IMPACT OF HUMAN CAPITAL ON THE PERFORMANCE (QUALITY OF PUBLICATIONS) OF RESEARCH INSTITUTES IN INDIA- AN EMPIRICAL STUDY

Ajay Kumar Saini[1], Harpreet Singh Grewal[2], Harish Kumar Singla[3]

[1]Uttarakhand Technical University, Dehradun, India

[2]Omkaranand Institute of Management and Technology, Rishikesh, India

[3]National Institute of Construction Management and Research
Altius-Institute of Universal Studies, Indore, India

Email: ajayksaini2310@gmail.com, grewal1650@gmail.com, hsingla25@gmail.com

ABSTRACT

The purpose of the paper is to see the impact of Knowledge, skills, Innovation & creative ability and human capital as a whole on the quality of publications in research institutions in India. The quality of publication is defined as number of SCI publications in last five years and Knowledge, skills, Innovative &Creative Ability and human capital is measured through a comprehensive research questionnaire on 5 point scale. The responses from 119 scientists across various research institutions were collected and analyzed using Structural Equation model. The results of the study show that Knowledge, skills and Innovative and creative capability and human capital as a whole have a positive significant impact on the quality of publications in India.

KEY WORDS: *human capital, intellectual capital, knowledge, R&D, performance*

1.0 INTRODUCTION

The concept of intangible and knowledge resources have been discussed a lot over the past few years across the world and this has led to the development of the concept of intellectual capital. The components of intellectual capital have been defined by Skandia model when it was first developed in 1991. Skandia model consists of four main intellectual capital components- human, customer, process, and renewal/development. Later on the renewal/development component was termed as innovation capital.

The different categories of intellectual capital represent a combination of intangibles. These are grouped by virtue of same characteristics, similar type of functions served and equal proprietary relationship with organization. Even if the nomenclature is different, the content of categories is more or less similar (Bontis, 2000).

The history of human capital can be traced back to the 1770s, when Adam Smith included all acquired and useful abilities of a country's inhabitants as part of capital. He included the skills and useful abilities of human beings in the category of fixed capital. According to him, the skill of a man is a machine that has a genuine cost and yields a profit.

The categorization of intangibles proposed by Meritum appears to be used most popularly in practice and academic research (OECD, 2006). The authors accept the definition of human capital given by Meritum (2002), which is as follows:

> *"Human capital is defined as the knowledge that employees take with them when they leave the firm. It includes the knowledge, skills, experiences and ability of people."*

Human capital has been considered as a vital resource for differentiating financial performance among firms (Reed et al., 2006, 2009).

In the present turbulent global scenario the research institutions have a fundamental role in the development of a nation by extending support to the organizations in facing the technological challenges. The studies conducted in Italy, UK, Finland and other parts of the world (Abdulai et al, 2012; Badrabadi and Akbarpour, 2013; Bollen et al, 2005; Chan, 2009; Coccia, 2008; Diez et al, 2010; Gazor et al, 2013; Grimaldi and Hanandi, 2013; Greco et al, 2013; Hsu and Wang, 2012; Kazan et al, 2012; Nejadirani et al, 2012; Phusavat et al, 2011; Shakina and Barajas, 2012; Sharabati et al, 2010; Hermans and Kauranen, 2005; Firer and Stainbank, 2003; Choudhury, 2010; Bramhandkar et al, 2007; Ballot et al, 2001) show the growing importance of the research institutes in development of a nation.

The research institutions across the world have been studied in the past vis-à-vis their performance (Hsu and Wang, 2012; Kazan et al, 2012; Nejadirani et al, 2012; Phusavat et al, 2011; Kamukana et al, 2010; Hermans and Kauranen, 2005; Diez et al, 2010; Bramhandkar et al, 2007; Bollen et al, 2005; Bontis et al, 2000; Carlucci et al, 2004; Kuafman and Schneider, 2004; Kim and Kumar, 2009; Pedrini, 2007; Reed et al, 2009; Cater and Cater, 2009; Coccia, 2004; Tikoria et al, 2010; Clarke et al, 2011) and it has been found that intangibles, specially human capital has a prolific influence on the performance of these research institutes.

During the past few years, there is a lot of discussion on the performance of research institutes in India particularly those which are funded by the government. These research institutes carry out scientific research, technological services and some administrative operations. They are considered as the backbone of growth of industry and development of the nation. It is important for these research institutes to keep increasing their efficiency and effectiveness. However, to the surprise of the researcher, limited work has been carried out to study the performance of the research institutions and the impact of intangibles specifically human capital on the performance of these institutions (Tikoria, et al 2010). Therefore, this paper is an attempt to see the impact *of human capital on the performance of research institutions in India.*

As defined earlier, human capital is measured through *Knowledge, Skills, and Innovative and Creative Capability* (Meritum, 2002). *The rest of the paper is organized as follows. First, literature on human capital and its impact on performance are discussed, followed by research eco system in India. The section is continued by research methodology. After this,*

research results are reported. Finally, the study is concluded by research findings and discussion.

2.0 LITERATURE REVIEW

2.1 Human Capital

The role of human capital is significant in research institutions. In addition to financial resources, human capital factors such as employee competence and knowledge regarding customers' needs and competitors' actions are important. The management of human capital and its evaluation has been in the focus of academicians and managers. It is considered as a key factor in the profitability of the organization and plays a major role in the creation of economic wealth. Therefore it is considered as a fundamental factor of success and a source of sustainable competitive advantage to the organization.

There are two dimensions of human capital- generic human capital and firm-specific human capital (Abdel-khalik, 2003; Hitt et al., 2001; Swart, 2006). According to Swart (2006) generic human capital is the outcome of the developments which take place outside the boundaries of the organization. It consists of level of formal education and years of work experience. An individual gets knowledge from education and experience before entering into an organization (Hitt et al., 2001). The firm specific human capital emerges after the individual enters the organization. The employee continues to learn and gain knowledge through "learning by doing" (Hitt et al., 2001). Firm-specific human capital is extremely valuable, because the knowledge and skills held by employees are unique to the firm and cannot easily be transferred to its competitors (Swart, 2006).

