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Role of intellectual capital on creation of innovation capabilities in HIS and computer units

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Abstract:

INTRODUCTION: Simultaneously along with information technology progress, knowledge has considered as a fundamental base for economic growth for the time being. In today's knowledge-based economy, production and exploitation of knowledge play the main roles in the process of wealth creation. The current revolution in information technology has given new light to the importance of knowledge such that it has now become the base of economy in today's world. In today's knowledge-based economy, production and exploitation of knowledge play the main roles in the process of wealth creation. Considering key contributions of knowledge management in competitiveness of organizations and their entry into global arenas, this study sought to evaluate the impact of different aspects of intellectual property on innovations in computer and health information system (HIS) units at selected medical center in the city of Isfahan during 2015.

OBJECTIVES: The present study seeks to evaluate the impact of different aspects of intellectual property on innovations in computer and HIS units at selected medical centers in the city of Isfahan during 2015 (2015).

SETTINGS AND DESIGN: Population of this research includes staff working in computer and HIS units of 10 medical centers. Data were collected using a questionnaire made by the researcher. A written questionnaire (also referred to as self-administered questionnaire) is a data collection tool in which written questions are presented that are to be answered by study individuals, where for the case of the present study include staff members working at computer and HIS units of 10 medical centers.

MATERIALS AND METHODS: In the first stage, medical factors were determined by experts of Isfahan University of Medical Sciences as intellectual property. Factors were then distributed randomly among 100 employees during a survey, after considering their validity and reliability.

STATISTICAL ANALYSIS: Descriptive and inferential statistics were used for data analysis.

RESULTS: Data analysis showed that innovation is one of the most important indicators of intellectual capital in computer and HIS units of medical centers and has a higher than average importance.

CONCLUSIONS: The results of this study, in addition to providing guidelines in the management of intellectual capital in Isfahan province hospitals, can be used as a model for improving innovation in hospitals and understanding various factors affecting organizational innovation.

Keywords:

Hospital, information technology, innovation, intellectual property

Introduction

Nowadays, knowledge is recognized as the economic base of the world. In the knowledge-based economy, production and exploitation of knowledge play major

roles in the process of wealth creation health information system.^[1] Therefore, for an organization, recognition, implementation, evaluation, and management of intellectual capital are of particular importance.^[2] Intellectual capital is one of the main factors of knowledge management and counted as the key to competitiveness. These capitals

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do not include tangible assets such as land and physical properties, but rather include intangible assets such as human capital, information technology, and innovation.

In addition, for modern organizations to be able to survive the new paradigm of competition currently present among organizations, it should consider innovation as an essential strategy and identify organizational factors which influence organizational innovation and provide the most appropriate answer to recent changes. Thus, this study tries to examine the impact of different indicators of intellectual capital on innovation in computer units of Isfahan's hospitals.

Problem Statement and Necessity of Research

Intellectual capital is a type of asset that enables wealth creation among organizations. As mentioned, this asset is not of a visible and physical nature. Rather, it is an intangible asset obtained through the deployment of assets associated with human resources, organizational performance, and relationships outside the organization.^[3] The newly emerging field of intellectual capital is a new research area that focuses on the creation of new measurement mechanisms for reporting important intangible variables, such as Information Technology and Innovation.^[4] This concept was first introduced by John Kenneth Galbraith in 1969. He believed that intellectual capital consists of not only knowledge and expertise but also the ability to apply them as a means to generate value.^[5]

Stewart also believed that intellectual capital is a combination of knowledge, information, experiential intellectual properties, competition, and organizational learning that can be used to create wealth.^[4] Its importance was highlighted after observing a 25% increase in employment in Europe between 2008 and 2010^[6] as well as 29% revenue growth and 20% increase in staff salaries.^[7] It should be noted that modern economy accompanied by intellectual capital shows its greatest impact and dynamics at the information communication technology industry.

On the other hand, the literature of strategic management views innovation as a critical factor for organizations to create value, and a sustainable competitive advantage in today's complex and changing environment, resulting in better and more successful performance in the organization.^[8] The process of organizational innovation is largely supported with the incorporation of human capital, organizational structure, and external organization relations. Therefore, the mastery of organizational processes, procedures, customer accounts, or property rights are the sources of success

in innovation.^[9] The new economy has doubled the importance of the role of intellectual capital in organizations,^[10] where this concept is considered as a strategy to gain and maintain competitive advantage.^[11]

Computer centers in therapeutic areas and hospitals need to recognize their intellectual capital and innovation in provision of services. The present study considers the question of "whether there is a relationship between intellectual capital and its components and innovation in HIS centers or not." Finally, it is hoped that the results of the study provide essential information and knowledge to improve and develop intellectual capital as a factor for development and improvement of organizational innovation among managers and directors of health centers.

