity and Reliability of The Instrument Using Exploratory Factor Analysis and Cronbach's alpha,” International Journal of Academic Research in Business and Social Sciences vol. 7, no.10, pp.400-411, 2017.
[11] D. L. Strainer, “Starting at the Beginning: An Introduction to Coefficient Alpha and Internal Consistency”, Journal of Personality Assessment, pp. 99-103, 2003.
[12] Vaske et al. “Rethinking Internal Consistency in Cronbach's Alpha”, Leisure Sciences, 2017, pp.163-173.
[13] L. J. Cronbach, “Coefficient alpha and the internal structure of test”, Psychometrika, vol.16, pp. 297-334, 1951.
[14] R. R. J. Glos, “Calculating, Interpreting, And Reporting Cronbach's Alpha Reliability Coefficient For Likert-Type Scales”, Midwest Research to Practice Conference in Adult, Continuing, and Community Education, pp.82-88, 2003.
[15] C.O. Quandt, H.D.F.N. Silva, A.A. Ferraresi, J.R. Frega, “Idea management and innovation programs: practices of large companies in the south region of Brazil”, International Journal of Business Innovation and Research, vol. 18, no.2, pp.187–207, 2019.
[16] B.P. Bailey and E. Horvitz, “What’s Your Idea? A Case Study of a Grassroots Innovation Pipeline within a Large Software Company”, In CHI2010 proceedings on the 28th annual CHI conference on human factors in computing systems, pp. 2065–2074, 2010, USA, Atlanta, NY: ACM. DOI: 10.1145/1753326.175364