

# Evaluation of Digital Data Effect on Computer Based Idea Generation

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## ABSTRACT

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**Organizations and businesses that do their best over long term are those who are the most creative and innovative. In order to achieve this, in today's business world, organizational creativity and employees idea generation became one of the most important and essential elements for success and survival. At the same time, the world is faced with a phenomenon known as digital data that may appear in various forms. Most employees in the business world use digital data on their organizational computer systems and these digital data always affect them. This study intends to investigate the relation between digital data and computer-based idea generation. Target population is Iranian computer users that work with organizational computer systems. The sample used in this empirical study includes 1270 Iranian organizational computer users. Data gathering is done by questionnaire and answers were designed with Likert Scale. The sampling technique is cluster and random together, the statistical Software SPSS 23.0 is used for Pearson correlation and investigate hypothesis, and finally the method used was library and field study. The findings show that textual, audio and visual digital data have a positive and meaningful relationship with employees' computer-based creative idea generation. The contribution of this paper is suggesting that certain digital data parameters are important to drive the creativity. The results presented in this paper can be useful for the competitive advantage of organizations and their survival in today's dynamic and complex business environment.**

**Keywords: Creativity, Idea generation, Digital Data, Audio Data, Visual Data, Textual Data.**

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## I. INTRODUCTION

In today's highly competitive environment the goal of each organization is to gain sustainable competitive advantage to defeat the competition and stabilizing their survival [1, 2, 3, 4]. Porter (1990) outlines three conditions for the sustainability of competitive advantage: 1) hierarchy of source, 2) number of distinct sources, and 3) constant improvement and upgrading [5]. Organizational creativity can be known as sustainable competitive advantage because it includes all these three conditions. According to a survey conducted by IBM, where they interviewed more than 1,500 CEOs from 60 countries and 33 industries; creativity is what is needed for success [6]. Creativity has also been defined as one key source for competitive advantage as well as for organizations' continued existence. Authors [7, 8, 9, 10, 11] agree that the 21st century is based on knowledge, information and innovative economy. Organizations' success depends on employees' knowledge, experience, creative activity and qualification and emphasis is placed on continuous learning and research and development [12, 13].

Knowledge, information and also idea generation depends on "Data" which is a core element [14, 15, 16, 17] which today can be seen commonly in digital form. Digital data is a binary representation of physical concepts such as video, text and audio. Audio text or video's information that is stored as a series of binary characters, ones and zeros, or on and off values [18]. Most employees in the business world use digital data on their organizational computer systems and these digital data always affect their information, knowledge and creative behaviours. Therefore determining the relation between digital data, which is mostly used to represent text, video, and audio form, and computer-based idea generation to achieve higher organizational creativity can be critical for sustainable competitive advantage.

Based on what was mentioned above, this study intends to investigate the relation between digital data and computer-based idea generation. The empirical analysis presented here is based on a large sample of organizational computer users and employs a set of explanatory variables. The contribution of this paper is suggesting that certain digital data parameters are important to drive the creativity. The results presented in this paper can be useful for the

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competitive advantage of organizations and their survival in today's dynamic and complex business environment.

## II. THEORETICAL BACKGROUND OF THE WORK

Creativity has been defined in different ways by different people. For instance, creativity was defined as a developing process for novel and imaginative views about different situations by [19]. On the other hand, Luthans states that creativity is combining ideas and individual and group approaches in a new way[20]. Torrance defines creativity as the process in which one become sensitive to problems, shortages, gaps in knowledge, pressures, lack of harmonies, and others. After this, the next step is finding new solutions for the identified problems in the previous step as well as presenting hypotheses and testing them. After this, the communication of obtained results is executed [21].

Creativity moves from an individual employee level to the organizational level. This process encompasses employees being creative in their own work, which aid the further development of the creative idea that is then passed through others to enhance the organization's creativity [22]. Therefore, understanding what causes creativity to flourish and what may inhibit creativity is beneficial for organizational research. Creative ideas have the potential to add value to the organization. Both personal and contextual factors [23] can affect creative performance, so organizational psychology has placed most of its focus on determining which factors promote creative ideas.

