IDEA QUALITY FORECASTING MODELS FOR DIFFERENT WEB-BASED IDEA MANAGEMENT SYSTEM TYPES

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Abstract. Web-based idea management systems are used by a wide range of organisations across private, public and academical sector. Organisations like NASA, Samsung, Panasonic, Virgin trains, etc. have shared cases in the past that prove the results that can be achieved by using these systems. Researchers have discovered that even web-based idea management systems that provide similar functionalities can still have technological differences. Based on this, the researchers have created idea management system type classifications. Researchers have researched which of these types will provide greater idea quality, idea quantity and involvement. But there is a research gap – there is no research that tries to explore idea quality forecasting models for different web-based idea management system types. In this paper, the authors aim to close this research gap by conducting a global survey (n > 400) of companies that apply the web-based idea management system to create idea quality forecasting models for different web-based idea management system types. The contribution of this research is as follows – it provides a forecasting model to estimate the expected idea quality (ideas selected for implementation) based on the number of people involved and quantity of ideas generated by applying different web-based idea management system types. As a result, there is a positive effect in idea quality in all IMS types. By increasing the number of generated ideas by 1000, the number of selected ideas will increase by between 1 to 3 ideas across all IMS types. By reaching the involvement level of 1000 in Internal, External and Passive IMS, the number of selected ideas will increase by between 1 to 3 ideas, while an involvement of 10000 people in Mixed and Active IMS, the number of selected ideas will increase by between 1 to 2 ideas. The results highlight that idea quantity and involvement have a direct positive impact on the idea quality.

Keywords: idea management systems, forecasting, models, idea quality.

Introduction

The ongoing globalisation and the global pandemic have made the use of knowledge and information technologies a clear priority. There is a scientific and practical topicality when looking at information technologies that help manage knowledge and information. There are different information management systems, such as electronic messaging systems, collaborative systems, group decision support systems; many of these at their core can be considered as web-based idea management systems (IMS).

The importance of IMS as a resource and research tool for doing social and technological research has grown over the last decade. It is an important part of innovation management with the goals of effective and efficient idea generation, evaluation and selection [1], but there are many approaches that support creative idea generation [2]. Web-based IMS are tools that provide a systematic and manageable process of idea generation, evaluation and repetition of the process if needed [3-4].

IMS could be the first step to the innovation process [5]. There is a lack of a general model how to manage these systems in corporate models [6-7] and there is no research that tries to explore idea quality forecasting models for different web-based IMS types. So, in this paper, the authors will answer the following question: how many ideas we need to generate to improve idea quality? In this paper, the authors aim to close this research gap by conducting a global survey (*n* > 400) of companies that apply web-based IMS to create idea quality forecasting models for different web-based IMS types and its statistical analysis.

Web-based IMS are used both locally and transnationally with positive results on involvement, idea quality, and quantity. It is worth noting the fact that multinational companies use systems mostly for internal IMS, but in very rare cases for international, mixed or external IMS.

Web-based IMS are themed towards idea development for various spheres (marketing, product development, process improvements, organisational improvements). Most often, ideas are generated for creating new products. This shows the universality of the usability of the web-based IMS. Web-based IMS are flexible in terms of application and timeframe as there are companies that use IMS for multiple

DOI: 10.22616/ERDev.2022.21.TF209

years and companies that apply IMS for separate occasions (e.g., specific projects), sometimes just for a few days.

Internal and external IMS are important in innovation processes [8] and both approaches are widely applied by companies, with a few cases where a mixed approach is used. Employees, clients, the public and experts are the most common groups taking part in idea generation according to reviewed cases. It is rare for the web-based IMS to be adapted for specific expertise and knowledge of participating groups (e.g., employees generate ideas and clients evaluate). When comparing the size of the network with the extent of involvement, it can be concluded that companies have the potential to increase the volume of creator/evaluator participation, as the size of the network is much larger than the actual volume of involvement.

