



ORIGINAL ARTICLE

Evaluation and Analysis of Intellectual Capital and Strategies for Enhancing It in National Water and Wastewater Engineering Company (NWWEC)

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ABSTRACT

Current work aims at evaluating and analyzing intellectual capital and offering strategies for promoting it in National Water and Wastewater Engineering Company (NWWEC). Sample includes 120 staffs of NWWEC selected by simple random sampling method. They completed Bontis's standardized intellectual capital questionnaire. Single-sample t-test results suggest significant difference between current and optimal status of intellectual capital. Minor questions of the research related to organizational capital, technological capital, and relational (customer) capital were supported. It means there is significant difference between current and optimal status in organizational, technological and relational (customer) capital. Rejection of hypotheses concerning human capital and social capital shows organization is in optimal level in this regards.

Keywords: Intellectual capital, social capital, and organizational performance

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INTRODUCTION

Most wealth production sources are located in knowledge and skill sectors of the organization in the current economic system. Unlike past decades when machineries, equipment and financial resources were regarded as the main sources of capital and wealth production, knowledge and skill and intellectual capitals of the organization are now more important than other sources in terms of wealth production. Drucker, management thinkers argues that we are entering an era in which the major sources of economy are not regarded as more capital, natural resources, more and more work, rather the main economy source is knowledge, and twenty-first century is the century of knowledge economy[1]. Accumulative knowledge of the organization is important in today knowledge economy [2]. Intellectual capital is representative of accumulative knowledge which is embedded in employers, organizational flow, and network relations of the organization [3-5].

Intellectual capital as an important source for organizations helps in achievement of sustainable competitive advantage [6,7]. Intellectual capital is a new theoretical topic introduced recently at global level. Since it is a valuable source for the countries and organizations, its development is increasing and it is becoming in index for development of the states. On the other hand, this invisible source is regarded as one of the most value making sources of the companies and a key capital in entrepreneurial growth. Hence, development and management of intellectual capital is a serious requirement at national macro level as well as in business. Movement toward knowledge-based economy has change governing industrial economy paradigm so that emergence of knowledge and information based economy is observed, basis of which is intellectual capital. In other words, intellectual capital can be considered as a knowledge package composed of intangible and implicit sources, Principles, culture, behavior, capabilities, competencies, structures, communication and the processes leading to the knowledge.

Studies in different countries provided different elements as constituents of intellectual capital. On the other hand, significance level of these constituents play important role in policy making and decision making by the managers. In 1982, per hundred dollars of investment in shares of U.S. manufacturing firms, 62% of this investment was spent on tangible assets, and tangible assets accounted for a considerable part of market value of the firms. However, it reduced to 16% in 1999, i.e. intellectual capital constituted almost 84% of market value of the firms. Studies indicate firms with higher level of control and focus on intangible assets have better performance and they have lower volatile stock prices compared to firms which neglect such capitals and especially intellectual capital.

Such significance is clearer when always a company is sold 4 or 5 times higher than value of its assets. Excess amount is paid on the value of intellectual capital such as human, structural, communication, brand capital and etc.

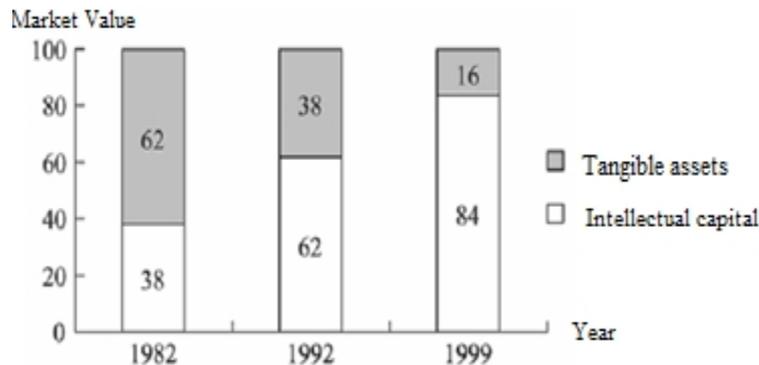


Fig 1. Intellectual capital percentage development in market value of the firms (Cheng et al., 2008)

Intellectual capital measurement in the organization is one of the intellectual concerns of the human resources practitioners in most developed and developing countries. Also, considering growth and considerable development of technology and the fact that it is not physical capital and financial resources which lead to organization growth and innovation, rather it is human capital, thus attention of the investors has been shifted to human resources capabilities rather than gaining information on financial assets, and they consider non-physical assets for valuation of the organizations. Meanwhile, automotive industry, as the third industrial field of the world, faces new challenges including saturation of markets, reduced profitability, increased customer expectations and seeking diversification, development of technology and the need to adapt and implement them before competitors and increasing attention to environmental issues and fuel consumption and etc. Confrontation with such challenges requires understanding and proper management of organization's knowledge and intellectual capital. Intellectual capital measurement is today one of the major issues in the organizations, since by correct measurement of this capital it is possible to offer main measures for intellectual capital management. You cannot manage what you cannot measure.