On the one hand, there are a lot of individual and organizational barriers to creativity such as lack of mental focus, limitation, evaluation, pressure, competition, lack of motivation and skill experiences [24], lack of flexibility, external motivation and soacial skills[25], time pressure, cumbersome rules[26], confidence, lack of data, information, knowledge, inability to tolerate ambiguity and conflict[27].

On the other hand, organizational climate, culture, leadership, resources, skills, organizational structures and systems [28], inherent risk [29], job design [30, 31], support [32, 33], diversity [34, 35], safety [36, 37], resources [35, 38], dynamics [36, 37] and structural and systems [39, 40] can motivate individual, group and organizational creativity.

Data, information, knowledge and technologies which deal with them are like a double-edged sword that have double face profound effect on creativity in all levels of it [41, 42, 43, 44, 45, 46, 47, 48, 49].That is why these subjects became an interesting topic for individual, group and organizational creativity researchers (e.g.:[50, 51, 52, 53, 54, 55, 56;57, 58, 59, 60, 61, 62, 63, 64, 65;66, 67, 68, 69, 70, 71, 72, 73]).

Siemon, Rarog and Robra-Bissantz (2016) in their research entitled "Semi-Automated Questions as a Cognitive Stimulus in Idea Generation" by assumption of importance role of textual data in creative idea generation have designed and implemented an innovative creativity support system, which stimulates an user during the stage of idea generation [50]. Varshney et al. (2013) in a study entitled "Cognition as a part of computational creativity" considered the relation between computational creativity

and computing and analytic. They stressed the important role of a knowledge base in creative computing system [64]. Jackson et al.(2012) examined the relation between information technology application by children and their creativity. These researchers considered application of 4 types of Information technologies:1) computer, 2) internet, 3) video games and 4) mobile. Jackson and his colleagues have showed that playing video games have a significant effect on creative actions of children. The researchers suggested that video game designers should consider various aspects of stimulating creativity such as visual and audio features [63].Becker, Bergener and Voigt (2010) in their study stated that Creative work is often conducted in distributed groups. Therefore, information exchange is frequently facilitated by groupware systems. However, group work suffers from several losses such as information overload, production blocking, free riding, evaluation apprehension and production matching and yet has not been tailored to the need of creative work. In order to reduce these losses and to best support creative group processes (CGP),they propose a framework which combines a) the stages of the creative process, b) the potential losses of creative group processes and c) different media characteristics drawn from the Media Synchronicity Theory to formulate groupware design principles [71].

Sharon Thompson-Schill et al.(2013), Jonathan Schooler et al.(2003), Jonathan Schooler et al.(2003), Ravi Mehta and Rui (Juliet) Zhu(2012), Beeman et al.(2004), Limb & Braun(2008), and Siyuan Liu et al.(2012) were among the researchers in the field of neurology and medicine that examined the effect of different type of data (visual, audio and textual data) on human brain and its idea generation process[74, 75, 76, 77, 78, 79].

## III. THEORETICAL FRAMEWORK

In this study, there is one general independent variable: digital data, and three independent variables: textual data, visual data and audio data. The dependent variable is computer-based creative idea generation. Figure 1 displays the research variables and the related dimensions considered in the theoretical framework.

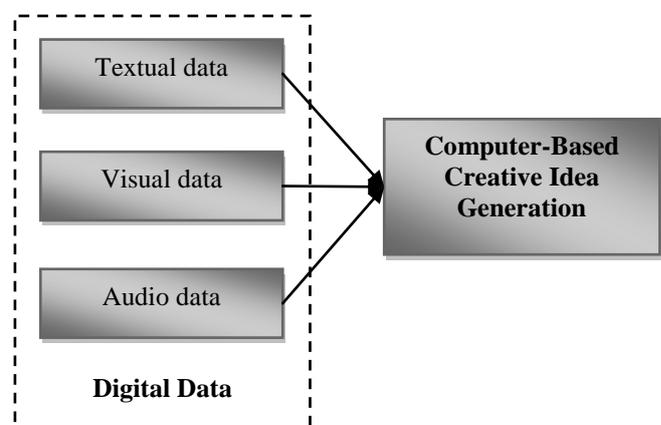


Figure 1: Research's Theoretical Framework

## IV. RESEARCH METHODOLOFY

This research from the consequent perspective is decision-oriented. According to the data collection method is a kind

of survey that is descriptive. According to the data analysis, this research is a correlation research. The independent variable computer-based creative idea generation was considered to have a relationship textual data, virtual data, and audio data independent variables. Based on theoretical framework the following set of hypotheses was developed for this research:

- **H1:** There is meaningful relationship between various visual data and computer-based creative idea generation.
- **H2:** There is meaningful relationship between various textual data and computer-based creative idea generation.
- **H3:** There is meaningful relationship between various audio data and computer-based creative idea generation.