This paper has the following contributions: (1) the practical contribution of the research results helps understand what kind of results organisations could expect from application of different IMS types; (2) the research results highlight the benefits/implications of adopting different types of IMS for organisations; (3) the research results provide managers with a way to make better informed decisions regarding the selection of IMS that is the best for achieving the results in a given context; (4) the research provides information on how many persons should be involved to reach desired idea quality, and lastly; (5) the way to forecast how many ideas should be generated to find ideas for implementation (better idea quality) by applying different web-based IMS types.

Materials and methods

A survey of companies using IMS was conducted in 2020 (autumn) to obtain primary data. The survey was conducted on “The QuestBack” platform set up BY UNICPARK (https://www.unipark.com/). This platform was selected because: (1) it focuses on academic surveys; (2) widely recommended by world-class researchers; (3) ensuring data security required by IVS - BSI-certified data centre according to ISO 27001 standard; (4) is in line with the requirements of the EU General Data Protection Regulation (GDPR). It should be noted that, in order to reach the survey audience more precisely, 107 IMS representatives described in the study were asked to distribute it to their customers. It was stipulated that the survey should only be sent to companies using the system in question or the person responsible for the IMS (mostly idea managers, innovation managers or company managers).

The authors, through private communication with 107 IMS developers and by using the information provided by the relevant IMS, concluded that IMS are used by around 120 000 companies (derived from the average number of IMS customers (companies) over 107 IMS). In the end, more than $n > 400$ valid surveys were received that could be included in the sample size. This survey allowed the pooling of data on IMS in 8 blocks, corresponding to the type adaptive structuration theory and the results to present in separate papers: (1) IMS; (2) tasks; (3) organisation system; (4) adaptation type of use; (5) IMS results; (6) benefits; (7) new structures; (8) problems with IMS. In this paper are applied results from part 5: IMS results. The questionnaire was formed and distributed in English because the dominant language of IMS and their users is English.

Main survey question logic applied in this paper – see Table 1, where the 3 main research elements are described: idea quality or ideas created; idea quantity or ideas selected for implementation and involvement – number of persons involved in the idea management process [9-12]. These three research elements were evaluated by using three IMS types based on involved sources (internal – idea creator involvement from in-house, external – from outside the company, mixed- in-house and outside the company simultaneously) and 2 based on IMS focus (active – participants generate ideas for the specific tasks and passive IMS are without a task focus) [13].

To test the hypotheses, the significance tests for population mean number for the result variable, the t-test was used to measure statistically significant variations between IMS types and correlation, then a regression analysis was applied. In addition, *p*-values were calculated for given test statistics and degrees of freedom. The authors apply the traditional for business and economic research *p*-value threshold 0.05 [14].

Table 1

Logic of Survey

What is the average number of ideas created per task? (x_{iC})				
Using internal idea management	Using external idea management	Using mixed idea management	Using active idea management (focused task)	Using passive idea management (unfocused task)
Number of ideas created				
What is the average number of ideas selected for development (per task)? (x_{iI})				
Using internal idea management	Using external idea management	Using mixed idea management	Using active idea management (focused task)	Using passive idea management (unfocused task)
Number of ideas selected				
What is the average number of involved persons (per task)? (y)				
Using internal idea management	Using external idea management	Using mixed idea management	Using active idea management (focused task)	Using passive idea management (unfocused task)
Number of persons involved				

Results and discussion

Data was analysed by applying correlation and regression analysis. Independent variables (x_{ij}) – ideas created (idea quantity) (x_{iC}) and involvement (x_{iI}), dependent variable (y) – ideas selected (idea quality). See Pearson's correlations for Active IMS in Table 2.

Table 2

Pearson's correlations for Active IMS

Variable	y_A	x_{AC}	x_{AC}^2	x_{AI}	x_{AI}^2
y_A	1.000	0.396	0.399	0.274	0.195
x_{AC}	0.396	1.000	0.945	0.461	0.347
x_{AC}^2	0.399	0.945	1.000	0.457	0.374
x_{AI}	0.274	0.461	0.457	1.000	0.946
x_{AI}^2	0.195	0.347	0.374	0.946	1.000

Independent variable correlations with the quality of ideas do not show a significant correlation, but all correlation ratios are statistically significant at the confidence level of 99%. Three statistically significant models were produced using the SPSS regression analysis procedure, the summary statistics of which are compiled in Table 3.

