

# STATISTICS AND MATHEMATICAL ANALYSIS OF THE ROLE OF RESEARCH IN CREATIVITY AND INNOVATION FOR ECONOMIC GROWTH OF BUSINESS SECTOR

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## ARTICLE INFO

Article History:  
Received: 10 Jan 2020  
Revised: 12 May 2020  
Accepted: 20 Jun 2020  
Available Online: 10 Jul 2020

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## ABSTRACT

*The Aim of the present paper is to explain in detail the concepts of creativity and innovation from the point of view of the economic growth of Business Sector. The purpose is to highlight the design thinking process as related to the leadership of the organization. The concept of corporate innovation has been discussed at length. Also, the significance of creativity at workplace has been highlighted. The methodology is based on the (i) Mathematical Modeling and optimization of Creativity and Innovation in terms of the expressions for Creativity, Innovation, and Research; and (ii) the Findings of the Researchers given in literature; and finally to suggest an Empirical and Statistical relationship between the two. The implications of the paper should be useful for the Leaders in Business Sector and the Researchers in this field, and encourage them to follow and observe the related norms at the work place by motivating the employees to understand the significance and importance of Creativity and innovation, and then following it's objectives very sincerely in their efforts for improving the economic growth of their Business concern. The other important implication and impact of this paper is to motivate the Business managers to have well designed Departments for constantly observing the growth as a function of these Parameters for taking appropriate corrective steps for it.*

**KEYWORDS:** Creativity and Innovation, Design Thinking, Business Sector, Invention risk-taking, and Research for Economic Growth

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## 1. INTRODUCTION

The concepts of creativity and innovation are so close, and yet so far from each other. It has been established, that creativity is not measurable. However, the Performance has to be measured, in order to identify the appearance of success. In the modern continuously changing world, the Business companies have to find out the difference between the two. Researchers have tried to differentiate between the two on the basis of Focus. Some important studies on the Topic ( Chopra, 2015, 2018, Krueger and Killham ,2007; Massoudi ; and Wood, 2013) have been reported.

## 2. SIGNIFICANCE OF THE STUDY

The significance of this study is to emphasize the role of Research on Creativity and Innovation for the Economic Growth of the Business Sector.

### 2.2 Creativity and Innovation

Creativity is measured in terms of the ability of mind's potential and ability to conceive new ideas and directions for the business, which can be considered in various ways like seeing or feeling, or even as experiments going in human mind. Creativity, on the other hand, is subjective, and really difficult to be measured or computed. However, Innovation can be easily measured in terms of (i) any change in relatively stable systems, or (ii) the work required to put an idea into practice. Most importantly, it is done by identifying an unrecognized requirement of an organisation by applying it's creative resources for designing a suitable solution, and then reaping a return for it's investment. As is observed, the organisations have a strong tendency to follow creativity, though the right approach for them should be to emphasize on innovation. It

has been recommended by Theodore Levitt - putting ideas to work, as stated "What is often lacking is not creativity in the idea-creating sense but innovation in the action-producing sense, i.e. putting ideas to work."

The real significance of this study is that the methodology based on the results of the Research efforts on creativity and innovation on the economic growth will motivate the Business Management Groups to invest more human effort and finances in the Research on these Parameters, which are so necessary for the further growth of the Business Economy. It has been understood that it is not possible to force innovation within an organisation, as it is either there or completely absent. Innovation, mostly considered as design thinking, makes it possible for the organisations to establish and measure milestones in their innovative efforts. In this technique, it is required to understand it as a system of overlapping spaces, and not as a set of process steps for moving forward. The spaces are (i) INSPIRATION, in which the problem motivating the solution- finding is identified, (ii) IDEATION, in which the ideas are generated and developed, and (iii) IMPLEMENTATION, in which the design thinking- based project team explores, develops, and implements its idea. In fact, the Design thinking gives a good approach for defining challenges, and also helps the organisations in identifying the problems by brainstorming sessions mostly associated with creativity. This helps the organisations in knowing what they were missing in the near past.