Literature Review

In his study, Egbu investigated the role of knowledge management and intellectual capital in organizational innovation. Results showed a positive and meaningful correlation between knowledge management and factors of intellectual capital and organizational innovation. Based on the results, knowledge-based assets within the organization promote innovative actions of organization's members through involvement of their opinions and new ideas as well as incorporation of the importance of ideas and thoughts, which in turn lead to organizational innovation.^[12]

Bollen *et al.* reviewed the relationship between intellectual capital and intellectual property and the performance of pharmaceutical industry of Germany. The results showed that human capital has a significant positive effect on a company's performance. They claimed that due to the increased investment in intellectual capital and the benefits of measuring it, organizations can assess their potential for innovation, knowledge management, and competitive ability by measuring intellectual capital.^[13]

O'Connor *et al.* indicated in their study regarding (organizational innovation capability assessment) that organizational innovation requires two variables; The direct variable, also called "human capital" and the indirect variables including "knowledge and the right attitude, specialized training courses, capital dynamic structure strategy designed for flexible organizational structure, relational capital by establishing good relationships with customers, and internal and external stakeholders."^[14]

Cohen and Kaimenakis studied the relationship between intellectual capital and performance in knowledge-based medium-sized organizations. Their research findings

showed that the interaction of various categories of intellectual property in medium-sized organizations differ from large firms in certain aspects. In addition, experimental data showed that certain categories of intellectual capital have positive effect on a company's performance.^[15]

Zerenler investigated the impact of intellectual capital on innovation performance. The results indicated three types of intellectual capital (employee's capital, structural capital, and customer capital) which had a significantly positive relationship with innovation performance. The results of the study also showed that high growth rates in industry confirms positive relationship between these three types of intellectual capital and innovation performance.^[16]

Wu *et al.* investigated the roles of the mediator (intellectual capital) and the moderator (entrepreneurial orientation and social capital to support innovation). In particular, companies with higher levels of social capital and entrepreneurial orientation tend to reinforce the impact of intellectual capital on innovation.^[17]

Study results of Ghorbani *et al.* in his study on relationship between intellectual capital and organizational innovation in banks, displayed significant positive relationship between management of intellectual capital and innovation.^[18]

Sweet *et al.* (2014) showed that motivation for innovation increases by upgrading the standards of intellectual capital. They studied the effect of intensive intellectual capital systems considering the index of economic complexity in 94 countries from 1965 to 2005. The obtained results confirmed that with stronger intellectual capital system, the economic complexity level and social welfare will also be higher.^[19]

Woo *et al.* (2015) examined the impact of intellectual property laws and registered knowledge on innovation and the resulting increased value of the industry. Using simulation equations on data from 12 countries regarding for three industries (chemical, electronics, and mechanical), the result showed that intellectual capital directly affects the increase in value of the industry and indirectly affects the Research and Development (R and D) factor. This conclusion proves the importance and the role of intellectual capital on the success of an organization or an industry.^[20]

Comin and Manenti (2015) examined intellectual capital to predict innovation and economic growth in IT units in Europe's software industry. In general, analysis of intellectual capital in such industries focuses on

patents and proprietary rights of the industry. The researchers tried to examine new and important issues in this field.^[21]

Materials and Methods

The overall purpose of this project is to examine the effect of intellectual property on innovation in computer units and HIS medical centers of Isfahan in 2015. The specific objectives of the project include:

- Identification of intellectual property indicators;
- Determination of the relationship between intellectual assets and finally
- Innovative evaluation of the impact of each intellectual property indicator on the innovation indicator, at computer units and HIS medical centers of Isfahan.

The results of this research will help managers of medical centers to realize the current status of intellectual property in their HIS unit and consequently strive to improve the property and further enhance innovation of their center.

The present study is a quantitative research with practical purpose in the form of a descriptive survey. This research studies intellectual property and innovation in computer units and HIS at Isfahan medical centers. Study population included IT professionals and employees of HIS computer units working at 10 medical centers in Isfahan from 2015 to 2016 medical centers.

In addition to incorporating available library resources including books, journals, dissertations, research projects, articles in English and Farsi, data collection also included the use of questionnaires. The data collection tools were based on the researcher questionnaire. In the first step, to determine contributing factors in intellectual-medical property, a questionnaire was distributed among specialists of new technologies at Isfahan University of Medical Sciences [Table 1]. In the second stage, a questionnaire developed based on the factors of the initial step was distributed among 100 employees of computer and medical documents units working at health centers of Isfahan.