Table 3

Regression models for Active IMS

Model	Variable	R^2	Standard error	F	p-value
Linear	x_{AC}	0.157	18.151	74.401	< 0.001
Linear	x_{AC}, x_{AI}	0.167	18.057	40.172	< 0.001
Second-degree polynomial	x_{AI}^2, x_{AC}, x_{AI}	0.180	17.946	29.103	< 0.001

The low values of the coefficient of determination (R^2) indicate that in the case of application of active IMS, only 16-18% of the variation in the number of selected ideas can be explained by the factors included in the model (ideas created and involvement) and this means that additional research is needed in order to assess the potential impact of other factors, e.g., industry, company size, rewards, etc. At the same time, as shown in Table 3, all models are statistically stable at > 99% confidence levels and can be used to forecast the idea quality.

The regression factors with estimates, standard errors and t-test statistics of the models obtained are summarised in Table 4. As it can be seen, the results of t-tests included in the last two columns of Table

4 show the statistical relevance of the parameters of all regression models at a confidence level of at least 97.5%, and the models are therefore to be used for forecasts.

Table 4

Regression coefficient for Active IMS

Model	Variable	Value for coefficient	Standard error	*t-statistic*	*p*-value
Linear	x_{AC}	0.0022	0.0003	8.626	< 0.001
	a	10.826	1.440	7.518	< 0.001
Linear	x_{AC}	0.002	0.0003	6.648	< 0.001
	x_{AI}	0.0001	0.0001	2.273	0.024
	a	10.769	1.433	7.516	< 0.001
Second-degree polynomial	x_{AI}^2	0.000	0.000	-2.443	0.015
	x_{AI}	0.001	0.000	3.060	0.002
	x_{AC}	0.002	0.000	5.614	< 0.001
	a	9.943	1.464	6.794	< 0.001

It can be concluded that when the number of ideas generated increases by 1000 the number of ideas selected should on average increase by 2 ideas using the Active IMS. On the other hand, as the number of involved increases by 10000, the number of ideas selected on average increase by 1 idea.

Table 5 summarises Pearson's correlation ratios, calculated on the basis of the results of a survey of respondents using Passive IMS. Independent variables' correlations with the quality of ideas show moderate links, with all correlation factors statistically significant at a confidence level of 99%.

Table 5

Pearson's correlations for Passive IMS

Variable	y_P	x_{PC}	x_{PC}^2	x_{PI}	x_{PI}^2
y_P	1.000	0.586	0.613	0.659	0.665
x_{PC}	0.586	1.000	0.964	0.635	0.485
x_{PC}^2	0.613	0.964	1.000	0.647	0.518
x_{PI}	0.659	0.635	0.647	1.000	0.919
x_{PI}^2	0.665	0.485	0.518	0.919	1.000

Three statistically significant models were produced using the SPSS regression analysis procedure, the summary statistics of which are compiled in Table 6.

Table 6

Regression models for Passive IMS

Model	Variable	R^2	Standard error	*F*	*p*-value
Linear	x_{PC}	0.344	11.905	62.268	< 0.001
Linear	x_{PI}	0.434	11.053	91.288	< 0.001
Linear	x_{PC}, x_{PI}	0.481	10.628	54.730	< 0.001

As it can be seen from Table 6, in the case of Passive IMS application, the coefficients of determination of the calibrated models are more than twice as large as in the case of Active IMS, and this indicates how the effects of other factors not included in the model are significantly smaller than for Active IMS. Regarding the stability of the calibrated models, the conclusions are similar as for Active IMS.

The regression factors with estimates, standard errors and *t*-test statistics of the models obtained are summarised in Table 7.