Human capital is present in knowledge, capabilities, competences and skills possessed by people in the organization. It is not the owned by organization, so it required that the organization should find ways and means to transform this tacit knowledge into explicit knowledge. The different contents of human capital can be- innovation capacity, know-how and previous experience, teamwork capacity, learning capacity, formal training and education. According to Sveiby (1997), human capital can be related to competences and can be defined as the capacity to act in a wide variety of situations so that tangible and intangible assets are created in the organization. According to Edvinnson and Malone (1997), human capital is the combination of knowledge, skill, innovativeness and ability of employees in the organization to accomplish the task.

Human capital has been defined on an individual level as well as the total workforce (Bontis and Fitz-enz, 2002; Wright et al., 1994). The individual level human capital is the combination of four factors- genetic inheritance, education, experience, and attitudes about life and business. The latter, the total workforce, refers to the total pool of human capital in a firm (Wright et al., 1994). Human capital, being a source of innovation and strategic renewal, is important for the organization. The sheer intelligence of the employee is the essence of human capital. The scope of human capital is limited to the knowledge node (i.e., internal to the mind of the employee). It can be measured as a function of volume. It is also the toughest of the three sub-parts of intellectual capital to codify. According to resource-based perspective an argument has been put forward that in some situations sustained competitive advantage can accrue to the organization from 'a pool of human capital' (Wright *et al*., 1994). This is achieved through the human capital adding value, being rare, inimitable and cannot be substituted by another resource by competitors.

Organizations obtain their human capital in one of two ways. Organizations can hire knowledgeable, skilled workers. They can also develop human capital internally with the use of training and development, mentoring, and knowledge sharing (Swart and Kinnie, 2010). The internal development of human capital is time consuming, but it is the most effective way of ensuring that the human capital for the organization is well versed with its practices (Hitt, et al, 2001). Empirically, scholars have seen the impact of human capital in numerous ways.

2.2 Impact of Human Capital on Performance

The outputs of research institutions are difficult to identify and measure due to their intangibility. Some of the outputs of research institutions related to human capital are- enhanced R&D process skills (Cordero, 1999), increase in tacit knowledge gained by experience or learning that has taken place by doing (Nonaka and Takeuchi, 1995; Chen, 2005; Mascitelli, 2000) and improved inter- personal relationships (Mayo, 2001).

Patents and their attributes in terms of citations are useful intermediate output measures of R&D projects (Lev, 2001). But it should be noted that patents are not relevant measures in all industries. As far as service industry is concerned, patents have minor importance (Hipp and Grupp, 2005). Brands and trademarks - a part of relational capital are customer related output indicators (Lev, 2001). Evaluation pertaining to intellectual property consists of number of patents granted to the organization per year per employee, the gravity of citations of patents of organization, the number of citations to scientific papers and the total number of patent applications (Leitner and Warden, 2004; Lev, 2001). The captured tacit knowledge in the form of documented papers and technical reports can be measured by the number of publications in refereed journals (Leitner and Warden, 2004). Radical innovations and incremental improvements are the measure of novelty in the organizations (Hipp and Grupp, 2005).

3.0 RESEARCH ECO SYSTEM IN INDIA

The R&D-and Science and technology related ecosystem in India is complex and multi-layered. It consists of central government agencies, autonomous bodies, universities, and private R&D and other ancillary departments. The Science and technology deportments working with the central government's support include the following:

- Department of Space
- Department of Biotechnology
- Department of Earth Sciences
- Department of Atomic Energy
- Department of Science and Technology
- Department of Science and Industrial Research

The Government is interested in running these institutes in most efficient and effective manner, in the light of scarcity of funds. These research institutes are under tremendous pressure from all sides to give improved performance every time so that they can match the global standards, counter the resource constraints and be more accountable to the national interest. That is the biggest challenge for them. Every research institute must generate the

feedback to know the gaps in their respective performance (patents for some organizations, consultancy for others, number of publications for some and quality of publications for some) so that corrective actions are taken and the performance is put on the right track again. The growing concern about India's minimal global scientific contribution gives a warning bell to the national policy makers. The performance evaluation of government research institutes is critical in bringing strategic change. It is also important to focus on the drivers of the performance. Human capital is one such major driver that impacts the performance.

4.0 RESEARCH METHODOLOGY

4.1 Identification of Variables

An attempt is made to see the impact of human capital on the performance of research institutes in India. For the present study, *quality of publications (Yazit and Zainab, 2007; Narin and Hamilton, 1996; Gu and Zainab, 2001; Uzun, 2002; Toutkoushian et al, 2003; Tsay, 2004; Kademani et al, 2005; Liu and Cheng, 2005; Meho and Spurgin, 2005;) is identified as a performance variable, which is the dependent variable in the study.*

Quality of Publications is measured in form of SCI publications in Last 5 years.
Human capital is defined as the sum total of Knowledge, Skills, and Innovative & Creative Capability (Garavan et al, 2001; Rastogi, 2002; Youndt et al, 2004; Frank and Bemanke, 2007; Rodriguez and Loomis, 2007; Alan et al, 2008; Beach, 2009). So, this is our independent variable and is measured on five point scale.

The survey instrument has been designed by carrying out a detailed review of existing literature to look for the relevant items to be put under each of the three sub components of humanl capital. The items used in survey instrument helped in getting the perception of the respondents about the respective institute. Kannan and Aulbur (2004) extensively studied these types of items for research on intellectual capital, of which, human capital is a part. They opined that the usage of these items have been quite often to study the organizational factors facilitating the performance of individuals, the overall development of human capital in the organization and organizational performance. For this purpose they reviewed hundred papers. Although the objective items score over perceptual items in terms of respondent bias, the evidence shows that both the items are most of the time congruent. The study further shows that the usage of these items is very common in spite of the fact that intangible assets are difficult to measure objectively.