A questionnaire was developed based on the theoretical framework, designed to be answered on a Likert scale and with a few demographic questions. In order to assess the validity and content validity of the questionnaire, experts and professors were used to better validate the results and make the questionnaire reliable. The study showed Cronbach's alpha coefficient of 0.826, which indicates high reliability and optimal scale used for assessment of the research. The data were collected by means of online questionnaire by Spread sheets.google.com; one of the most popular tools which Google site offer to organizational computer users. The survey sample consisted of Iranian organizational computer users. The sampling technique is cluster and random together. The responses of this electronic questionnaire were anonymous and without any monetary incentives offer. The data gathered at 6 month limitation. In this term, 1270 people responded to the questionnaire. Not to mention according to Cochran formula and considering the unlimited community samples above 384 are sufficient.

## V. RESULTS

### V.I. Descriptive Research Findings

The numbers of participants in this study were 1270 Iranian organizational computer users. Due to the gender prevalence, 58.8% were male and 41.2% were female. Also in terms of age, the collected sample shows that the largest number of frequency samples belongs to the 21-30 years old range, in which 43% of the participants were 21-30 years old. The frequency distribution of data shows that 31% of the participants daily use computer and information systems for a period of 5-10 hours, while 22.8% of them use them for a period of 3-5 hours every day. Moreover, 76.9% of these Iranian organizational computer users believe they are capable of creative idea generation while 23.1% believe they are not. Further details of the frequency distribution and percentages of demographic variables can be seen in Table 1.

**Table 1:** Frequency distribution and percentages of demographic variables

		Frequency	Percent	Valid Percent	Cumulative Percent	
Gender	Valid	Woman	523	41.2	41.2	41.2
		Man	747	58.8	58.8	100.0
		Total	1270	100.0	100.0	
Age	Valid	Lower Than 20 Year Old	48	3.8	3.8	3.8
		21-30 Year Old	546	43.0	43.0	46.8
		31-40 Year Old	503	39.6	39.6	86.4
		41-50 Year Old	148	11.7	11.7	98.0
		51-60 Year Old	22	1.7	1.7	99.8
		Higher Than 60 Year Old	3	.2	.2	100.0
		Total	1270	100.0	100.0	
Rate of Computer and Information Systems Usage Per Day	Valid	Less Than 1 Hour	149	11.7	12.6	12.6
		1-3 Hours	238	18.7	20.1	32.6
		3-5 Hours	289	22.8	24.4	57.0
		5-10 Hours	394	31.0	33.2	90.2
		More Than 10 Hours	116	9.1	9.8	100.0
		Total	1186	93.4	100.0	
Missing	I Have No Idea	84	6.6			
Total		1270	100.0			
Creative Idea Generation Ability	Valid	Yes	977	76.9	76.9	76.9
		No	293	23.1	23.1	100.0
		Total	1270	100.0	100.0	

Table 2 represent the descriptive analysis for dependent and independent variables. Frequency distribution of dependent variable data show that 32.5% of participants admitted that computer-based creative idea generation level is "Middle" and 22% found it "High", 16.2% "Low", 15.7% "Very Low" and finally 6.8% of the participants in this research believed it happen "Very High". Also the descriptive analysis for independent variables show that 34.4% of participates have "Middle" level of visual data in them computer and information systems while 37.2% of them have "Very Low" level of audio data in them systems and 36% on these organizational computer users face "High" level of textual data on them computer and information systems.