As it can be seen, the results of *t*-tests included in the last two columns of Table 7 show the statistical significance of the parameters of all regression models at a confidence level of at least 92.9% and therefore the models could be used for forecasting. It can be concluded that when the number of ideas generated increases by 1000 the number of ideas selected should on average increase 2 ideas and when involvement increases by 1000 the number of ideas selected should on average increase 1 using Passive IMS.

Table 7

Regression coefficient for Passive IMS

Model	Variable	Value for coefficient	Standard error	*t-statistic*	*p*-value
Linear	x_{PC}	0.004	0.0005	7.891	< 0.001
	a	2.392	1.278	1.872	0.064
Linear	x_{PI}	0.001	0.0001	9.554	< 0.001
	a	3.497	1.099	3.181	0.02
Linear	x_{PC}	0.002	0.001	3.274	0.001
	x_{PI}	0.001	0.000	5.597	< 0.001
	a	2.079	1.142	1.821	0.071

Table 8 summarises Pearson's correlation ratios calculated based on the results of a survey of respondents using Internal IMS.

Table 8

Pearson's correlations for Internal IMS

Variable	y_I	x_{IC}	x_{IC}^2	x_{II}	x_{II}^2
y_I	1.000	0.666	0.597	0.719	0.654
x_{IC}	0.666	1.000	0.923	0.422	0.323
x_{IC}^2	0.597	0.923	1.000	0.337	0.262
x_{II}	0.719	0.422	0.337	1.000	0.963
x_{II}^2	0.654	0.323	0.262	0.963	1.000

As shown in Table 8, the independent variable correlations with the quality of ideas show moderate associations, with all correlation ratios statistically significant at a confidence level of 99%. Using the SPSS regression analysis procedure, four statistically significant models were produced, the summary statistics of which are summarised in Table 9.

Table 9

Regression models for Internal IMS

Model	Variable	R^2	Standard error	F	*p*-value
Linear	x_{IC}	0.443	10.879	181.621	< 0.001
Linear	x_{PI}	0.517	10.130	244.434	< 0.001
Second-degree polynomial	x_{II}^2, x_{II}	0.538	9.936	132.017	< 0.001
Linear	x_{PC}, x_{PI}	0.677	8.301	238.278	< 0.001

The regression factors with estimates, standard errors and *t*-test statistics of the models obtained are summarised in Table 10.

Table 10

Regression coefficient for Internal IMS

Model	Variable	Value for coefficient	Standard error	*t-statistic*	*p*-value
Linear	x_{IC}	0.005	0.0003	13.477	< 0.001
	a	7.626	0.823	9.261	< 0.001
Linear	x_{II}	0.001	0.0001	15.634	< 0.001
	a	10.542	0.687	15.337	< 0.001
Second-degree polynomial	x_{II}^2	-1E-08	5E-09	-3.159	0.002
	x_{II}	0.002	0.0003	7.352	< 0.001
	a	9.615	0.735	13.007	< 0.001
Linear	x_{IC}	0.003	0.0003	10.609	< 0,001
	x_{II}	0.001	0.0001	12.830	< 0.001
	a	7.587	0.628	12.074	< 0.001

As it can be seen, the *t*-test results included in the last two columns of Table 10 show the statistical significance of the parameters of all regression models at 99% confidence level and, consequently, the models can be used for forecasts.

It can be concluded that, with an Internal IMS, the increase of the number of ideas generated by 1000 should lead to average growth by 3 ideas selected. On the other hand, the number of ideas selected should grow on average by 1 idea as the number of those involved increased by 1000.

Table 11 summarises Pearson's correlation ratios calculated based on the results of a survey of respondents using External IMS.

Table 11

Pearson's correlations for External IMS

Variable	y_E	x_{EC}	x_{EC}^2	x_{EI}	x_{EI}^2
y_E	1.000	0.412	0.488	0.133	0.180
x_{EC}	0.412	1.000	0.947	0.489	0.422
x_{EC}^2	0.488	0.947	1.000	0.502	0.472
x_{EI}	0.133	0.489	0.502	1.000	0.949
x_{EI}^2	0.180	0.422	0.472	0.949	0.000

As shown in Table 11, the independent variables' correlations with the quality of ideas do not show significant associations, but all correlation ratios are statistically significant at 96% confidence level. Using the SPSS regression analysis procedure, two statistically stable ($p < 0.05$) models were produced for which summary statistics are compiled in Table 12.