Some of the most relevant research papers (Abdulai et al., 2012; Bramhandkar et al., 2007; Choudhury, 2010; Coccia, 2004; Firer and Stainbank, 2003; Hsu and Wang, 2012; Kazan et al., 2012; Nejadirani et al., 2012; Shakina and Brajas, 2012; Sharabati et al., 2010; Tikoria et al., 2010) have also been reviewed for short listing the items for the survey instruments.

Items of the Questionnaire

Knowledge	People are considered as the most important resource and hence organization is committed for long learning.
	People share knowledge with each other.

	There exists motivation for research.
	We implement a large portion of new ideas.
	Training is the regular feature to hone up the skills and expertise.
	People are satisfied in the organization.
	Decisions are based on data rather than personality.
	The competence of people as a whole is equal to the most ideal level (matching with their work requirements and responsibilities).
	Our people are aware of global trends in their respective areas.
	Informal networks across the organization are encouraged.
Skills	People perform consistently at their best.
	Your job profile matches with your knowledge, skills and abilities.
	People are bright.
	The organization is able to attract and retain top quality people.
	People are willing to make tough decisions.
	Peoples' trustworthiness and credibility cannot be doubted.
	There is a personal commitment to organizational strategy.
	Required skills and expertise are available in people.
	People are excited to voice their opinions in group discussions.
	People are helpful to each other.
Innovative and creative capability	Failure is not stigmatized, rather seen as an opportunity to learn.
	People are creative.
	People have an entrepreneurial zeal in them while doing research in the organization.
	People are proactive in approach and highly adaptable to change.
	Team leaders are willing to stand up to department, when it is necessary.
	Scientists are encouraged to take risks.
	We face a conflict between "who is right" and "what is right".
(Dependent Variable) or Performance Variable	Quality of Publications

4.2 Hypothesis Development

The following hypotheses were prepared for the analysis purpose.
H_1= Knowledge is appropriate measure for human capital.
H_2= Skill is appropriate measure for human capital.
H_{03}= Innovation and Creative capability is appropriate measure for human capital.
H_{04}= Human Capital has a positive impact on quality of publications in research institutes in India

4.3 Sampling and Data collection

A comprehensive questionnaire is developed to measure the impact of knowledge, skills, innovative & creative capability on quality of publications where knowledge, skills, innovative and creative capability is measured on a 5 point scale, where 1 = strongly disagree, 2= disagree, 3= undecided, 4= agree, 5 = strongly agree., whereas quality of

publications is measured in form of the number of SCI publications in last 5 years. The questionnaire was duly tested for its validity and reliability. The value of Cronbach alpha for dependent variable is 0.968, and for independent variables is 0.945, which is quite good. Therefore, we can say that the instrument is quite reliable. More than 200 scientists from various research institutes were contacted through personal visits and mails to provide response on the questionnaire, 119 responses were finally available for analysis. The respondents include scientists under the aegis of CSIR (council of scientific and industrial research), ICAR (Indian council of agriculture research), DST (Department of science and technology) and MEF (Ministry of environment and forest).

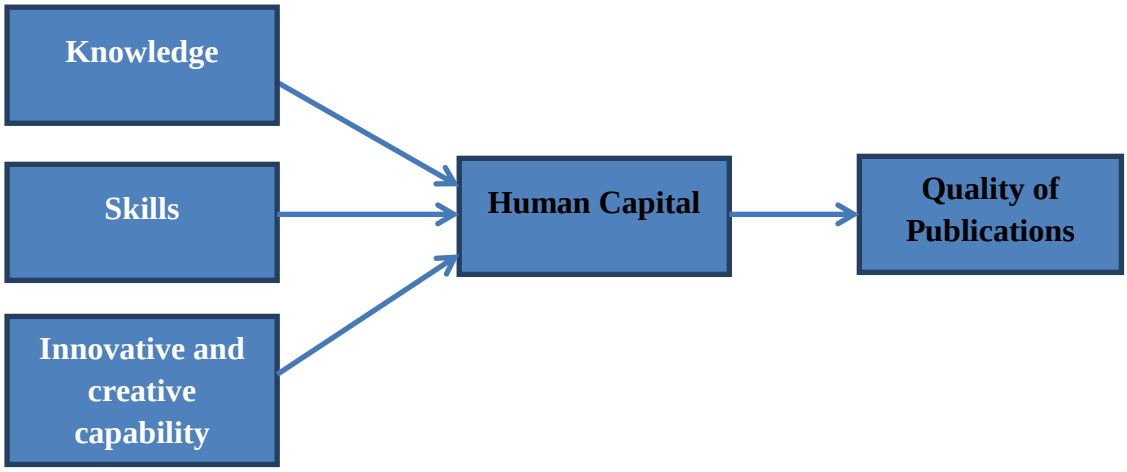

Figure 1: Conceptual Framework

5.0 RESULTS

5.1 Descriptive Statistics

Table-1 presents a summary statistics of the variables and it can be seen that the average score is above 3 on a scale of 5 for all the variables, which indicate that scientist in research institute consider these components to be important for research institute. Average publications each scientist in last five years is approximately 5, that is, one every year.

