

Variables Responsible for Innovation in Information Technology Sector: An Empirical Study

M. Vishwanath Pai^{1*}, Sureshramana Mayya², H.G. Joshi³

¹Department of Computer Science, M. G. M. College, Udipi-576102

² Department of Commerce, M.G.M College, Udipi-576102

³School of Management, Manipal Academy of Higher Education, Manipal – 576104

Available online at: www.ijcseonline.org

Accepted: 23/Jul/2018, Published: 31/July/2018

Abstract: Innovation is the key factor for an organization to be successful. Innovation is result of ‘out of the box thinking’ in an organization and is essential in this competitive world for its survival and to be successful. Innovation is not linear but multidimensional and complex. It is very important to identify the variables which are significant for innovation. In this paper both tangible and intangible variables which may have significant influence on innovation are identified and listed. An empirical study is carried out to find out the kind of influence each of the various identified variables have on innovation. Since no proper tool is available there is a need also to have a tool which is helpful in measuring the impact of various identified variables which may have significant influence on innovation. An instrument developed to measure the significance of each of the variables on innovation is presented in this paper. Cluster sampling technique is used for the empirical study and the respondents are professionals from the IT sector.

Keywords- Innovation, Information Technology, Tangible Variables, Intangible Variables, Innovation Measurement Instrument, Innovation Mechanism

I. INTRODUCTION

Organizations which do not innovate continuously will fail in the long run. Ample examples are there to prove this point. Conglomerates which did not innovate are now fighting for the survival and few of them are fast losing their relevance in the market. Organizations which respond to the opportunity and provide sufficient space to think and act out of the box will have the right tool to beat the competition and stay ahead of others.

There are many variables which contribute towards innovation and these are the mix of tangible and intangible in nature. Origin of innovation may cross the boundary of an organization and it could be an open environment.

Measuring the influence of intangible contributor is not straight forward. It may need aliases to interpret their influence.

Intangible and tangible contributors may be classified as follows:

- Characteristics of employees
- Characteristics of organizations
- Characteristics external to the organization and employees

Researches have ample proof to believe that both tangible and intangible characteristics will contribute to the emergence of innovation. But which of the tangible or intangible characteristics are responsible for the emergence of innovation is not clearly understood.

This research is aimed at finding out the tangible and intangible variables which may be responsible for driving innovation. In this paper various variables which may have significant influence on innovation is identified. With the help of empirical study the opinion about the influence of identified tangible and intangible variables are obtained from the professionals who are working in the different hierarchy in the software industry. Thus this research is resulted into a tool which can be used to measure the influence of different tangible and intangible variables on innovation in Information Technology sector.

Rest of the paper is organized as follows. Section I contains the literature review and it has resulted in identifying the list of tangible and intangible variables which may have significant influence on innovation. These identified variables have become the items of a questionnaire which is used to get the opinion of professionals working in the various hierarchies of software industry. In section II methodology used to find out the level of influence each of the identified tangible and intangible have on innovation is discussed. Section III contains the analysis of the responses

received. Inference obtained is discussed in section IV. Section V contains conclusion and future scope.

II. LITERATURE REVIEW

Innovation cannot be measured with a single indicator or it cannot be measured directly because it is not simple but is a complex and multidimensional activity [5].

- If innovation is to be successful many factors which are compliment to each other are essential and not just the technology but it is much more than that.
- Innovation's complex multiplicity feature cannot be captured adequately with a single measurement.
- Demand in the market determines the rate of investment and bringing out the new products. So this is also important in driving innovation.

It is understood that both tangible and intangible factors are responsible for innovation but since intangible assets are not present in the physical format, measuring influence of them is not a straight forward task. So the indirect measurement option is used. Substitution methods are formulated and they are characterized. Depending on the kind of control the companies have on the intangible assets, they can be categorized into three different categories [1] and they are listed as given below:

- Databases the companies build and the patents which are created are owned and controlled by the companies, so they may be separated and sold. These assets are at the discretion of the companies.
- Assets like Research and Development department and certain processes which are pertaining to organizations although are controlled and owned by the organizations, they may not be separated out and sold.
- Although the patents and processes are created by the employees but owned by the companies the knowledge and the skills acquired by the employees during the process cannot be owned and controlled by the organizations. Companies can make use of it.