In knowledge-based economy, intellectual capital is used for value making for the organization. Today growing importance of intellectual capitals as an effective tool for increasing competition in the organization is clearly observed, and it leads to increased importance of intellectual capital as a research and economic category. Role and contribution of intellectual capital in managerial, technical and social, and economic development have been studied so that it is considered as a valuable tool for development of key assets of the organization. Intellectual capital measurement is done for comparison of different companies, determining their real value and even developing their controls based on strategic approach to intangible assets.

To this end, current research aims at evaluating and analyzing intellectual capital and providing strategies for its promotion in National Water and Wastewater Engineering Company (NWWEC).

METHOD, SOCIETY AND RESEARCH SAMPLE

Research design is descriptive survey, since aim of which is investigating intellectual capital of National Water and Wastewater Engineering Company (NWWEC). Statistical society consisted of all staffs and employees of NWWEC who were active in 2013 spring. Following relation was used for calculating sample size:

$$\frac{nz \frac{\alpha}{2} p(1-p)}{\frac{4}{\varepsilon} (n-1) + z^2 \frac{\alpha}{2} p(1-p)} = N$$

Where, statistical society with 450 ones and standard error 0.05, sample size was specified as 120 ones using this formula. Simple random sampling method was used.

Measurement Tool

Bontis's Intellectual Capital Measurement Questionnaire

Bontis's standardized intellectual capital questionnaire was used for intellectual capital measurement.

This scale includes five components (human capital, social capital, structural capital, technological capital, organizational capital) and 53 items. Results of statistical calculations using Cronbach alpha in order to estimate the internal consistency of the items indicate internal consistency coefficient as 0.96 which suggest very high internal consistency for the items.

Table 1 gives descriptive indices for investigation of appropriate distribution and data distribution normality

Table 1. Descriptive indices of research variable

Intellectual components	capital	Frequency	Mean	Standard error of the mean
Human capital		120	2.7667	0.85187
Customer capital		120	3.0833	0.69914
Structural capital		120	2.8333	0.96435

Considering above table, mean is 2.7, 3.08, and 2.83 in human, customer and structural capital, respectively. Thus, highest mean is associated to customer capital and lowest mean is related to human capital.

In order to test main research hypothesis, single-sample t-test was used. Main research hypothesis is where there is significant difference between current status and optimal status of intellectual capital in the organization. As observed in Table 2, since P-value = 0.127 is higher than 0.05, main hypothesis is supported and it can be stated current status of intellectual capital in *NWVEC* is lower than optimal status. Thus, main research hypothesis stating significant difference between current status and optimal status of intellectual capital in the organization is supported.

Table 2. Results of single-sample t-test for investigating intellectual capital

	Test criterion = 3					
	T	Degree of freedom	p-value	Sig difference	Confidence interval 95%	
					High level	Low level
Intellectual capital	-1.153	119	0.127	-0.105	0.3	-0.241

First minor hypothesis is whether there is significant difference between current status and optimal status of human capital in the organization in the view of the *NWVEC* managers. Single-sample t-test was used. As observed in Table 3, considering p-value = 0.003 is lower than 0.05, H_0 is rejected. I.e. mean of human capital is higher than 3 and it can be stated current status of human capital in *NWVEC* is better than optimal status. Thus, according to findings first minor hypothesis is rejected.

Table 3. Results of single-sample t-test for investigating human capital

	Test criterion = 3					
	T	Degree of freedom	p-value	Sig difference	Confidence interval 95%	
					High level	Low level
Human capital	-3.001	119	0.003	-0.23	-0.79	-0.38

Second minor hypothesis is whether there is significant difference between current status and optimal status of organizational capital in the organization in the view of the *NWVEC* managers. Single-sample t-test was used. As observed in Table 4, considering p-value = 0.729 is higher than 0.05, H_0 is not rejected.

I.e. mean of organizational capital is lower than 3 and it can be stated current status of human capital in *NWWEC* is lower than optimal status level. Thus, according to findings second minor hypothesis is supported.