Table 1: Descriptive Statistics

	Average Scores of Human Capital Component				
Scientist	Knowledge	Skill	I&C	HC (Latent Variable Predicted through model)	Quality of publications (SCI Publications Last 5 Years
1	4.30	4.50	4.00	0.66	8.00

2	2.20	3.30	3.29	-0.71	2.00
3	2.90	2.90	2.71	-0.76	2.00
4	2.80	3.30	2.57	-0.72	1.00
5	4.00	4.80	4.14	0.58	6.00
6	2.80	2.80	2.14	-0.90	2.00
7	4.40	3.90	4.43	0.36	5.00
8	3.00	2.80	2.86	-0.68	3.00
9	4.20	4.30	3.86	0.49	7.00
10	2.60	3.40	2.71	-0.61	3.00
11	4.70	4.80	4.29	0.84	7.00
12	3.50	3.50	2.71	-0.35	3.00
13	2.70	2.90	3.29	-0.78	1.00
14	2.40	2.50	2.29	-1.13	1.00
15	3.60	4.20	3.43	0.00	3.00
16	3.40	3.50	4.00	-0.13	4.00
17	4.40	3.50	3.43	0.03	4.00
18	3.10	3.80	3.43	-0.25	3.00
19	4.00	3.20	4.00	-0.20	2.00
20	4.10	3.30	3.57	-0.14	3.00
21	4.00	3.20	4.00	-0.14	3.00
22	4.00	3.00	3.00	-0.35	3.00
23	3.70	3.60	4.00	-0.02	4.00
24	3.30	3.60	3.57	-0.24	3.00
25	3.30	3.40	2.43	-0.48	3.00
26	2.70	2.90	3.43	-0.70	2.00
27	4.10	4.10	3.71	0.31	6.00
28	3.90	3.70	3.00	-0.15	3.00
29	4.20	3.90	3.71	0.15	4.00
30	4.10	4.10	3.71	0.31	6.00
31	2.70	2.90	3.43	-0.70	2.00
32	4.10	4.10	3.71	0.25	5.00
33	2.70	2.90	3.43	-0.70	2.00
34	3.60	3.60	2.57	-0.31	3.00
35	5.00	5.00	4.43	1.34	13.00
36	4.30	4.10	3.86	0.57	9.00
37	3.90	3.00	3.43	-0.20	5.00
38	4.10	4.30	4.86	0.73	9.00
39	4.10	3.80	4.43	0.43	8.00
40	4.30	4.20	4.00	0.56	8.00
41	3.80	3.80	3.29	-0.04	4.00
42	4.30	4.30	4.14	0.72	10.00
43	4.60	5.00	4.57	1.28	13.00
44	4.50	4.20	3.14	0.59	10.00
45	3.80	3.60	3.71	0.02	5.00

46	4.60	3.90	4.43	0.53	7.00
47	4.20	4.10	4.14	0.51	8.00
48	3.80	3.90	3.71	0.00	3.00
49	2.50	3.00	2.57	-0.84	2.00
50	4.00	3.80	2.86	-0.10	3.00
51	3.60	3.20	3.14	-0.31	4.00
52	3.80	3.50	2.71	-0.28	3.00
53	3.70	3.50	3.43	-0.14	4.00
54	3.40	2.50	3.29	-0.56	4.00
55	3.90	4.20	3.29	0.12	4.00
56	3.70	3.30	3.00	-0.33	3.00
57	4.70	4.10	3.43	0.42	6.00
58	3.40	3.50	2.57	-0.45	2.00
59	4.90	5.00	4.29	1.13	10.00
60	3.50	3.20	3.29	-0.31	4.00
61	3.90	2.90	3.71	-0.25	4.00
62	4.90	4.50	4.86	0.99	9.00
63	4.10	3.60	3.14	0.06	6.00
64	4.90	4.50	4.86	1.11	11.00
65	3.00	3.10	3.29	-0.58	2.00
66	4.10	3.60	3.57	0.19	7.00
67	4.00	3.70	4.29	0.30	7.00
68	4.00	4.00	3.86	0.34	7.00
69	3.60	3.80	3.43	-0.01	5.00
70	4.00	3.50	3.57	0.02	5.00
71	2.80	3.30	3.43	-0.49	3.00
72	4.60	4.00	3.57	0.39	6.00
73	1.00	1.00	2.00	-2.07	0.00
74	4.10	3.50	3.14	-0.03	5.00
75	4.60	4.10	3.71	0.55	8.00
76	4.20	3.40	3.71	0.05	5.00
77	3.70	4.10	3.14	0.01	4.00
78	4.00	3.70	4.00	0.14	5.00
79	4.00	3.90	3.86	0.25	6.00
80	3.00	2.60	2.57	-0.91	1.00
81	4.20	4.10	3.57	0.44	8.00
82	3.60	3.50	2.86	-0.18	5.00
83	3.60	2.00	2.00	-0.93	3.00
84	4.50	4.50	4.00	0.82	10.00
85	4.40	4.00	3.43	0.55	10.00
86	4.20	3.40	3.00	-0.05	5.00
87	4.00	4.10	4.00	0.51	9.00
88	4.20	4.00	3.86	0.45	8.00
89	4.00	3.70	3.86	0.19	6.00

90	4.20	4.10	3.86	0.43	7.00
91	4.10	3.90	3.71	0.19	5.00
92	4.80	4.80	4.29	1.10	11.00
93	3.70	3.70	3.14	0.05	7.00
94	4.40	4.10	3.57	0.43	7.00
95	4.50	4.20	3.86	0.59	8.00
96	3.90	3.90	3.86	0.23	6.00
97	3.20	3.70	3.86	0.05	7.00
98	4.10	3.70	4.00	0.34	8.00
99	2.10	1.90	1.57	-1.50	1.00
100	3.00	2.60	1.71	-0.92	3.00
101	4.20	3.90	2.86	0.15	6.00
102	3.40	3.10	2.57	-0.41	5.00
103	3.80	4.00	3.43	0.16	6.00
104	3.80	4.00	3.43	0.22	7.00
105	3.00	3.10	3.14	-0.49	4.00
106	3.30	3.20	3.29	-0.36	4.00
107	4.10	4.00	4.00	0.50	9.00
108	2.90	3.20	3.29	-0.57	2.00
109	4.10	4.00	3.71	0.34	7.00
110	3.70	3.90	3.14	0.00	5.00
111	2.90	3.80	3.71	-0.08	6.00
112	3.40	3.00	3.29	-0.28	6.00
113	2.90	3.00	2.00	-0.77	3.00
114	4.10	3.70	4.00	0.40	9.00
115	4.00	3.80	3.14	0.04	5.00
116	3.90	3.70	4.00	0.29	8.00
117	2.80	3.40	3.43	-0.40	4.00
118	3.60	3.80	3.29	-0.03	5.00
119	3.80	4.00	3.57	0.19	6.00
Average	3.75	3.64	3.46		5.27

5.2 Correlation Analysis

It can be observed from Table-2 that quality of publications has a positive significant correlation with knowledge, skills, innovation and creative capability and human capital as a whole. It is an indication that the publication quality in research institutes is directly influenced by knowledge, skills and innovation and creative capability and overall by human capital.