Innovation metrics are evolved over the years and it has taken several forms. These metrics were used to measure both the tangible and intangible assets in an organization.

Few of the generations of innovation metrics are identified [6] and are given in Table1:

Table 1: Evolution of Innovation Metrics[6]

First Generation (1950s-1960s)	R & D Expenditure, S & T Personnel, Capital & Tech Intensity
Second Generation	Patents, Publication, Quality Change & Products

(1970s -1980s)	
Third Generation (1990s)	Innovation Surveys, Indexing, Bench marking innovation capacity
Fourth Generation (2000 onwards)	Knowledge, Intangibles, Networks, Demand, Management techniques, Clusters, Risk/Return, System Dynamics

- Inputs like R & D investments, R & D infrastructure, number of S & T personnel etc. were used to measure the innovation related activities in 1st generation metrics.
- Intermediate outputs of R&D activities such as patents, publications etc. were considered during the 2nd generation metrics.
- Focus was on wider group of innovation indexes and indicators which were based on interviews, surveys etc. in the 3rd generation metrics.
- In the 4th generation metrics the focus is on intangible assets like knowledge, networks, demand, management skills etc. and it is getting evolved.

A number of metrics that are generally engaged for measuring innovations are listed below [8]:

- Revenue growth from new products: This is one of the widely used metric by the major companies. It is based on strategic revenue earning targets benchmarked by the companies and an indulgent of how the companies can reach its growth targets.
- Patent submission: It talks about the number of patents by an organization and thus protecting intellectual property.
- Idea submission and flow: The new creative ideas flowing through an idea managing system deliver a noticeable locus point to the magnitude and superiority of proposals.

There are few instruments available for measuring the intangible assets and innovation capacity but they are not complete. These instruments are not comprehensive in measuring the influence of tangible and intangible factors on innovation. Following are the few instruments which are used to measure innovation but are not complete.

Intangible Asset Monitor: This tool is a structure for measuring intangible assets and information movements using metrics which are non-monetary [2], [7]. The companies gather intangible assets to enable this gathered knowledge and physical inputs to be transformed into tangible outputs which results into financial gains.

Cash Curve: This tool uses the profit made as a metric for examining the progress and success of the innovative product. This demonstrates the total amount of cash flow in

the entire innovation process leading to innovative product. The cash flow at any given point of time in the innovation process is a function of past investments, present costs, projected and actual sales revenue from the product under consideration. Depending on projections about the market trends, needs and technical viability the cash curve gives the approximate requirement for cash needed for bringing out an innovative product [4].

Technology Factors: This tool is used for gauging the productivity of R &D and other accomplishments which generate knowledge and in turn patents which are intangible assets. Thus this tool is used to manage the knowledge base in turn the intellectual capital [2].

Skandia Navigator: Intangible assets report which represents the intellectual capital of an organization is produced along with the traditional financial report for the first time by Skandia a Swedish accounting and financial services company. Many companies have formed Skandia’s methods for measuring and reporting knowledge base [2].

IC-dVal: This tool integrates a resource based view of the company which correlates the financial outcome with the economic value of intangible assets [3].

III. METHODOLOGY

Tangible and intangible variables which may have significant influence on innovation is identified with the help of the literature review and a pilot study which was conducted with the select group of IT professionals working in the different hierarchies in the IT industry. Thus in total 25 tangible and intangible variables are considered and they became the items of the questionnaire.

The target populations for this research are the IT professionals of different cadres in the software industry. Samples are selected through cluster sampling technique. The sample questionnaire is shown in Figure 1. Questionnaire was sent both in electronic and physical format.

IT professional have given their opinion about their perception towards each of the 25 variables. The responses received were analyzed and are tabulated in the result section.

Objective: To measure the influence of the variables listed below on innovation in IT-Sector.

Name		
Organization		
Designation		
E-mail		
Contact Number	Cell	Office

Note: Please indicate on the rating scale how significant you feel each of the variables is in the context of innovation in IT sector.