**Table 2:** Frequency distribution and percentages of dependent and independent variables or research

		Frequency	Percent	Valid Percent	Cumulative Percent	
Various Visual Data	Valid	Very Low	204	16.1	16.7	16.7
		Low	272	21.4	22.3	39.1
		Middle	437	34.4	35.9	75.0
		High	238	18.7	19.5	94.5
		Very High	67	5.3	5.5	100.0
		Total	1218	95.9	100.0	
		Missing	I Have No Idea	52	4.1	
Total		1270	100.0			
various Textual Data	Valid	Very Low	79	6.2	6.3	6.3
		Low	168	13.2	13.5	19.8
		Middle	396	31.2	31.7	51.5
		High	457	36.0	36.6	88.1
		Very High	149	11.7	11.9	100.0
		Total	1249	98.3	100.0	
Missing	I Have No Idea	21	1.7			
Total		1270	100.0			
Various Audio Data	Valid	Very Low	473	37.2	39.3	39.3
		Low	322	25.4	26.7	66.0
		Middle	257	20.2	21.3	87.3
		High	111	8.7	9.2	96.5
		Very High	42	3.3	3.5	100.0
		Total	1205	94.9	100.0	
Missing	I Have No Idea	65	5.1			
Total		1270	100.0			
Computer-Based Creative Idea Generation	Valid	Very Low	199	15.7	17.2	17.2
		Low	206	16.2	17.8	34.9
		Middle	413	32.5	35.6	70.6
		High	255	20.1	22.0	92.6
		Very High	86	6.8	7.4	100.0
		Total	1159	91.3	100.0	
		Missing	I Have No Idea	111	8.7	
Total		1270	100.0			

## V.II. RESULTS OF ANALYTICAL RESEARCH

Since the sample size of this study is very large (1270 person), it turns out that the distribution of data is normal. Given that the distribution of data is normal for all variables in the society, the Pearson correlation coefficient was used to analyze the relationship between variables. The results of computing the correlation coefficient between the variables is shown in Table 3. Given that the “Sig” is less than the significance level (0.01) significant relationship between the variables in the model is proved.

**Table 3:** Pearson correlation test for research variables

			Computer-based Creative Idea Generation
Pearson Correlation	<b>Various Visual</b>		.299**
Sig. (2-tailed)	<b>Data</b>		.000
N			1127
Pearson Correlation	<b>Various Textual</b>		.285**
Sig. (2-tailed)	<b>Data</b>		.000
N			1144
Pearson Correlation	<b>Various Audio</b>		.093**
Sig. (2-tailed)	<b>Data</b>		.002
N			1113

\*\* . Correlation is significant at the 0.01 level (2-tailed).

To analyze the impact of each independent variable to predict the dependent variable linear regression equation for the relationships outlined in the model is calculated. According to Table 4, the Durbin-Watson d = 1.808 is between the two critical values of  $1.5 < d < 2.5$  and therefore we can assume that there is no first order linear auto-correlation in the data. Also, we found that the adjusted R<sup>2</sup> of our model is .126 with the R<sup>2</sup> = .128 that means that the linear regression explains 12.8% of the variance in the data.

**Table 4:** Model summary table

Model Summary <sup>b</sup>					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.358 <sup>a</sup>	.128	.126	1.084	1.808

Table 5 indicates the F-test. The linear regression's F-test has the null hypothesis that there is no linear relationship between the two variables (in other words R<sup>2</sup>=0). With F = 53.169 and 1088 degrees of freedom the test is highly significant, thus we can assume that there is a linear relationship between the variables in our model.

**Table 5:** The linear regression's F-test

ANOVA <sup>a</sup>					
Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	187.319	3	62.440	53.169	.000 <sup>b</sup>
1 Residual	12741.193	1085	1.174		
Total	1461.511	1088			

The Table 6 shows the regression coefficients, the intercept and the significance of all coefficients and the

intercept in the model. We find that our linear regression analysis estimates the linear regression function to be:

$$y = 1.398 + 0.263(\text{various visual data}) + 0.223(\text{various textual data}) - 0.008(\text{various audio data})$$

Also according to table 6, the coefficient for Various Visual Data (0.263) is significantly different from 0 because its p-value is 0.000, which is smaller than 0.05. The coefficient for Various Textual Data (0.223) is significantly different from 0 because its p-value is 0.000, which is smaller than 0.05. The coefficient for Various Audio Data (-0.008) is not statistically significantly different from 0 as its p-value is 0.803, which is larger than 0.05. The intercept is significantly different from 0 at the 0.05 alpha levels.