Another advantage of using design thinking is that the organisations can make use of creativity by analysing the life of the idea after developing it. The applied creativity is useful only if it leads to innovation, by linking a great idea with an actual customer need or even needs of a whole market. However, this exercise requires the guidance of engaged leadership. It is imperative to have dedicated Leaders for ensuring the success of any group's long-term innovation strategy. They have to see that innovation is constantly followed, and their employees also pursue it sincerely. Organisations seriously doing innovation have to be deeply concerned with risk-taking and failure aversion, as innovations are invariably involving risk, including the possibility of failure. Failures should not disappoint leaders, as they invariably teach something useful for further planning. Leaders must incorporate the innovations without any fear of failure. Design thinking shows a direction to risk-taking, which can be managed for maximizing the effectiveness of the new idea. We know that innovation is connected with something novel and different. It is good for the consistently innovative companies to pay attention to the industries involved in similar trade, which helps them for achieving their strategic goals. Most successful companies are investing a considerable amount of their profit into doing innovation. Though Creativity is important in modern business world, it is just the beginning, and the Organisation must foster creativity. To conclude, Creativity is the price of admission, but it is the innovation, which has to pay for the bills incurred in it.

### **3. RESEARCH GAP**

It is quite surprising for the Business Researchers to note that there is a considerable gap between the research efforts conducted so far on the impact of research in creativity and innovation on the economic growth and those required for this purpose. To fill this gap, the Researchers need to pose many questions in order to meet their objectives, including those given below:

### **4. RESEARCH QUESTIONS AND OBJECTIVES ON CREATIVITY AND INCORPORATE INNOVATIONS**

The researcher on this interesting topic has to consider answers to various questions on Creativity and Corporate Innovations, described below:

- Creativity refers to the techniques, which encourage creative actions, in all fields including arts and sciences. The researchers focus on various aspects of creativity, like the techniques for generating ideas and thinking methods of reframing and reshaping problems.
- Though some techniques require groups of persons, some others can also be done by a single person. Some of these techniques are like word games, different types of improvisation, algorithms for solving the problems, and even techniques exploiting randomness.
- McKinsey has published an interesting report, according to which about 80% of business executives are of the opinion that the present businesses models are at risk. Also, about 84% believe that innovation is a crucial factor of their economic growth strategy, and a mere 6% are satisfied with their present innovation performance.

It has also been observed that the companies are investing in innovation, so that they don't lag behind their potential competitors, and move ahead of them. Many interesting corporate innovation facts have been observed, which show the development and improvements of innovation in recent years. It is absolutely necessary for the companies to do innovation for keeping them above their competitors. The early adopters have started to adapt to a new model of innovation. Companies have gradually started to change from inward-focused innovation to open innovation, since the Entrepreneurs have realized that the environment around them can be efficiently used for their benefit. They aim to follow new ideas, technologies and external talents from their competitors. There is still a way to go, but the attitude is shifting toward a more sustainable and collaborative attitude. Though, we can use a lot of data and analytics to process, as

a solid ground for future improvement recommendations; and also use statistical data to collect information from around the world, for subsequent comparing it with the present situation. In fact, we can use them to predict or direct the future. Therefore, we can analyze the relevant innovation-related statistics from well-known experts, and provide some conclusions and guidance on best practices in this area. Some of these observations are as:

It is interesting to note that the Worldwide Research and Development expenditure among the world's 1000 largest corporate Research and Development increased by 11.4 percent in 2018 to \$782 billion. As given by Statista, Amazon tops the list of the 20 companies having highest expenditure on Research and Development at \$22.6bil, which is 41% more than in 2016. Even the Industry giant like IBM, in 2018, was the most innovative company in the world with 9,100 patents including the patents for artificial intelligence, block chain, cloud computing, and quantum computing. It is really important to note that a case study has reported that 84% of customers feel that it is very important that the company they buy from is innovative. Another interesting fact has been reported that the PWC's annual Global innovation 1000 report has not found any statistical evidence to show any correlation between money spent on Research and Development and financial performance. This logically implies that it is how we spend the money, rather than how much we spend, is important and effective.

## **5. IMPORTANCE OF CREATIVITY AT WORKPLACE**

The importance of creativity for work is clear from the following points:

It has been emphasized that Creativity is the single most important skill (Linkdin, 2019) in the world. 94% of hiring managers are of the opinion that it is important to consider creativity when selecting (Adobe, 2014) a job candidate. It is again very interesting to note that 35% of workers (Gallup 2017 American Workplace Survey) are given time to be creative at work a few times per year. CEOs of IBM (IBM Report) say that creativity is the top most factor for future success. Interviewers doing Recruitment (Bloomberg Businessweek) consider the creative problem solving as very important and most difficult skill to find among job applicants. 78% of college-educated workers over 25 wish (Adobe, Hiring for the Future, 2014) that they had more creative ability. A good example of creative works is that of Leonardo Da Vinci, who is well known for his creative works. It has been considered that Creativity has been associated with right or forehead brain activity, or even more importantly with lateral thinking. Some researchers of creativity have emphasized that there is an element of chance in the creative process. According to Guru of Creativity, Linus Pauling, Creativity is an endeavor for coming up with many ideas, and then discarding the useless ones, one by one to reach the optimum idea. Another important definition of creativity is that it is a process involving assumptions-breaking, since Creative ideas are mostly generated when we go on discarding the preconceived assumptions; and subsequently, attempt a new approach or method that might seem unthinkable to others.