Table 12

Regression models for External IMS

Model	Variable	R^2	Standard error	F	*p*-value
Linear	x_{EC}	0.169	16.884	39.767	< 0.001
Second-degree polynomial	x_{EC}^2, x_{EC}	0.263	15.949	34.549	< 0.001

The low values of the coefficient of determination (R^2) indicate that in the case of application of External IMS, only 17-26% of the variation in the number of selected ideas can be explained by the factors included in the model (ideas created) and this means that additional research is needed in order to assess the potential impact of other factors, e.g., industry, company size, rewards, etc. At the same time, as shown in Table 12, all models are statistically stable at > 99% confidence level and can be used to forecast the idea quality.

The regression factors with estimates, standard errors and *t*-test statistics of the models obtained are summarised in Table 13.

Table 13

Regression coefficient for External IMS

Model	Variable	Value for coefficient	Standard error	*t-statistic*	*p*-value
Linear	x_{EC}	0.002	0.0003	6.306	< 0.001
	a	0.154	2.156	0.072	0.943
Second-degree polynomial	x_{EC}^2	4E-07	1E-07	4.953	< 0.001
	x_{EC}	-0.0025	0.001	-2.552	0.011
	a	8.204	2.606	3.148	0.002

As it can be seen, the results of *t*-tests included in the last two columns of Table 13 show the statistical relevance of all regression factors at 98%; however, uncertainty in the value of the intercept of Model 11 is very significant and consequently the results of this model may be incorrect. The results come to the conclusion that the number of ideas selected should grow on average by 2 ideas using External IMS, increasing the number of ideas generated by 1000.

Table 14 summarises Pearson's correlation ratios calculated based on the results of a survey of respondents using Mixed IMS.

Table 14

Pearson's correlations for Mixed IMS

Variable	y_M	x_{MC}	x_{MC}^2	x_{MI}	x_{MI}^2
y_M	1.000	0.397	0.393	0.349	0.281
x_{MC}	0.397	1.000	0.952	0.470	0.399
x_{MC}^2	0.393	0.952	1.000	0.464	0.420
x_{MI}	0.349	0.470	0.464	1.000	0.944
x_{MI}^2	0.281	0.399	0.420	0.944	1.000

As shown in Table 14, the independent variables' correlations with the quality of ideas do not show significant associations, but all correlation ratios are statistically significant at 99% confidence level. Using the SPSS regression analysis procedure, four statistically stable models were produced, the summary statistics of which are compiled in Table 15.

Table 15

Regression models for Mixed IMS

Model	Variable	R^2	Standard error	F	p-value
Linear	x_{MC}	0.157	21.413	45.043	< 0.001
Linear	x_{MI}	0.122	21.862	33.414	< 0.001
Second-degree polynomial	x_{MI}^2, x_{MI}	0.143	21.639	20.047	< 0.001
Linear	x_{MC}, x_{MI}	0.191	21.022	28.389	< 0.001

A low value of R^2 (0.157, 0.122, etc.) indicates that only one factor included in the regression model (the number of ideas generated or involvement) can not sufficiently explain the change in the number of ideas selected. There are other factors that could have a significant impact on the number of ideas selected, such as industry, size of company, rewards, etc. It is the aspect of the future research studies for the authors. At the same time, it should be noted that all models calibrated, as shown in Table 3, 6, 9, 12 and 15, and regression factors 4, 7, 10, 13 and 16, are statistically significant at least with a confidence level of 0.95. Forecasts are reliable, only the interval at which the number of ideas selected is expected, forecasting only the number of ideas generated, is wide. In order to narrow this, it is necessary to explore the impact of the number of factors on the number of ideas selected.

The regression factors with estimates, standard errors and *t*-test statistics of the models obtained are summarised in Table 16.