5-Strongly Agree, 4-Moderately Agree, 3-Neutral, 2-Moderately Disagree, 1-Strongly disagree

Sl No	Questions	5	4	3	2	1
1	Educational level of an employee is very important to be innovative.					
2	Experience of an employee enhances his innovative skills.					
3	Attitude of an employee influences innovation.					
4	Team spirit of an employee triggers innovation.					
5	Incentives motivate employees to be more innovative.					
6	Organizational structure influences the innovation level of employees.					
7	Freedom to experiment given in work place contributes to the innovative skills of an employee.					
8	The support for R & D promotes innovation.					
9	Interdepartmental communication promotes innovation in employees.					
10	The innovative nature in employees depends on the size of the organization.					
11	The profit motive of the organization triggers innovation in employees.					
12	The market trend triggers innovation.					
13	The market needs and innovation are directly linked.					
14	Changes in economic activity influences innovation.					
15	The globalization triggers innovation.					
16	The opportunity influences innovation.					
17	The market leadership of the organization has a significant impact on innovation.					
18	Intense competition influences innovation.					
19	The government policy encourages innovation.					
20	The technology change necessitates innovation.					
21	Social Security of an employee enhances his innovative skills.					
22	Regular training for the employees enhances their innovative skills.					
23	Free Environment promotes innovation.					
24	Working with other innovators promotes innovation.					
25	Customer partnership promotes innovation.					

Figure 1: Sample Questionnaire

IV. RESULT

In total 1023 completed responses are received back (with the return rate of 60%) after repeated follow up from the IT professionals. These responses are analyzed and the influence of identified variables as perceived by the IT professionals is calculated.

Out of the total 1023 responses percentage of respondents who have opted for ‘Strongly agree’ and ‘Moderately agree’ for the influence of each of the variables on innovation is calculated. This analysis is shown in Table 2. A list of variables which have percentage of respondents who have opted for ‘Strongly agree’ and ‘Moderately agree’ for each of the variables is equal to or greater than 70% is identified. There are 14 variables which satisfy the criteria. Thus this list of 14 variables are inferred to have significant influence on innovation and this is shown in Table 3 and depicted using graph as shown in Figure 2. It is also noted that influence of each of the 14 variables are not equal but differ. For example Percentage of influence of the variable “Freedom to experiment given at work place” is considered to have highest influence with 89.73% compared to the other variables and the percentage of influence of the variable “Interdepartmental communication has significant impact in promoting innovation in employees” has just 71.94% which is lowest among the 14 variables which surpass the 70% mark.

A= Number of respondents out of the total 1023 respondents who have opted for ‘Strongly agree’ and ‘Moderately agree’ for the influence of each of the variables on innovation.

B= Percentage of respondents out of the total 1023 respondents who have opted for ‘Strongly agree’ and ‘Moderately agree’ for the influence of each of the variables on innovation.

Table 2: Analysis of the responses

Variables identified	A	B
Educational level of an employee has significant impact on innovation.	644	62.93
Experience of an employee significantly enhances his innovative skills.	797	77.90
Attitude of an employee has significant influence on innovation.	850	83.09
Team spirit of an employee has significant impact on triggering innovation.	878	85.82
Incentive given has significant influence to motivate employees to be more innovative.	745	72.82
Organizational structure has significant influence on innovation level of employees.	783	76.33
Freedom to experiment given in the work place has significant relationship to the innovative skills of an employee.	918	89.73
Support for R & D has significant relationship with innovation.	852	83.28
Interdepartmental communication has significant impact in promoting innovation in employees.	736	71.94
Size of the organization has significant relationship with the innovative nature of employees.	281	27.46
Profit motive of the organization has significant relationship in triggering innovation in employees.	382	37.34
Market trend has significant impact on triggering innovation.	667	65.20
Marketed significantly influences innovation.	677	66.17
There is a significant relationship between changes in economic activity and innovation.	365	35.63
Globalization has significant impact on triggering innovation.	612	59.82
There is a significant relationship between the opportunity and innovation.	851	83.18
Market leadership of the organization has a significant impact on innovation.	651	61.68
Intense competition has significant influence on innovation.	764	74.68
Government policy has significant impact in encouraging innovation.	406	39.68
There is a significant relationship between technological changes and innovation.	841	82.20
There is a significant relationship between the social security of an employee and his innovative skills.	347	33.47
Regular training for the employees significantly enhances their innovative skills.	795	77.51
Free Environment significantly promotes innovation.	839	82.01
Working with other innovators significantly promotes innovation.	868	84.84
Customer partnership significantly promotes innovation.	711	69.50