Table 2: Correlations

	Knowledge	Skill	I&C	HC	Quality of Publication

Knowledge	1				
Skill	0.789*	1			
I&C	0.668*	0.717*	1		
HC	0.908*	0. 934*	0.822*	1	
Quality of Publication	0.764*	0. 770*	0.698*	0.904*	1

* Correlation is significant at the 0.01 level (1-tailed).

5.3 Structural Equation Model

In order to overcome the problem of multicolinearity, SEM model is built where knowledge, skill and innovation and creative capability are considered as observed variable and human capital is taken as latent variable. A measurement SEM model is used to see if knowledge, skill and innovation and creative capability are fitting to human capital and if human capital has an impact on quality of publications. The results are presented in table-3 and figure-2 given below. Where IC is innovation and creative capability, and HC is human Capital.

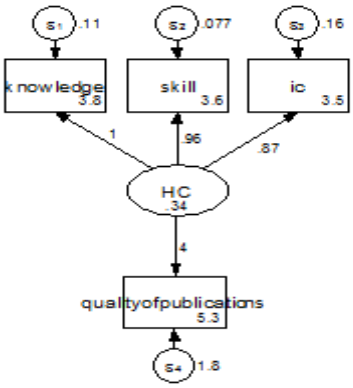

Figure-2, SEM

Table-2 Model Output

```
Exogenous variables

Latent:       HC

Fitting target model:

Iteration 0:   log likelihood = -466.65363
Iteration 1:   log likelihood = -466.61826
Iteration 2:   log likelihood = -466.61819
Iteration 3:   log likelihood = -466.61819

Structural equation model                       Number of obs      =       119
Estimation method  = ml
Log likelihood     = -466.61819

 ( 1)  [knowledge]HC = 1
```

	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Measurement						
knowledge <-						
HC	1	(constrained)				
_cons	3.754622	.061623	60.93	0.000	3.633843	3.875401
skill <-						
HC	.9641102	.0718716	13.41	0.000	.8232444	1.104976
_cons	3.642857	.0577644	63.06	0.000	3.529641	3.756073
ic <-						
HC	.8663236	.0814463	10.64	0.000	.7066918	1.025955
_cons	3.461345	.0590046	58.66	0.000	3.345698	3.576992
qualityofpublications <-						
HC	3.986918	.3145704	12.67	0.000	3.370372	4.603465
_cons	5.268908	.2469209	21.34	0.000	4.784952	5.752864
var(e.knowledge)	.10729	.0192882			.0754282	.1526107
var(e.skill)	.0767619	.01579			.0512924	.1148784
var(e.ic)	.1556758	.0235376			.1157505	.2093725
var(e.qualityofpublications)	1.777819	.3188353			1.250928	2.526635
var(HC)	.3446004	.0584561			.2471283	.4805172

```
LR test of model vs. saturated: chi2(2)   =      1.30, Prob > chi2 = 0.5219
```

As observed in above tables, knowledge, skill and innovation and creative capability are fitting the measurement model (p = 0.000) and for the structural model, the Chi square is significant (P>chi2)) and the values of CFI and TLI are above .9, so the structural model is also significant. Based on the above, we can conclude that human capital is significantly affecting the quality of publications in research institutes in India. The model is a good fit and on the basis of above results all the above hypotheses, i.e. knowledge is appropriate measure for human capital, skill is appropriate measure for human capital, innovation and creative capability is appropriate measure for human capital and human Capital has a positive impact on quality of publications of research institutes in India are accepted.

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(2)	1.301	model vs. saturated
p > chi2	0.522	
chi2_bs(6)	345.427	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.000	Root mean squared error of approximation
90% CI, lower bound	0.000	
upper bound	0.160	
pclose	0.613	Probability RMSEA <= 0.05
Information criteria		
AIC	957.236	Akaike's information criterion
BIC	990.586	Bayesian information criterion
Baseline comparison		
CFI	1.000	Comparative fit index
TLI	1.006	Tucker-Lewis index
Size of residuals		
SRMR	0.008	Standardized root mean squared residual
CD	0.924	Coefficient of determination

6.0 FINDINGS AND DISCUSSION

Analyzing the role of human capital, this research paper concentrated on the role of Knowledge, Skills, Innovation & Creativity on the quality of publications in research institutes in India. Based on the empirical analysis, it is found out that knowledge, skills and Innovative & Creative Capability does play an important role in the performance (Cater and Cater, 2009; Fugate et al, 2009; Li et al, 2009; Rasula et al, 2012) (Calantone et al, 2002; Hagedoorn and Cloodt, 2003; Damanpour et al, 2009; Jimenez-Jimenez and Sanz-Valle, 2011; Bowen et al, 2010; Greenhalgh et al, 2010 Gunday et al, 2011; Cingoz and Akdogan, 2011; Sok and O'Cass, 2011; Camison and Villar, 2012; Hassan et al, 2012, 2013a, 2013b). The findings are consistent with the prevailing view. Human capital as a whole impacts the quality of publications of research institutes in a significant manner (Rastogi, 2000; Namasivayam and Denizci, 2006; Marimuthu et al, 2009; Choudhury, 2010; Slaus and Jacobs, 2011; Maditinos et al, 2011; Crook et al, 2011; Alipour et al, 2012).