## **6. MATHEMATICAL MODELING FOR RESEARCH DESIGN AND SOFTWARE**

The research design and software for the study are discussed below:

Creativity (C) may be expressed as a function of so many Parameters like Number of persons (N) involved in the Team, their respective Intelligence quotients (IQ), their past experience (PE), and Educational qualifications (EQ) as:

$$C = f(N, IQ, PE, EQ) \text{ --- (1)}$$

where each parameter has different weightage (importance) e.g. is generally more important than PE. By maximization technique of Differential Calculus, C can be maximized, by finding differential coefficient of various rates, and equating them to zero, for all the cases. In the same way, the Innovation (I) can be maximized, being dependent on mostly the same parameters (though weightages may be marginally different), I being given as:

$$I = f(N, IQ, PE, EQ) \text{ --- (2)}$$

In general, on a scale of 10, I is around 1, and C is in the range. 2.5-3.5. This is why, that we hardly find a new type of market as a result of innovation of some company, but after that innovation, there are so many firms making similar items out of their creativity. So the team can be chosen on the basis of these operations. Here, it has to be noted that the team leader has to use his experience and do some modeling to arrive at the perfect combination. This team has to be dynamic, and needs to be slightly changed at regular intervals of say, 6 months or 1 year, as all the Parameters are empirically chosen, and require adjustments to be carried out very carefully by the team leader on the basis of his constant critical watching the performance of the team. From another simpler point of view, we can consider creativity and innovation combined as nothing but a sort of Research. We have noticed that the great business houses invest a big part of their profits in Research for their economic growth, and the positive results make the other companies to follow this trend.

Research can just be considered as a function of creativity and innovation, as

$$Research = f(Creativity, Innovation) \text{ --- (3).}$$

The research input improves the performance of the firm by an amount given by:

$$ImprovedPerformance = InitialPerformance(1 + \alpha Research) \text{ --- (4).}$$

From the data available in the literature ( $\alpha Research$ ) is in the range 0.1 to 0.35, which means that the performance can be improved by 10% to 35%. Of course, this is only an empirical estimate.

Mathematical optimization or mathematical progress-review is done by selecting a best element, on the basis of some criterion from a given set of available alternatives. Optimization problems are encountered in all quantitative disciplines from computer science and engineering to operations research and economics: and the development of solution methods has been of interest in mathematics. In the simplest case, an optimization problem is in the form of maximizing or minimizing a real function by systematically choosing input values from within an allowed set and computing the value of the function. The generalization of optimization theory and techniques to other formulations constitutes a large area of applied mathematics. In general, optimization is just finding the best available values of some objective function in a defined domain (or input), including a variety of different types of objective functions and different types of domains. In this way, by applying the Optimization techniques, and using these equations, the optimum solution for creativity, innovation, and Research can be found. It may be noted that in this exercise, the leader's knowledge of various parameters of all individuals plays a very crucial part. However, this process is slightly Empirical in nature, and so only an approximate solution is possible. It is to be noted that these equations can be computed by the software developed by the Researchers working on the economics and statistics problems on the basis of some popular programs. However, some softwares based on Matlab and even some commercially available softwares can be used.

## **7. NEW RECENT SPURT IN THE RESEARCH ACTIVITY OF CREATIVITY AND INNOVATION**

Recently, with the better understanding the significance of the topic, a spurt (Creativity and Innovation, 2019,2020; International Journal of Design Creativity and Innovation, 2019,2020) in the studies connected with the subject has been observed. Pisanu and Menapace (2014) have done a literature review, and de-scribed the results of two decades of research on creativity and innovation in the educational and organisational field, to underline what seemed to work and what did not, to enable these processes function effectively. This study is based on one of the outputs of the European Commission funded project, named CLEAR (Creativity and innovation: pedagogical framework for the learning chain).

Forgeard and Kaufman (2015)

have presented a detailed review of the studied on Creativity and Innovation.

Very recently, more novel studies on this evolving topic

(Creativity and Innovation, 2019,2020; International Journal of Design Creativity and Innovation, 2019,2020; and Wiley Online Library, 2020), have been made.