Table 3: Variables identified to have influence on Innovation

Sl. No.	Variables
1	Experience of an employee
2	Attitude of an employee
3	Team spirit of an employee
4	Incentive given to employees
5	Organizational structure
6	Freedom to experiment given at the work place
7	Support for R & D
8	Interdepartmental communication has significant impact in promoting innovation in employees
9	Opportunity available
10	Intense competition
11	Technological changes
12	Regular training to employees
13	Free environment in the work place
14	Working with other innovators significantly promotes innovation

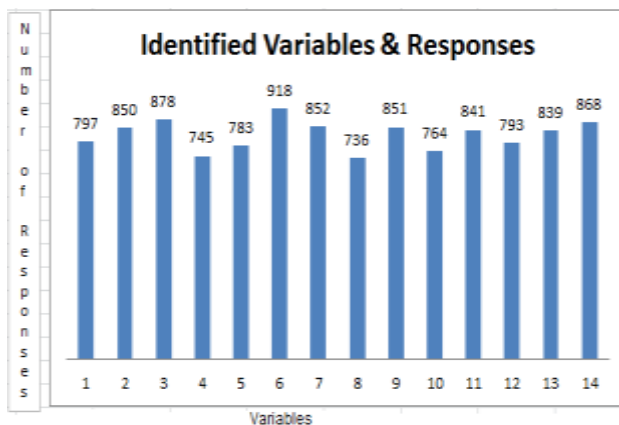


Figure 2: Analysis of the response for each of the variables

V. CONCLUSIONS AND FUTURE SCOPE

The search for the specific variables which may have significant influence on innovation has narrowed down to 14 from a total of 25 tangible and intangible variables initially identified. This process is carried out with the help of the analysis of the responses. This test has gauged the influence of different selected variables that are part of the three categories of factors which may have significant influence on innovation.

Thus the analysis has drawn an inference which has identified 14 out of the 25 variables showing their influence on innovation and they are experience of an employee, attitude of an employee, team spirit of an employee, incentive given to an employee, structure of the organization, freedom to experiment in workplace, support to R & D, opportunity, intense competition, technological changes, regular training and free environment are synchronous with the general perception of the IT industry that these variables may have significant influence on innovation and it is also practically proved by the examples of many IT companies.

A further study on how these shortlisted 14 variables influence innovation is being carried out. Creation of an innovation index is in progress. These identified variables and corresponding observable activities or practices under each of the variables can become the components of the innovation index which can be used to measure the innovation capability of an IT organization.

REFERENCES

- [1]. Blair, M. M., &Wallman, S. M. (2000). Unseen wealth: Report of the Brookings task force on intangibles. Washington, D.C.: Brookings Institution Press.
- [2]. Bontis, N. (2001). Assessing knowledge assets: a review of the models used to measure intellectual capital. International journal of management reviews, March, 3(1), 41-60.
- [3]. Bounfour, A. (2003). The IC-dVAL approach. Journal of Intellectual Capital, 4(3), 396-413.
- [4]. James P. Andrew, Harold L. Sirkin, (2007) "Using the cash curve to discuss and discipline innovation investments", Strategy & Leadership, Vol. 35 Iss: 4, pp.11- 17.
- [5]. Milbergs, E. (2004). Measuring innovation for national prosperity. National innovation initiative—innovation framework report, version, 3, 1-18.
- [6]. Milbergs, E., & Vonortas, N. (2004). Innovation metrics: measurement to insight. Center for Accelerating Innovation and George Washington University, National Innovation Initiative 21st Century Working Group, 22.
- [7]. Sveiby, K. E. (1997). The new organizational wealth: Managing & measuring knowledge-based assets. Berrett-Koehler Publishers.
- [8]. Turrell, M. (2004). Show me t
- [9]. The numbers: A look at innovation metrics. Innovation Tools, 23.