Overall, we can say that the innovation & creativity is something, which is internal to the scientists, but the research institutes must provide adequate work environment to scientists to develop their knowledge, skills and creative ability. The research institutes should facilitate the sharing and application of knowledge which is in the minds of people. If it remains isolated in the minds, then it does not serve any purpose.

6.1 Contribution of the Present Study

This study is helpful for the policy makers, academicians and scientists to understand the influence of human capital on performance of research institutes for economic growth and sustained competitive advantage. The government can use this study to conduct further

studies in research institutes and other sectors of the economy to improve the knowledge about human capital and its usefulness in giving an impetus to economic growth. The impact of elements of human capital on the workers' knowledge and abilities decides the success or failure of the organization.

REFERENCES

Abdel-Khalik, A. R. (2003). Self-sorting, incentive compensation and human-capital assets. *European Accounting Review, 12*(4), 661-697.

Abdulai, M.S., Kwon, Y and Moon, J. (2012). Intellectual Capital and Firm Performance: An Empirical Study of Software Firms in West Africa. *The African Journal of Information Systems, 4*(1), 1-30.

Alan, K.M.A., Altman, Y., and Roussel, J. (2008). Employee Training Needs and Perceived value of Training in the Pearl River Delta of China: A Human Capital Development Approach. *Journal of European Industrial Training, 32*(1), 19-31.

Alipour, F., Idris, K., Ismail, I.A., and Karimi. R. (2012). The relationship between human capital and organizational performance: Mediating effect of Intrapreneurship. *Archives Des Sciences, 65*(5), 377-393.

Badrabadi, H.H. and Akbarpour, T. (2013). A study on the effect of intellectual capital and organizational learning process on organizational performance. *African Journal of Business Management,* 7(16), 1470-1485.

Ballot, G., Fakhfakh, F. and Taymaz, E. (2001). Firms' Human Capital, R&D and Performance: A study on French and Swedish Firms. *Labour Economics, 8*, 443-462.

Beach, M.J. (2009). A critique of Human Capital Formation in the U.S. and the Economic Returns to Sub-Baccalaureate Credentials. *Educational Studies: A Journal of The American Educational Studies, 45*(1), 24-38.

Bollen, L., Vergauwen, P. and Schnieders. S. (2005). Linking intellectual capital and intellectual property to company performance. *Management Decision, 43*(9), 1161-1185.

Bontis N. (2000). *Queen's Management Research Centre for Knowledge-Based Enterprises.* Assessing knowledge assets: a review of the models used to measure intellectual capital, working work. Available at http://www.business.queensu.ca/kbe.

Bontis, N. and Fitz-enz, J. (2002). Intellectual capital ROI: a causal map of human capital antecedents and consequents. *Journal of Intellectual Capital, 3*(3), 223-247.

Bowen, F.E., Rostami, M., & Steel, P. (2010). Timing is everything: A meta-analysis of the relationships between organizational performance and innovation. *Journal of Business Research, 63*(11), 1179-1185.

Bramhandkar. A, Erickson, S. and Applebee, I. (2007). Intellectual Capital and Organizational Performance: an Empirical Study of the Pharmaceutical Industry. *Electronic Journal of Knowledge Management, 5*(4), 357-362.

Calantone, R.J., Cavusgil, S.T., and Zhao, Y. (2002). Learning orientation, firm innovation capability and firm performance. *Industrial Marketing Management, 31*, 515-524.

Camison, C., & Villar-López, A. (2012). Organizational innovation as an enabler of technological innovation capabilities and firm performance. *Journal of Business Research, 67*(1), 2891-2902.

Carlucci, D., Marr, B., & Schiuma, G. (2004). The knowledge value chain: How knowledge management impacts business performance. *International Journal of Technology Management*, *27*(6/7), 575-590.

Cater, T., & Cater, B. (2009). (In)tangible resources as antecedents of a company's competitive advantage and performance. *Journal for East European Management Studies, 14*(2), 186-209.

Chan, K.H. (2009). Impact of intellectual capital on organizational performance: An empirical study companies in the Hang Seng Index (Part 2). *The Learning Organization, 16*(1), 22-39.

Chen, S. (2005). Task partitioning in new product development teams: a knowledge and learning perspective. *Journal of Engineering and Technology Management*, *22*, 291-314.

Choudhury, J. (2010). Performance Impact of Intellectual Capital: A Study of Indian IT Sector. *International Journal of Business and Management*, *5*(9), 72-80.

Cingoz, A., and Akdoğan, A. A. (2011). An empirical examination of performance and image outcome expectation as determinants of innovative behavior in the workplace. *Procedia-Social and Behavioral Sciences, 24*, 847-853.

Clarke, M., Seng, D. and Whiting, R.H. (2011). Intellectual Capital and Firm Performance in Australia. *Journal of Intellectual Capital*, *12*(4), 505-530.

Coccia, M. (2004). New models for measuring the R&D performance and identifying the productivity of public research institutes. *R&D Management*, *34*(3), 267-280.

Coccia, M. (2008). Measuring scientific performance of public research units for strategic change. *Journal of Informetrics*, *2*(3), 183-194.

Cordero, R. (1999). Developing the knowledge and skills of R&D professionals to achieve process outcomes in cross-functional teams. *The Journal of High Technology Management Research, 10*(1), 61-78.

Crook, T.R., Todd, S.Y., Combs, J.G., Woehr, D.J., and Ketchen, D.J. (2011). Does human capital matter? A meta-analysis of relationship between human capital and firm performance. *Journal of Applied Psychology, 96*(3), 443-456.

Damanpour, F., Walker, R., and Avellaneda, C. (2009). Combinative effects of innovation types and organizational performance: A longitudinal study of service organizations. *The Journal of Management Studies*, *46*(4), 650-675.