**Table 6:** Simple linear regression coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	1.398	.132		10.582	.000
Various Visual Data	.263	.034	.247	7.823	.000
Various Textual Data	.223	.035	.192	6.394	.000
Various Audio Data	-.008	.031	-.007	-.249	.803

## VI. CONCLUSION

The main idea behind this paper was to analyse if digital data, such as Text, Video and Audio, affects computer based idea generation or creativity which is being recognised as one key factor for the long term sustainability of organisations and businesses. In order to verify this relation, it was decided to develop a questionnaire with answers designed using the Likert Scale. Furthermore, to make the study more credible the chosen target population is Iranian computer users that work with organizational computer systems.

The findings proved that textual, audio and visual digital data have a positive and meaningful relationship with employees' computer-based creative idea generation. The results described in this paper demonstrate that certain digital data parameters are important to drive creativity.

Therefore, it can also be concluded that the results obtained in the work described in this paper is important to increase the competitive advantage of organizations and their survival in today's dynamic and complex business environment.

## References

- [1] J. B. Barney, Gaining and sustaining competitive advantage, M.A.: Adison Wesley, Reading, 1999.
- [2] F. Mata, W. Fuerst and J. Barney, "Information Technology and Sustained Competitive Advantage: a Resource Based Analyses," *MIS Quarterly*, p. 19, 1995.
- [3] M. E. Porter, Competitive Advantage: Techniques for Analyzing Industrial and Competitors, New York: Free Press, 1980.
- [4] M. Hakkak and M. Ghodsi, "DEVELOPMENT OF A SUSTAINABLE COMPETITIVE ADVANTAGE