Table 4. Results of single-sample t-test for investigating organizational capital

	Test criterion = 3					
	T	Degree of freedom	p-value	Sig difference	Confidence interval 95%	
					High level	Low level
organizational capital	-0.347	119	0.729	-0.32	0.16	-0.22

Third minor hypothesis is whether there is significant difference between current status and optimal status of social capital in the organization in the view of the *NWWEC* managers. Single-sample t-test was used. As observed in Table 3, considering p-value = 0.001 is lower than 0.05, H_0 is rejected. I.e. mean of human capital is higher than 3 and it can be stated current status of social capital in *NWWEC* is higher than optimal status level. Thus, according to findings third minor hypothesis 3 is rejected.

Table 5. Results of single-sample t-test for investigating social capital

	Test criterion = 3					
	T	Degree of freedom	p-value	Sig difference	Confidence interval 95%	
					High level	Low level
Social capital	3.407	119	0.001	0.267	0.42	0.11

Fourth minor hypothesis is whether there is significant difference between current status and optimal status of technological capital in the organization in the view of the *NWWEC* managers. Single-sample t-test was used. Considering p-value = 0.121 is higher than 0.05, H_0 is not rejected. I.e. mean of organizational capital is lower than 3 and it can be stated current status of technological capital in *NWWEC* is lower than optimal status level.

Table 6. Results of single-sample t-test for investigating technological capital

	Test criterion = 3					
	T	Degree of freedom	p-value	Sig difference	Confidence interval 95%	
					High level	Low level
Technological capital	-1.256	119	0.121	0.3	0.12	0.48

Fourth minor hypothesis is whether there is significant difference between current status and optimal status of relational capital (customer) in the organization in the view of the *NWWEC* managers. Single-sample t-test was used. Considering p-value = 0.194 is higher than 0.05, H_0 is not rejected. I.e. mean of organizational capital is lower than 3 and it can be stated current status of relational capital in *NWWEC* is lower than optimal status level. Thus, minor hypothesis 5 is supported.

Table 7. Results of single-sample t-test for investigating relational capital (customer)

	Test criterion = 3					
	T	Degree of freedom	p-value	Sig difference	Confidence interval 95%	
					High level	Low level
relational capital	1.306	119	0.194	0.833	2.9	4

In order to investigate homogeneity of variable prioritization, Friedman test was used. As observed in Table 8, since p-value is zero and smaller than 0.05, thus H_0 is rejected, i.e. homogeneity of all ranks is not supported.

Table 8. Friedman test

Number	90
Chi-square	997.34
Degrees of freedom	6
P - Value	0.000

Table 9 is descriptive statistical indices which show mean of ranks for variables. According to the table, significance of human capital variable is most and the next priorities include: social capital, human capital, organizational capital, relational capital, technological capital.

Table 9. Mean of ranks for variables

Components	Mean of ranks
Human Capital	4.77
Social capital	4.12
Relational capital	3.25
Technological capital	2.92
Organizational capital	3.53

In order to investigate difference between demographic variables, statistical difference tests were used. As observed in Table 10, there is no significant difference in specified groups (below 10 years, 11-20 years, above 21 years) of working experience.

Table 10. Significant difference test for different groups in terms of working experience

Strategy	Sum of squares	Degree of freedom	Mean of squares	F	P-value
Between groups	1.224	2	0.612	0.940	0.403
In groups	16.914	86	0.651		
total	18.18	88			

As in Table 10, since p-value is 0.403 and it is larger than 0.05, H_0 is not rejected, i.e. there is no significant difference in specified groups in terms of working experience.

Table 11. Significant difference test for different groups in terms of academic degree

Intellectual capital	Sum of squares	Degree of freedom	Mean of squares	F	P-value
Between groups	1.23	2	1.123	1.882	0.172
In groups	13.26	87	0.0452		
total	14.19	89			

Since p-value = 0.172 which is higher than 0.05, there is no significant difference in terms of academic degree (BA, MA, PhD and higher) in supporting main question.

Table 12. Significant difference test for different groups in terms of gender

Strategy	Sum of squares	Degree of freedom	Mean of squares	F	P-value
Between groups	2.22	2	1.111	0.936	0.11
In groups	15.944	87	0.591		
total	18.167	89			

Since p-value = 0.11 which is higher than 0.05, there is no significant difference in terms of gender in supporting main question.

Table 13 indicates difference in human capital, customer capital, and structural capital aspects are in the process of strategy implementation. As observed in Table 13, these three aspects are difference according to four statistics, since p-value is below 0.05 in all statistics, thus there is significant difference between three aspects supporting main question.