Diez, J. M., Ochoa, M. L., Prieto, M. B., & Santidrian, A. (2010). Intellectual capital and value creation in Spanish firms. *Journal of Intellectual Capital, 11*(3), 348-367.

Edvinsson L., Malone M. (1997). *Intellectual Capital: Realizing your Company's True Value by Finding its Hidden Brainpower*. New York, Harper Business.

Firer, S. and Stainbank, L. (2003). Testing the relationship between intellectual capital and a company's performance: Evidence from South Africa. *Meditari Accountancy Research, 11*, 25-44.

Fugate, B.S., Stank, T.P., and Mentzer, J.T. (2009). Linking improved knowledge management to operational and organizational performance. *Journal of Operations Management, 27*, 247-264.

Garavan, T.N., Morley, M., Gunnigle, P., and Collins, E. (2001). Human capital accumulation: The role of human resource development. *Journal of European Industrial Training, 25*(2/3/4), 48-68.

Gazor, H., Kohkan, F., Kiarazm, A. and Rastegri, H. (2013). Impact of Intellectual Capital on Performance in Audit Institutes. *Asian Journal of Finance & Accounting, 5*(1), 60-72.

Greco, M., Cricelli, L. and Grimaldi, M. (2013). A strategic management framework of tangible and intangible assets. *European Management Journal*, *31*(1), 55-66.

Grimaldi, M., and Hanandi, M. (2013). Evaluating the Intellectual Capital of Technology Transfer and Learning Public Services. *International Journal of Engineering Business Management, 5*(7), 1-10.

Gu, Y., and Zainab, A.N. (2001). Publication productivity of Malaysian researchers in the field of Computer science and Information technology. *Malaysian Journal of Library and Information Science, 6*(1), 1023.

Gunday, G., Ulusoy, G., Kilic, K., and Alpkan, L. (2011). Effects of innovation types on firm performance. *International Journal of Production Economics, 133*(2), 662-676.

Hagedoorn, J., and Cloodt, M. (2003). Measuring innovative performance: is there an advantage in using multiple indicators? *Research Policy, 32*, 1365-1379.

Hassan, M.U., Shaukat, S., Shakeel, M., and Imran, M. (2012). Interrelation between Organizational Culture, Innovation and Employee Performance: Evidence from banking Sector of Pakistan. *Pakistan Journal of Social Sciences, 32*(2), 339-355.

Hassan, M.U., Malik, A.A., Hasnain, A., Faiz, M.F., and Abbas, J. (2013a). Measuring employee creativity and its impact on organization innovation capability and performance in the banking sector of Pakistan. *World Applied Sciences Journal*, *24*(7), 949-959.

Hassan, M.U., Shaukat, S., Nawaz, M. S., and Naz, S. (2013b). Effects of Innovation Types on Firm Performance: An Empirical Study on Pakistan's Manufacturing Sector. *Pakistan Journal of Commerce and Social Sciences, 7*(2), 243-262.

Hermans, R., and Kauranen, I. (2005). Value creation potential of intellectual capital in biotechnology – empirical evidence from Finland. *R&D Management*, *35*(2), 171-185.

Hipp, C., and Grupp, H. (2005). Innovation in the service sector: the demand for service-specific innovation measurement concepts and typologies. *Research Policy*, *34*, 517-35.

Hitt, M. A., Bierman, L., Shimizu, K., and Kochhar, R. (2001). Direct and moderating effects of human capital on strategy and performance in professional service firms: a resource-based perspective. *The Academy of Management Journal*, *44*(1), 13-28.

Hsu, L.C., and Wang, C.H. (2012). Clarifying the Effect of Intellectual Capital on Performance: The Mediating Role of Dynamic Capability. *British Journal of Management*, *23*(2), 179-205.

Jimenez- Jimenez, D., and Sanz- valle, R. (2011). Innovation, organizational learning and performance. *Journal of Business Research*, *64*(4), 408-417.

Kademani, B.S., Kalyane, V.L., Kumar, V., and Lalit, M. (2005). Nobel Laureates: Their publication productivity, collaboration and authorship status. *Scientometrics*, *62*(2), 261-268.

Kamukama, N., Ahiauzu, A., and Ntayi, J.M. (2010). Intellectual Capital and Performance: Testing Interaction Effects. *Journal of Intellectual Capital*, *11*(4), 554-574.

Kaufmann, L., and Schneider, Y. (2004). Intangibles: a synthesis of current research. *Journal of Intellectual Capital*, *5*(3), 366-388.

Kim, D., and Kumar, V. (2009). A Framework for Prioritization of Intellectual Capital Indicator in R&D. *Journal of Intellectual Capital*, *10*(2), 277-293.

Kazan, H., Pekkanli, B., and Catal, H.V. (2012). Performance Evaluation in research and development, intellectual capital, and firm infrastructure projects as intangible assets. *African Journal of Business Management, 6*(5), 1872-1882.

Leitner, K-H., and Warden, C. (2004). Managing and reporting knowledge-based resources and processes in research organisations: specifics, lessons learned and perspectives. *Management Accounting Research*, *15*, 33-51.

Lev, B. (2001). *Intangibles: Management, Measurement, and Reporting*. Washington DC, Brookings (Italian edition Intangibles, Etas, Milan, 2003).

Li, Y.H., Huang, J.W., and Tsai, M.T. (2009). Entrepreneurial orientation and firm performance: The role of knowledge creation process. *Industrial Marketing Management, 38*, 440-449.

Liu, N.C., and Cheng, Y. (2005). Academic rankings of world universities- methodologies and problems. *Higher Education in Europe*, *30*(2), 127-132.

Maditinos, D., Chatzoudes, D., Tsairidis, C., and Theriou, G. (2011). The impact of Intellectual capital on firms' market value and financial performance. *Journal of Intellectual Capital*, *12*(1), 132-151.