Table 16

Regression coefficient for Mixed IMS

Model	Variable	Value for coefficient	Standard error	*t-statistic*	p-value
Linear	x_{MC}	0.003	0.0004	6.711	< 0.001
	A	8.730	2.664	3.277	0.001
Linear	x_{MI}	0.0004	0.0001	5.780	< 0.001
	A	17.985	1.751	10.269	< 0.001
Second-degree polynomial	x_{MI}^2	-7E-07	3E-09	-2.447	0.002
	x_{MI}	0.0009	0.0002	4.232	0.003
	A	15.132	2.089	7.243	< 0.001
Linear	x_{MC}	0.002	0.0004	4.543	< 0.001
	x_{MI}	0.0002	0.0001	3.169	0.002
	A	8.891	2.616	3.399	0.001

As it can be seen, the results of the *t*-tests included in the last two columns of Table 16 show the statistical relevance of the parameters of all regression models at 99% and, consequently, the models can be used for forecasts. It can be concluded that the number of ideas selected should grow on average by 2 ideas as a result of the increase in the number of ideas generated by a Mixed IMS of 1000. On the other hand, the number of ideas selected should grow by an average of 2 ideas as the number of those involved increased by 10000.

Conclusions

1. The practical contribution of the research results helps understand what kind of results organisations could expect from application of different IMS types by showing how the different IMS types affect the idea quality as the generated idea quantity and people involvement are changed. The research results highlight the benefits and implications of adopting different types of IMS for organisations and provide the managers with a way to make better informed decisions regarding the selection of the IMS type that is best suited for achieving the results in a given context. Lastly, the models created based on the received survey results give an insight and a way to forecast the expected number of ideas for implementation (idea quality) based on the amount of people involvement and quantity of ideas generated depending on the applied web-based IMS type. The results highlight that idea quantity and involvement have a direct positive impact on the idea quality.
2. When organisations apply the Active IMS type, which is focused on a specific task, for every 1000 ideas generated, it is expected that the idea quality on average will increase by 2 ideas (ideas selected). By increasing the number of people involved in idea generation by 1,000, the idea quality on average will increase by 1 idea. The forecasting models of the Active IMS type explain between 15.7% to 18.0% of variability in the dependant variable (idea quality) by the independent variables (idea quantity and involvement).
3. When organisations apply the Passive IMS type, which is not focused on any specific task, for every 1000 ideas generated, it is expected that the idea quality on average will increase by 2 ideas. By increasing the number of people involved in idea generation by 1000, the idea quality on average will increase by 1 idea. The forecasting models of the Passive IMS type explain between 34.4% to 48.1% of variability in the dependant variable (idea quality) by the independent variables (idea quantity and involvement).
4. When organisations apply the Internal IMS type, which only involves people from within the organisation in idea generation, for every 1000 ideas generated, it is expected that the idea quality on average will increase by 3 ideas. By increasing the number of people involved in idea generation by 1000, the idea quality on average will increase by 1 idea. The forecasting models of the Internal IMS type explain between 44.3% to 67.7% of variability in the dependant variable (idea quality) by the independent variables (idea quantity and involvement).
5. Regardless if the External IMS type (involved only people from outside the organisation) or the Mixed IMS type (involved people from both – within and outside the organisation) is used, the idea quality on average will increase by 2 ideas as the number of ideas created increases by 1000 ideas. Lastly, by increasing the number of people involved in the Mixed IMS type by 10,000, the idea quality on average will increase by 2 ideas. The forecasting models of the External IMS type explain between 16.9% to 26.3% of variability in the dependant variable by the independent variables, while for the Mixed IMS type this is 14.3% to 19.1% of variability in the dependant variable (idea quality) by the independent variables (idea quantity and involvement).
6. In future research the authors could further look into improving forecasting models by exploring the effect of adding several different independent variables (e.g., organisation size, type of activities, sector, geographical scope), to increase the variability explained in the dependent variable by further adding relevant independent variables that help explain this variability and provide a way to even more accurately forecast idea quality based on specific variables in a given context.