- MODELBASED ON BALANCED SCORECARD,” *International Journal of Asian Social*, vol. 5, no. 5, pp. 298-308, 2015.
- [5] M. Porter, *The Competitive Advantage of Nations*, N.Y.: The Free Press, 1990.
- [6] S. Tomasco, “IBM 2010 Global CEO Study: Creativity Selected as Most Crucial Factor for Future Success,” 18 05 2010. [Online]. Available: <http://www-03.ibm.com/press/us/en/pressrelease/31670.wss>. [Accessed 19 09 2016].
- [7] F. Bartes, *Paradigma inovací a hodnotové inženýrství*, Brno: V UT, 2009.
- [8] G. Hamel and B. Green, *The Future of Management*, Boston: Harvard Business School Press, 2007.
- [9] P. Senge, *Pátá disciplína – Teorie a praxe učící se organizace*, Praha: Management Press, 2007.
- [10] J. Barták, *Skrýté bohatství firmy*, Praha: Alfa, 2006.
- [11] C. Collison, *Knowledge management*, Brno: Computer Press, 2005.
- [12] H. Urbancová, “Competitive Advantage Achievement through Innovation and Knowledge,” *Journal of Competitiveness*, vol. 5, no. 1, pp. 82-96, 2013.
- [13] T. Karami, *The first blogger festival*, vol. 3, no. 4, 2005.
- [14] J. Rosenblum, “Why Creative Teams Need to Make 'Sweet Love' with Data,” 24 08 2016. [Online]. Available: <http://adage.com/article/digitalnext/creative-teams-embrace-data/305572/>. [Accessed 19 09 2016].
- [15] C. Wei Choo, *Information Management for the Intelligent Organization: The Art of Scanning the Environment*, Information Today, Inc., 2002.
- [16] I. Romero and J. A. Martine-Roman, “Self-employment and innovation. Exploring the determinants of innovative behaviour in small business,” *Research Policy*, vol. 4, no. 1, pp. 178-189, 2012.
- [17] K. Hoffman, M. Parejo, J. Bessant and L. .. Perren, “Small firms, R&D, technology and innovation in the UK: A literature review,” *Technovation*, vol. 18, no. 1, pp. 39-55, 1998.
- [18] techopedia, “Digital Data,” [Online]. Available: <https://www.techopedia.com/definition/24872/digital-data>. [Accessed 19 09 2016].
- [19] Moorhead and Griffin, *Organizational behaviour*, 10th edition ed., Tehran: Morvarid Publication, 2005.
- [20] S. Kalantarian, S. Nargesi and S. Gholami, “Relationship among entrepreneurship, creativity and innovation,” *entrepreneurship and business management knowledge-based National Conference*, pp. 3-12, 2011.
- [21] E. P. Torrance, *The Torrance Tests of Creative Thinking-Norms-Technical Manual Research Edition-Verbal Tests, Forms A and B-Figural Tests, Forms A and B.*, Princeton NJ: Personnel Press, 1966.
- [22] C. E. Shalley, Z. J. and G. R. Oldham, “The Effects of Personal and Contextual Characteristics on Creativity: Where Should We Go from Here?,” *Journal of Management*, 30,, vol. 30, no. 6, pp. 933-958, 2004.
- [23] J. Zhou and C. E. Shalley, *Handbook of Organizational Creativity*, New York: Taylor & Francis Group, 2008.
- [24] A. Kazemi and A. Shakiba, “Considering effective factors on development of innovation, creativity and entrepreneurship,” 2007.
- [25] F. r. Haghghi, N. Jahdi, S. Khajeh eem moghaddam and A. Najaba, *Creativity and problem-solving methods*, Tehran: Kelishe Publication.
- [26] R. Talei far , H. Hatami nasab and A. Khosh kholgh dastaki, “Considering management views about organizational creativity barriers and its relationship with demographic variables,” vol. 4, no. 10, pp. 169-193, 2010.
- [27] S. Haghayegh, “features of creative and innovative industrial organizations,” *Tadbir*, vol. 111, pp. 22-27, 1380.
- [28] C. Andriopoulos, “Determinants of organizational creativity: a literature review,” *Management Decision*, vol. 39, no. 10, pp. 834- 840, 2001.
- [29] R. J. Sternberg, L. A. O'Hara and T. I. Lubart., “Creativity as investment,” *California Management Review*, vol. 40, pp. 8-21, 1997.
- [30] J. L. Farr, *Facilitating individual role innovation*, West, M. & Farr, J. L. (eds.) *Innovation and creativity at work*. ed., Jone Wiley and Sons Ltd., 1990.
- [31] A. Cummings and G. R. Oldham, “ Enhancing creativity: Managing work contexts for the high potential employee,” *California Management Review*, pp. 22-38, 1997.
- [32] J. Zhou and J. M. George, “ When job dissatisfaction leads to creativity: Encouraging the expression of voice,” *Academy of Management journal*, vol. 44, no. 4, pp. 682-696, 2001.
- [33] G. Ekvall, “Organizational Climate for Creativity and Innovation,” *European Journal of Work & Organizational Psychology*, vol. 5, no. 1, pp. 105-123, 1996.
- [34] L. Cummings, “Organizational Climates for Creativity,” *The Academy of Management Journal*, vol. 8, no. 3, pp. 220-227, 1965.
- [35] T. M. Amabile, “ How to kill creativity.,” *Harvard Business Review*, vol. 76, no. September/October, pp. 76-87, 1998.
- [36] N. Anderson, G. Hardy and M. West, “Management Team Innovation,” *Management Decision*, vol. 30, no. 2, 1992.
- [37] G. Dutton, “ Enhancing creativity,” *Management Review*, vol. 85, p. 44, 1996.
- [38] S. Ohly, S. Sonnentag and F. Pluntke, “Routinization, work characteristics and their relationships with creative and proactive behaviors,” *Journal of*