Marimuthu, M., Arokiasamy, L., and Ismail, M. (2009). Human Capital development and its impact on firm performance: Evidence from developmental economies. *Journal of International Social Research, 2*(8), 265-272.

Mascitelli, R. (2000). From experience: harnessing tacit knowledge to achieve breakthrough Innovation. *Journal of Product Innovation Management*, *17*, 179-193.

Mayo, A. (2001). *The Human Value of the Enterprise: Valuing People as Assets – Monitoring, Measuring, Managing*. London, Nicholas Brealey Publishing.

Meho, L. I., and Spurgin, K.M. (2005). Ranking the research productivity of LIS faculty and schools: an evaluation data sources and research methods. *Journal of the American Society for Information Science and Technology*, *56*(12), 1314-1331.

Meritum (2002). *Measuring intangibles to understand and improve innovation management*. Final Report, European Community, available at: www.kunne.no/meritum

Namasivayam, K., and Denizci, B. (2006). Human capital in service organizations: identifying value drivers. *Journal of Intellectual capital*, *7*(3), 381-393.

Narin, F., and Hamilton, K. (1996). Bibliometric performance measures. *Scientometrics*, *36*(3), 293-310.

Nejadirani, F., Namvar, F.G., Rasouli, R., and Yadegari. M. (2012). Examining the Effects of Intellectual Capitals Management on Organizational Performance: The Case Study. *Research Journal of Applied Sciences, Engineering and Technology*, *4*(9), 1040-1050.

Nonaka, I., and Takeuchi, H. (1995). *The knowledge creating company*. New York, Oxford University Press.

OECD. (2006). *Intellectual Assets and Value Creation: Implications for Corporate Reporting*, Organization for Economic Co-operation and Development report, [Online] Available at: http://www.oecd.org/daf/corporate-affairs.

Pedrini, M. (2007). Human capital convergences in intellectual capital and sustainability reports. *Journal of Intellectual Capital*, *8*(2), 346 – 366.

Phusavat, K., Comepa, N., Sitko-Lutek, A., and Ooi, K. B. (2011). Interrelationships between Intellectual Capital and Performance. *Industrial Management & Data Systems*, *111*(6), 810-829.

Rastogi, P. (2000). Sustaining enterprise competitiveness- is human capital the answer? *Human System Management*, *19*(3), 193-203.

Rastogi, P.N. (2002). Knowledge management and intellectual capital as a paradigm of value creation. *Human System Management*, *21*, 229-240.

Rasula, J., Vuksic, V.B., and Stemberger, M.I. (2012). The Impact of Knowledge Management on Organizational Performance. *Economic Business Review*, *14*(2), 147-168.

Reed, K. K., Lubatkin, M., and Srinivasan, N. (2006). Proposing and testing an intellectual capital-based view of the firm. *Journal of Management Studies*, *43*(4), 867-893.

Reed, K. K., Srinivasan, N., and Doty, D. H. (2009). Adapting human and social capital to impact performance: some empirical findings from the U.S. personal banking sector. *Journal of Managerial Issues*, *21*(1), 36-57.

Rodriguez, P.J., and Loomis, R.S. (2007). A New View of Institutions, Human Capital and Market Standardization. *Education, Knowledge and Economy*, *1*(1), 93-105.

Shakina, E., and Barajas, A. (2012). The relationship between intellectual Capital quality and corporate Performance: an empirical study of Russian and European companies. *Economic Annals*, *58*(192), 79-97.

Sharabati, A.A.A., Jawad, S.N., and Bontis, N. (2010). Intellectual Capital and Business Performance in the Pharmaceutical Sector of Jordan. *Management Decision*, *48*(1), 105-131.

Slaus, I., and Jacobs, G. (2011). Human capital and sustainability. *Sustainability*, *3*(1), 97-154.

Sok, P., and O'Cass, A. (2011). Achieving superior innovation-based performance outcomes in SMEs through innovation resource–capability complementarity. *Industrial Marketing Management, 40*(8), *1285-1293*.

Sveiby, K. E. (1997). The Intangible Assets Monitor. *Journal of Human Resource Costing and Accounting*, *2*(1), 73-97.

Swart, J. (2006). Intellectual capital: disentangling an enigmatic concept. *Journal of Intellectual Capital*, *7*(2), 136-159.

Swart, J., and Kinnie, N. (2010). Organizational learning, knowledge assets and HR practices in professional service firms. *Human Resource Management Journal*, *20*, 64-79.

Tikoria, J., Banwet, D.K., and Deshmukh, S.G. (2010). Measuring the effectiveness of success factors: a case of government funded R&D organizations in India. *International Journal of Business Excellence, 3*(3), 279-302.

Toutkoushian, R.K., Porter, S.R., Danielson, C., and Hollis, P.R. (2003). Using publication counts to measure an institution's research productivity. *Research in Higher Education, 44*(2), 121-148.

Tsay, M.Y. (2004). Literature growth, journal characteristics and author productivity in subject indexing, 1977-2000. *Journal of the American Society for Information Science and Technology, 55*(1), 64-73.

Uzun, A. (2002). Productivity ratings of institutions based on publication in Scientometrics, Informetrics and Biblimetrics, 1981-2000. *Scientometrics, 53*(3), 297-307.

Walker, R.M. (2004). Innovation and organizational performance: Evidence and a research agenda. *Advanced Institute for Management Research Working Paper*, WP No: 002 - June.

Wright, P. M., McMahan, G. C., and McWilliams, A. (1994). Human resources and sustained competitive advantage: a resource-based perspective. *International Journal of Human Management, 5*(2), 301-326.

Yazit, N., and Zainab, A.N. (2007). Publication productivity of Malaysian authors and institutions in LIS. *Malaysian Journal of Library and Information Science, 12*(2), 35-55.

Youndt, M.A., Subramaniam, M., and Snell, S.A. (2004). Intellectual capital profiles: An examination of investments and returns. *Journal of Management Studies, 41*(2), 335-361.