Table 13. Significant difference test for three aspects

	Value	F	Degree of freedom	p-value
Pillai's Trace	0.252	4.75	2	0.017
Wick's Lambda	0.747	4.75	2	0.017
Hotelling's Trace	0.340	4.75	2	0.017
Roy's Largest Root	0.340	4.75	2	0.017

DISCUSSION AND CONCLUSION

Aim of the current work is investigating and evaluating elements of intellectual capital in National Water and Wastewater Engineering Company (NWVEC) and providing solution for its promotion and reaching to optimal status. To this end, one main and five minor questions were proposed. Findings were analyzed

and provided in the form of tables and descriptive statistics using inferential statistics tests. Considering obtained results, general conclusions are made in relation with the research in this section.

Data obtained from *Bontis's standardized intellectual capital questionnaire* were classified based on 5-score Likert scale (very low = 1, low = 2, medium = 3, high = 4, very high = 5) and criterion mean was considered as 3. In answering question 1, it can be stated intellectual capital has descriptive mean as 2.89, thus it is smaller than 3. Considering *p-value* (0.127) is larger than 0.05, i.e. current status of intellectual capital in National Water and Wastewater Engineering Company (NWWEC) is lower than optimal status level. These findings are consistent with findings by Li (2010) and Shojaee et al. [7] regarding importance of human and organizational capital in ABFA Co. and findings by Setayesh et al. [8] regarding significant positive impact of intellectual capital on the organization's future performance.

Considering confirmation of the main research question, important and crucial and different role of intellectual capital in promoting appropriate structure and shaping optimal status can be mentioned. Given difference influence of intellectual capital in organization sectors, it should be properly measured and given influence level of indices of this capital, it should be utilized.

Confirmation of the minor research questions suggests the fact that there is significant difference between current and optimal status of organizational, technological, relational (customer), and intellectual capitals, and rejection of hypotheses regarding human and social capital shows these cases are in optimal status in National Water and Wastewater Engineering Company (NWWEC).

Followings are recommended for enhancing components of human capital:

1. Identification of strategic jobs (jobs that achieving organizational goals depends on effectively identifying them)
2. Continuous measurement of competence level of personnel and using improvement programs to improve and designing and developing systems for measuring job satisfaction in the organization
3. Continuous measurement of job satisfaction in time intervals and analyzing this information
4. Adopting decisions based on the results of information analysis in order to eliminate obstacles to achieve job satisfaction
5. Defining balanced performance plans and goals, yet with a systematic approach to them
6. Continuous measurement of employee performance in time intervals
7. Analysis of data obtained from measuring employee performance and comparing it with the performance standards and taking measures such as punishment and reward
8. Preparing career paths and succession tables for the jobs in the organization, using performance data to upgrade employees
9. Providing training, consulting and organizational opportunities to help employees with good performance are further improved.

Followings are recommended for enhancing components of organizational capital:

1. Identifying those key processes that have the most value for customers
2. Documentation of processes and practices and identification and utilization of experiences of domestic and foreign competitors
3. Using sophisticated and modern structures like project and team structures in different parts of the organization; using information systems that make it easy to access the information
4. Allocating more budget and time to applied research and development and interaction and cooperation with the authorities and the scientific community and using experiences of domestic and foreign competitors
5. Using Suggestions system within the organization to receive the views of staff and outside the organization to receive customer comments.

Followings are recommended for enhancing components of social capital:

1. Paying attention to the knowledge and awareness of employees to improve their attitude and enabling them
2. Establishing a relationship based on trust between managers and employees and customers
3. Participation of members in decision making to attract their full-scale support for achieving goals of the organization
4. Using systematic and competent management principles and methods that creates and strengthens social capital as an intangible asset in the organization. Expanding and strengthening social capital within the organization play significant role in improvement of quality and productivity and success.

Followings are recommended for enhancing components of technological capital:

1. Improving performance indicators and enhancing productivity arising from the implementation of employee suggestions

2. Enabling employees to work for improving and dynamiting working environment through proper ground for realization of creativity and talents of employees
3. Creating enthusiasm for learning, studying, training and research in employees for finding opportunities for improvement and suggestion
4. Promoting and facilitating implementation of decisions and performing affairs by increased employee participation in decision making
5. Creating ways to make easy access to information through the proper informing and focused systems
6. Using new methods of service delivery and reduced costs

Followings are recommended for enhancing components of relational capital (customer):

1. Training proper customer orientation to employees which are in direct contact with customers and other clients
2. Identifying needs of employees and customers; distribution of feedbacks across the organization
3. Inclusion of comments in designing and providing services; enhancing customer orientation attitude among all members of the organization
4. Hiring, training, motivating and empowering employees so that they are able to provide services to each other and organization's clients
5. Continuous tracking and timely response to complaints and criticisms and expectations and proposals.

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