- Organizational Behavior*, vol. 27, no. 3, pp. 257-279, 2006.
- [39] S. Williams, "Increasing employees' creativity by training their managers," *Industrial and Commercial Training*, vol. 33, no. 2, pp. 63-68, 2001.
- [40] C. Andriopoulos, "Determinants of organisational creativity: A literature review," *Management Decision*, vol. 39, no. 10, pp. 834-841, 2001.
- [41] S. E. Caplan, Problematic internet use in the workplace, T. S. H. Teo and C. A. Simmers, Eds., New York: Armonk, 2006.
- [42] K. Dibben, "Hi-tech crime: phones hit by virus," *The Sunday mail*, vol. June, no. 28, p. 27, 2009.
- [43] T. Abraham and L. W. Boone, "Computer-Based Systems and Organizational Decision Making: An Architecture to Support Organizational Innovation," *Creativity Research Journal*, vol. April/May, pp. 111-123, 1994.
- [44] J. R. Evans, *Creative Thinking in the Decision and Management Sciences*, Cincinnati, OH.: South-Western Publishing, 1991.
- [45] S. Winship, "Packages Stimulate Creative Process, Buyers Say," *PC Week*, vol. 23, no. 1, pp. 109-110, 18 March 1991.
- [46] A. VanGundy, *IdeaPower*, New York, NY: American Management Association, 1992.
- [47] G. M. Marakas and J. J. Elam, "Creativity enhancement in problem solving: through software or process?," *Management Science*, vol. 43, no. 8, pp. 1136-1146, 1997.
- [48] D. Dayton, "Idea Generators Spark New Solutions," *PC Week*, vol. March, pp. 109-110, 1991.
- [49] L. Young, *Decision Support and Idea Processing Systems*, Dubuque, IA.: WC Brown, 1989.
- [50] D. Siemon, T. Rarog and S. Robra-Bissantz, "Semi-Automated Questions as a Cognitive Stimulus in Idea Generation," in *2016 49th Hawaii International Conference on System Sciences (HICSS)*, Hawaii, 2016.
- [51] A. Gabriel, D. Monticolo, M. Camargo and M. Bourgault, "Creativity Support Systems: A Systematic Mapping Study," *Thinking Skills and Creativity*, vol. 21, pp. 109-122, 2016.
- [52] F. Ulrich, "A Group Creativity Support System for Dynamic Idea Evaluation," in *The Sixth Scandinavian Conference on Information Systems (SCIS 2015)*, Oulu, Finland, 2015.
- [53] F. Ulrich, *IMAGINATION FROM EVALUATION: A DESIGN THEORY FOR CREATIVITY ENHANCING*, Denmark: Aalborg Universitetsforlag, 2016.
- [54] C. M. Olszak and J. Kisielnicki, "Organizational Creativity and IT-based Support," *Informing Science: the International Journal of an Emerging Transdiscipline*, vol. 19, pp. 103-123, 2016.
- [55] P.-J. Cheng, "Development of a mobile app for generating creative ideas based on exploring designers' on-line resource searching and retrieval behavior," *Design Studies*, vol. 44, pp. 74-99, 2016.
- [56] G. R. Oldham and N. Da Silva, "The impact of digital technology on the generation and implementation of creative ideas in the workplace," *Computers in Human Behavior*, vol. 42, pp. 5-11, 2015.
- [57] K. Muldner and W. Burleson, "Utilizing sensor data to model students' creativity in a digital environment," *Computers in Human Behavior*, vol. 42, pp. 127-137, 2015.
- [58] L. S. Chechurin, W. W. Wits and H. M. Bakker, "Invention software support by integrating function and mathematical modeling," *Chemical Engineering Research and Design*, vol. 103, p. 32-39, 2015.
- [59] A. Ivanov and D. Cyr, "Satisfaction with outcome and process from web-based meetings for idea generation and selection: The roles of instrumentality, enjoyment, and interface design," *Telematics and Informatics*, vol. 31, no. 4, pp. 543-558, 2014.
- [60] M. Voigt, "Improving Design of Systems Supporting Creativity-intensive Processes—A Cross-industry Focus Group Evaluation," *Communications of the Association for Information Systems*, vol. 34, no. 1, p. 86, 2014.
- [61] D. W. I. M. Voigt, K. Bergener and J. Becker, "Comprehensive Support for Creativity-Intensive Processes," *Business & Information Systems Engineering*, vol. 5, no. 4, pp. 227-242, 2013.
- [62] M. Voigt, B. Niehaves and J. Becker, *Towards a unified design theory for creativity support systems. In Design Science Research in Information Systems. Advances in Theory and Practice*, Springer: Berlin Heidelberg, 2012, pp. 152-173.
- [63] L. A. Jackson, E. A. Witt, A. I. Games, H. E. Fitzgerald, A. von Eye and Y. Zhao, "Information technology use and creativity: Findings from the Children and Technology Project," *Computers in human behavior*, vol. 28, no. 3, pp. 370-376, 2012.
- [64] L. R. Varshney, F. Pinel, K. R. Varshney, A. Schörgendorfer and Y. M. Chee, "Cognition as a part of computational creativity," in *12th IEEE International Conference on Cognitive Informatics & Cognitive Computing (ICCICC)*, New York, 2013.
- [65] S. D. Muller and F. Ulrich, "Creativity and information systems in a hypercompetitive environment: A literature review," *Communications of the Association for Information Systems (CAIS)*, vol. 32, no. 1, pp. 175-201, 2013.
- [66] S. Vijayarani and S. Radjamanogary, "Motivating Employees Creativity through Suggestion System – An Empirical Study," *Journal of Business and Management*, vol. 9, no. 2, pp. 22-27, 2013.
- [67] V. Santos, L. Amaral and H. Mamede, "Information Systems Planning-How to Enhance Creativity?," in *International Conference on ENTERprise Information Systems*, Berlin Heidelberg, Springer, 2011, pp. 398-407.
- [68] F. Müller-Wienbergen, O. Müller, S. Seidel and J. Becker, "Leaving the beaten tracks in creative work-a