Acknowledgements

The paper is granted 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 an external financing, investing in human resources and infrastructure" of the Operational Programme "Growth and Employment" (N-1.1.1.2/VIAA/4/20/670).

Author contributions

Example: Conceptualisation, E.M.; methodology, A.S. and E.M.; software, A.S.; validation, A.S. and T.V.; formal analysis, A.S. and E.M.; investigation, E.M., A.S., J.P.S. and T.V.; data curation, E.M.; writing – original draft preparation, E.M.; writing – review and editing, E.M. et al.; visualisation, A.S., E.M.; project administration, E.M.; funding acquisition, E.M. All authors have read and agreed to the published version of the manuscript.

References

[1] Brem A., Voigt K.-I. Innovation management in emerging technology ventures - the concept of an integrated idea management. International Journal of Technology, Policy and Management, vol.7, Issue 3, 2007, pp. 304-321.

[2] Bonnardel N., Didier J. Brainstorming variants to favor creative design. Applied Ergonomics, vol.83, Issue 1, 2020, 102987

[3] Poppe M. Requirements and Effects on Companies and Employees of Idea Management Systems in SMEs. CEUR. WS.org Proceedings 39, December 25, 2020. [online][11.03.2022] Available at: http://ceur-ws.org/Vol-2628/paper6.pdf.

[4] Mikelsone E., Spilbergs A., Segers J.-P., Volkova T., Liela E. Better Ideation Task Results in Web-Based Idea Management Systems. Businesses, vol.2, Issue 1, 2022, pp.129-140.

[5] Herrmann T., Roth D., Binz, H. Framework Of An Ambidextrous Process Of Idea Management Supporting The Downstream Product Development Process. Proceedings of the conference "Design Society", 2020, pp. 587-596.

[6] Gerlach S., Brem, A. Idea management revisited: A review of the literature and guide for implementation. International Journal of Innovation Studies, vol. 1, Issue 2, 2017, pp. 144-161.

[7] Mikelsone E., Spilbergs A., Volkova T., Liela E. Ideas Management: From a Management Perspective, World Scientific Book Chapters, in: Patricia de Sá Freire & Suliman Hawamdeh & Gertrudes Aparecida Dandolini (ed.), Knowledge Governance and Learning for Organizational Creativity and Transformation, chapter 11, 2022, pp. 191-212, World Scientific Publishing Co. Pte. Ltd.

[8] de Brittos Valdati A., de Souza J.A., Segura M.I.S., de Jesus, C.G. Maturity Model for Ideas Management in: Patricia de Sá Freire & Suliman Hawamdeh & Gertrudes Aparecida Dandolini (ed.), Knowledge Governance and Learning for Organizational Creativity and Transformation, chapter 12, 2022, pp.213-233, World Scientific Publishing Co. Pte. Ltd.

[9] Deichmann D. Idea Management: Perspectives from Leadership, Learning, and Network Theory, PhD diss. ERIM: Netherland, 2012. 212p.

[10] Girotra K., Terwiesch C. Idea Generation and the Quality of the Best Idea. Management Science, vol.56, Issue 4, 2010, pp. 591-605.

[11] Korde R., Paulus P.B. Alternating individual and group idea generation: Finding the elusive synergy. Journal of Experimental Social Psychology, vol. 70, 2016. DOI: 10.1016/j.jesp.2016.11.002

[12] Selart M., Johansen, S.T. Understanding the Role of Value - Focused Thinking in Idea Management. Creativity and Innovation Management, vol. 20, Issue 3, 2011, pp.196-206.

[13] Mikelsone E., Volkova T., Liela E. Practical Evidence of Web-Based Idea Management Systems: Classification and Application. Proceedings of the 25th International Scientific Conference "Research for Rural Development 2019", May 15-17, 2019, Rīga, Latvia, pp.268-275.

[14] Moore D., McCabe G., Alwan L., Craig, B. The practice of statistics for business and economics (4th ed.), 2016, W. H. Freeman & Co.