Authors Profile

Vishwanatha Muroor Pai, born in Udupi, Karnataka, India on 1st March 1967. He has earned an Engineering Degree in Computer Science from University of Mysore, India in 1988, Post Graduation in Information Technology(IT) from Sikkim Manipal University, India in 2004, MPhil in Computer Science from Annamalai University, India in 2008 and currently doing his research to get PhD in Computer Science from Manipal Academy of Higher Education, Manipal, India. Rich experience of 30 years in the IT field.



He has worked for 12 years in the IT industry and since 18 years he is in academics. When he was in the industry he worked in the Research and Development Department of different companies. He has developed communication software for remote uploading and downloading of files, designed a working communication protocol, designed and developed hardware cards for different kinds of communications and error corrections. His other job profiles are designing of software systems and systems administration. He has also worked as trainer in many high profile institutions. He is working at present as Head of the Department of Computer Science at Mahatma Gandhi Memorial College, Udupi. He is a visited different countries to give lectures and present papers. He has written 12 books related to various topics of IT. He has carried out two research projects funded by University Grants Commission, India.

Mr Pai is also a consultant for different Software companies like Invenger Technologies Pvt. Ltd, LCode Technologies Pvt. Ltd., www.lessons2all.com, to name a few.

Dr. Sureshramana Mayya acquired M.Com (Personnel Mgt and Industrial Relations) from Mangalore University in 1982, M.Phil (Workers Cooperatives) from Maangalore University in 1997 and Ph.D (Workers Cooperatives) from Mangalore University in 2003. He has successfully carried out 8 research projects sponsored by UGC, ICAI, ICSSR, DSIR and MHRD, New Delhi. He has guided 5 Ph.D Scholars and currently 4 Ph.D scholars are working under his guidance. He has published more than 35 research articles in national and international journals, presented 30 plus research papers in national and international conferences. He was resource person for various training programs for students and teachers.



He was Instrumental in bringing National Mission for Education (NME) supported 10 mbps connection to MGM College during the year 2013, now all the Departments of MGM College is connected with unlimited Broadband Connection. The College has to pay only 25% of its annul charges, 75% met by Government of India. He has Good knowledge of Adobe Professional, Adobe Screen Shot, Abby Fine Reader 9, OCR Conversion, Snag It, Photo Plus, Web Copier, MP3 Direct Cut, This knowledge is shared and used only for enhancing the knowledge of my students, which they use during Vocational Seminar. He was honored with Facilitator Award from CLHRD, Affiliated to Mangalore University for having undergone a Facilitator Certification in Human Resource Development and having accomplished independently

administering the same programme for different groups as per the stipulations and requirements of the Institute. The Award was given by Chairman of Academic Senate Dr. M. I Savadatti.

Harisha G.Joshi has earned M.Com (Personel Management) from Mangalore University, in year 1988 and PhD (Management –Entrepreneurship) from Sikkim Manipal Institute of Technology, Sikkim Manipal University in year 2007. He started his profession as Senior Lecturer in Upendra Pai Memorial College, Udupi in year 1993,joined as Associate Professor in Manipal University in year 2007 and currently serving as rofessor in School of Management, Manipal Academy of Higher Education, Manipal. Along with 28 years of teaching experince, he has expertise in enterprise setting and Entrepreneurship Development. He also has ability to create and maintain strong relationships with NGOs, Government bodies and is promoting Interdisciplinary approach in Technology, education and Research.



Harisha G.Joshi has published 28 articles in reputed international journals and supervised more than 10 Ph.D scholars. He was granted with prestigious role of Coordinator for Dr TMA Pai Endowment Chair for Social Entrepreneurship (2013 to 2015). He is developing Business Incubators for promoting Innovative Individual and organizations to transform their feasible dreams into a commercial venture.