design theory for systems that support convergent and divergent thinking,” *Journal of the Association for Information Systems*, vol. 12, no. 11, pp. 714-740, 2011.

- [69] S. Seidel, F. Müller-Wienbergen and J. Becker, “The Concept of Creativity in the Information Systems Discipline: Past, Present, and Prospects,” *Communications of the Association for Information Systems*, vol. 27, no. 1, pp. 217-242, 2010.
- [70] H. Yuhashi and I. Junichi, “The Power to Activate a Creative Core in Enterprise,” *Pacific Asia Journal of the Association for Information Systems*, vol. 2, no. 2, 2010.
- [71] J. Becker, K. Bergener and M. Voigt, “ Supporting Creative Group Processes: Design Principles for Appropriate Groupware,” in *ECIS 2010*, 2010.
- [72] F. Forster, “Improving creative thinking abilities using a generic collaborative creativity support system,” *Research, reflections and innovations in integrating ICT in education*, pp. 539-543, 2009.
- [73] T. T. Hewett, “Informing the design of computer-based environments to support creativity,” *Int. J. Human-Computer Studies*, vol. 63, no. 4, p. 383–409, 2005.
- [74] E. G. Chrysikouab, R. H. Hamiltonc, H. B. Coslett, A. Dattad, M. Biksond and S. L. Thompson-Schill, “Noninvasive Transcranial Direct Current Stimulation Over the Left Prefrontal Cortex Facilitates Cognitive Flexibility in Tool Use,” *Cognitive Neuroscience*, vol. 4, no. 2, pp. 81-89, 2013.
- [75] S. Liu, H. M. Chow, Y. Xu, M. G. Erkkinen, K. E. Swett and M. W. Eagle, “Neural Correlates of Lyrical Improvisation: An fMRI Study of Freestyle Rap,” Nature Publishing Group, 2012.
- [76] C. Limb and A. Braun, “Neural Substrates of Spontaneous Musical Performance: An fMRI Study of Jazz Improvisation,” *PLoS ONE*, vol. 3, no. 2, p. e1679, 2008.
- [77] A. W. Flaherty, “FRONTOTEMPORAL AND DOPAMINERGIC CONTROL OF IDEA GENERATION AND CREATIVE DRIVE,” *The Journal of comparative neurology*, vol. 493, no. 1, p. 147–153, 2005.
- [78] B. Baird, J. Smallwood, M. D. Mrazek, J. W. Y. Kam, M. S. Franklin and J. W. Schooler, “Inspired by Distraction :Mind Wandering Facilitates Creative Incubation,” *Psychological Science*, vol. 23, p. 1117–1122, 2012.
- [79] M. Jung-Beeman, E. M. Bowden, J. Haberman, J. L. Frymiare, S. Arambel-Liu, R. Greenblatt, P. J. Reber and J. Kounios, “Neural Activity When People Solve Verbal Problems with Insight,” *PLoS Biolo*, vol. 2, no. 4, pp. 500-510, 2004.