Also, an international symposium (7th SYMPOSIUM ON CREATIVITY FOR SUSTAINABLE EDUCATION, April (20-21) 2020) on CREATIVITY FOR SUSTAINABLE EDUCATION is being held. Another Conference by the Creative Education Foundation (CEF, CPSI 2020), is going to be held in USA, which will focus on deliberations on creativity, innovation and change of leadership. CPSI aims to teach practical creativity skills and tools in an inspiring learning environment.

## **8. CLEAR STRONG CONCLUSION**

On the basis of the results available in the literature and the empirical analysis presented in this paper, it can be concluded that the research efforts on creativity and innovation can increase the economic growth of the business by 10% to 35%. Also on the basis of the spurt in the Studies on the topic in the last five years, it can be very clearly and strongly concluded that the importance of the topic and the interest of the researchers in this field are increasing very fast, and consequently, the subject is evolving very rapidly with Research efforts being made at regular intervals in the last decade.

## **9. ACKNOWLEDGEMENTS**

The author is grateful to Dr. Nand Kishore Garg, Chairman, Maharaja Agrasen Institute of Technology, GGSIP University, Delhi for providing the facilities for carrying out this research work, and also for his moral support. The author is thankful to Dr. M. L. Goyal, Vice Chairman for encouragement. Thanks are also due to Dr Neelam Sharma, Director, and Dr. V. K. Jain, Deputy Director for their support during the research work. The author is deeply indebted to Prof. Dr V.K.Tripathi of the Indian Institute of Technology, Delhi, and Sh.G.Krishnarao, Dean, ELOIRA, DRDO, Vignyana

Kancha, Hyderabad for their motivation to do research in this important and evolving area of Management Studies, and Economic Growth of the Business Sector.

## **REFERENCES**

Adobe, Hiring for the Future (2014).

Bloomberg Businessweek.

Chopra Kamal Nain, (2015) Mathematical Modeling on “Entrepreneurship Outperforming Innovation” for Efficient Performance of the Industry, AIMA Journal of Management and Research (AJMR) 9 , 1-10.

Chopra Kamal Nain, (2018), Technical Analysis and Overview of Creativity and Innovation, with emphasis on their Impact for improving the Business, Singaporean Journal of Business economics and management Studies, 6. 54-61

CPSI 2020 conference to be held in June 16-20, 2020, at the University at Buffalo in Buffalo, New York.

Creativity and Innovation, Edited By: Katharina Hölzle and Jennie Björk (Management), Online ISSN:1467-8691, © John Wiley & Sons Ltd Vol 28, Issue 4, December 2019, PP 421-575; and Vol 29, Issue 1, March 2020, PP 1-191.

Forgeard Marie and Kaufman Jsmes C., Who Cares About Imagination, Creativity, and Innovation, and Why? A Review in Psychology of Aesthetics Creativity and the Arts 10(3) · January 2015.

Gallup (2017) American Workplace Survey

IBM Report .

International Journal of Design Creativity and Innovation, (2019) Volume 7, and (2020) Volume 8.

Krueger Jerry and Killham Emily , (2007), The Innovation Equation Strengths development + engagement = innovation, according to a Gallup study,Business Journal (April 12, 2007).

LinkedIn Learning, (January 2019). Massoudi, Ari <http://management-of-innovation.over-blog.com/article-the-secret-magic-mathematic-formula-of-innovation-99318843.html>.

Pisanu Francesco and Menapace Paola , Creativity and Innovation: Four Key Issues from a Literature Review, Creative Education 5(03):145-154 · February 2014. DOI: 10.4236/ce.2014.530237

7th SYMPOSIUM ON CREATIVITY FOR SUSTAINABLE EDUCATION, (April 20,21 2020), Council for Creative Education (CCE) Finland.

Wiley online library (Baumgarth Carsten and Robert Rose, Katharina Hölzle and Jennie Björk, More than a quarter century of Creativity and Innovation Management: The journal's characteristics, evolution, and a look ahead, Pages: 5-20; First Published: 20 February 2020;

Guilherme Sette and Pedro Quelhas Brito, To what extent are digital influencers creative,First Published: 21 February 2020; and Katharina Hölzle ,Harry Boer and Jennie Björk, From past to present and beyond:New perspectives on creativity, collaboration, and innovation, Pages: 3-4 First published: 27 February 2020.).

Wood Charles M., (2015) 10 Hangs -On Exercises to Spark Student Creativity and Innovation, <https://venturewell.org/open2015/wp-content/uploads/2013/10/WOOD.pdf>.