Table 1: The details of the questionnaire

Index	No specific questions related
Questions from 1 till 10	Human capital factors
Questions from 11 till 15	Factors innovation capital
Questions from 16 till 23	Factors IT
Questions from 24 till 29	Factors finance
Questions from 30 till 33	Factors organizational process
Questions from 33 till 39	Factors organizational innovation

The questionnaire provided was examined by several experts and professors in order to assess content validity, which was approved after minor fixes. Reliability was also assessed using Cronbach's alpha coefficient 0.90 in the first phase after distributing and collecting 30 questionnaires

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Results

To achieve the first objective (determination of intellectual property indicators), Hong's Intellectual Capital Model was used with six indicators of "human capital, financial capital, customer capital, innovation, process capital, and information technology." To test this hypothesis, all subfactors of the index were collected based on survey experts. Then, based on a questionnaire (Likert), the most important factors in computer and HIS units in hospitals were extracted.

Participants scored factors from 1 to 5 according to their importance. Then, by adding up the scores and choosing the factors with arithmetic average >4, 35 factors were selected and surveyed for the second questionnaire. Indicators and primary factors are shown in Table 2.

As can be concluded from the factors, many of the intellectual capital and innovation factors have been evaluated and a number of top-rated innovation factors were included in the questionnaire.

T-test was also used to assess the second research objective, which was whether the innovation indicator is above average regarding intellectual capital of the population or not. Test results determined that according to the population, importance of innovation index was significantly higher than average. T-test results are shown in Table 3.

Table 2: Factors collected in six areas

Customer capital	Financial capital	IT investment	Capital innovation	Investment process	Human capital
The market growth	Salary level in the same industry	Knowledge workers of IT	The ratio of new ideas created to new ideas has been done	The number of organizational levels	Culture of learning from others
Capacity to respond to the educational needs of customers	Funds rate	Use of information technology for internal affairs	Share knowledge	Investing in process improvement	Cooperation in the form of specialized committees
Maintain regular customers	Process cost - the cost of maintenance	Capacity utilization of information technology	The protection of the environment	Quality of products or services offered	Creativity and innovation employees
Manage the relationship between staff and customers	Management fees	The number of employees who are familiar with information technology	Learning critical technologies	Hospital social image	Value added per employee
Dependence on patrons	The cost of training per employee per year	Number of internet servers	Attitude to learning new things	Internal communication systems	Knowledge and expertise of staff
Timely delivery of services	The cost of ICT/ employees	Investment in computer equipment	Patent the idea	Turnover	Education staff
According to customer complaints	Percentage of the total expenditure on education investment	The number of personal computers/ number of employees	Designing products or services based on customer needs	Providing strategic objectives	Timely delivery of services
Physician relations	Afford to come to every employee	The use of information technology by employees	Equal opportunities for professionals for research and development	The process support new ideas	Job satisfaction
Customer focus	Price projects	Creating a database for use in updating the database organization	The cost of research	Taking time for processing activities in organizational processes	Staff training
The number of customers	The average monthly salary	Systems of decision-making at the management level	Effectiveness of spending on research	The efficiency of organizational processes	The number of managers
Pay attention to customer needs	The average annual salaries for professionals	DSS Use soft DSS software	Culture of innovation	The organization tends to get global standards	Delegation of authority
The average duration of the relationship with each customer	Take advantage sick of your personal information online	The use of electronic records MIS	Innovation in order to meet the full needs of customers and other stakeholders	The organization's ability to reuse the knowledge produced or acquired	The number of female managers

Contd...

Table 2: Contd...

Customer capital	Financial capital	IT investment	Capital innovation	Investment process	Human capital
Profitability per customer	The use of information technology specialists	Use soft EHR software	Medical knowledge up to date	Prioritize the processes	Number of employees under 40 years
Customer satisfaction	Running website	Use softwares HIS	Resources available for research and development	Implementation of management systems and continuous improvement	Number of employees with <2 years experience
Patient	Collaboration with physicians from different hospitals using IT	Using the data mining process	The overall investment process innovation	Provide high-quality care	Professional skills
The ability of the maintenance specialists	Telemedicine	Accuracy of the information entered into the information system	Research over the past 2 years/general studies	Review organizational processes	The interaction between the organization and employees
The number of new employees in the past year	Protection of patient data (security)	Timber-related insurance services	Introduction of new products or results	Judicious use of methods of dissemination of knowledge	Active employees
Attractive workplace	Design and implementation of a computer network in an organization	Launch automation	The number of appeal, which is still not accepted	Organizational culture	There are equal opportunities for the participation of each employee
The ability and incentive compensation programs	Use of expert advisors	Effect of exercise on staff	Investment in knowledge management processes	Quality management	The effect of desertions
The percentage of employees who are licensed, doctor	The number of hospital committees	Responsibility employees	The average age of employees	The value of the beliefs and attitudes of specialists	Employee loyalty to the job and the organization
Employee recognition	Knowledge management	Number of officials	Average hours of training	According to staff health and spiritual	Experienced staff

ICT=Information and Communication Technology, MIS=Management information systems

Table 3: t-test output

P	n	t	SD	Average
0.92	103	1.44	0.81	2.88

SD=Standard deviation

The third goal was finding a meaningful relationship between intellectual capital and innovation indicators in computer and HIS units in Isfahan Medical Centers. To achieve this goal, the following regression equation was applied:

Formula 1: Regression formula

$$y = a_1 \times x_1 + a_2 \times x_2 + a_3 \times x_3 + a_4 \times x_4 + a_5$$

Y: Indicators of innovation in organization, x_1 : Human Capital Index, x_2 : Finance Capital Index, x_3 : IT index and x_4 : Organizational Process Index. Coefficients a_1, a_2, a_3, a_4, a_5 set according to existing data. Notably, according to the survey, there was no intuitive correlation between disease index and innovation, so the patient's index was not included in the above equation.

According to the regression equation, it was found that human capital, financial, process, and IT indicators

have a positive impact on organization innovation index. The effect of human capital and organizational process indicators was significant and financial, and IT indicators had no significant impact on the innovation index. In other words, it is believed that the effects of finance and IT indices on innovation index are low for a desired population. Results of linear regression using SPSS software are shown in Table 4.

By examining the output of this regression model in Table 5 and assessing the last column of the ANOVA table, i.e., the column sig., the probability of model was obtained as zero.

Discussion

The present study was found three factors of "human, financial, and process capital and IT" as indicators of intellectual capital with a positive impact on creation and growth of innovation in organizations and intended departments.

"Human capital" with effective sharing of information and changing control of information, encourages people to work together, create competitive advantage,

Table 4: ANOVA test output in the study of the impact of information technology on innovation index

Model	Sum of squares	df	Average of squares	F	Significant
Model 1					
Regression	780.715	4	195.179	21.568	000.0
Error	832.543	92	9.049		
Total	1613.258	96			

Table 5: Coefficients in the test output to determine the impact of information technology on innovation index

Model	Nonstandard		Standardized (β)	t	Significant
	B	SE			
Fixed	-0.600	2.175		-0.276	0.83
Human capital score	0.228	0.066	0.288	3.453	0.001
Points finance	0.126	0.068	0.177	1.849	0.068
Points IT	0.048	0.048	0.091	1.004	0.318
Investment rating process	0.336	0.102	0.337	3.295	0.001

By examining the output of this regression model in Table 4 and assessing the last column of the ANOVA table, i.e., the column significant, the probability of model was obtained as zero. SE=Standard error

and create new opportunities for learning. Innovative organizations achieve success through their employees and organizations are bound to the dynamicity and creativeness of their members.

“Finance capital” has a direct impact on innovation and will cause its allocation to organizational innovation and create new processes. Obviously, innovation with impact on the performance of organization will increase financial capitals. In fact, there is a two-way relationship between these two indicators which may improve or weaken an organization.

“Organizational processes” have a direct impact on the increase or decrease of innovation in an organization. Factors such as support of new procedures in the organization reinforce the desire to provide higher quality services or increase organization’s capabilities and open the way to new methods and products.

Similar to all other researches, the human resources index is included in all of the common results. Other indicators are different considering which study was conducted in which society.

Conclusions

Innovation is knowledge-based process and is the product of knowledge and intellectual capital. It can be said that organizations with an appropriate level of intellectual capital are more innovative. This is due to the fact that learning occurs more in such organizations because of the intellectual capital and use of knowledge.

This, in turn, results in solutions for problems and provides new and nonmimetic solutions for practices and innovation in general.^[21]

“Information Technology” provides different opportunities for faster update on innovation and creativity of individuals and organizations. Since the life cycle of products and services are rapidly shortening and new technologies are born with ever-increasing speeds, IT could be important at different stages of organizational innovation management. Use of information technology can play a crucial role in the creation and formation of new ideas and resulting creativity and innovation in the organization.

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Conflicts of interest

This article has conflicts of interest from mentioned research center.

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