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EURASIA Journal of Mathematics, Science and Technology Education, 2018, 14(5), 1663-1682
ISSN:1305-8223 (online) 1305-8215 (print)
Research Paper https://doi.org/10.29333/ejmste/85037

Identifying the Variables of Intellectual Capital and Its Dimensions with the Approach of Structural Equations in the Educational Technology of Iran

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Received 8 June 2017 ▪ Revised 24 October 2017 ▪ Accepted 25 November 2017

ABSTRACT

With the growth of the knowledge economy, organizations have found that the value of an organization is not just the financial capital of an organization but also its intellectual capital. Since intellectual capital is an intangible asset, identification of its indicators and its variables from the financial and cost perspective has become a challenge for managers. This has increased the importance of intellectual capital as research and economic categories. Due to the role of intellectual capital spending in the value added of organizations, this topic is the subject of new research. The purpose of this study is to identify intellectual capital variables based on cost indices in the Iranian educational technology. Therefore, firstly, cost indicators that are effective are found, then a questionnaire based on the Likert scale is developed. Exploratory factor analysis has been used to extract factors. After performing the factor analysis, the indicators are classified into nine categories. According to the extracted factors, 9 factors are classified into 3 groups. Confirmatory factor analysis has been used to confirm this categorization. For this purpose, all the statistical indices introduced by the experts in this field have been presented to confirm the model. The results of this research show that human capital dimension includes 4 factors, structural capital dimension includes 3 factors, and dimension of relational capital includes 2 factors in intellectual capital of Iranian educational technology.

Keywords: intellectual capital, confirmatory factor analysis, human capital, structural capital, relational capital, educational technology

INTRODUCTION

The concept of intellectual capital is introduced as a relatively new perspective that is an integration of resource-oriented and knowledge-oriented perspective (Stam & Andriessen, 2009). In the resource-oriented view, there was no clear distinction between varieties of organizational resources. On the other hand, in the knowledge-based view (knowledge management), all attention was focused on organizational knowledge and its explicit and hidden forms. But in terms of intellectual capital, emphasis is placed on the identification and management of all intangible resources and capital of the organization. In this view, knowledge and other intangible assets as valuable resources along with the resources of work, land, and capital (previously considered in the economy) are presented as assets that, unlike previous sources, their value is increased as they are being used (Afrazeh, 2005). With the advent of the information technology revolution, the information and networking society, and the rapid growth and development of superior technology, the pattern of global economic growth has changed. As a result, knowledge has become the most important alternative to financial and physical capital in today's global economy. In a knowledge-based organization, traditional accounting methods, based on tangible assets of the organization, are inadequate to value intellectual capital, the largest and most valuable intangible assets of organizations. Studies have shown that, contrary to the decline in the returns of traditional resources such as money, land, machinery, etc., knowledge is really a source of business performance improvement. Intellectual capital has been

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Contribution of this paper to the literature

- This research, considers on studying the structures of intellectual capital factors in educational technology through exploratory factor analysis, based on indicators in subject literature and interviews with educational experts.
- Using statistical methods, it's been confirmed and categorized so as to 1. Choosing effective factors in educational industry, 2. Allocating costs of each indicator to the related dimension.
- EFA method considers on dimensions of intellectual capital and categorization of them into educational technology, also CFA method was used for confirmation of these categorizations.

conceptualized by various disciplines. For example, accountants are interested in measuring it in balance sheets, information technology experts are trying to codify it in information systems, sociologists tend to balance power using it, psychologists tend to develop minds, human resource managers tend to calculate the return on investment through it, and education and development staff are keen to be sure they can put it into human resource development programs. With regard to the elements that comprise intellectual capital and its components, many comments and models have been presented by scientists. It seems that when looking at the literature of intellectual capital research, most intellectual capital models have tried to consider three components of human capital, structural capital, and relational capital for intellectual capital (Bontis, 2003).

Factor analysis is a general approach to some of the multivariate methods, the main purpose of which is to summarize the data, and it examines the internal correlation of a large number of variables and ultimately describes them in the form of finite general factors. This technique is a method in which all variables are simultaneously considered. Therefore, the value of factor analysis is that it derives a useful organizational design that can be used to explain a large amount of behavior with the most savings in structures (Hair Jr, Hult, Ringle, & Sarstedt, 2016). In this paper, exploratory and confirmatory factor analysis is used to identify and categorize the cost indices of intellectual capital. In this research, we first studied the literature of the subject and extracted items related to the cost indexes of intellectual capital. Then, a questionnaire has been developed to examine the relationship between these items and their categorization. The statistical population of the research consisted of researchers and experts in the educational technology of Iran. Finally, 300 people responded to the research questionnaires. The reliability of the Guttman test is appropriate for each case of reliability. To use the exploratory factor analysis, we examined the data normality. For this purpose, the KMO coefficient is used for data adequacy, the Bartlet test is used for spatial and symmetry, and principal component method is used to extract the factors, and the VARIMAX rotation have been used. After performing factor analysis, the indices are classified into nine categories. It was found out that the intellectual capital indices were classified into three categories of human capital, structural capital and relational capital, and, according to the factors extracted, the nine factors were classified into these three groups. Confirmatory factor analysis has been used to confirm this categorization. For this purpose, all the statistical indices introduced by the experts in this field have been presented to confirm the model.

SIGNIFICANCE OF THE STUDY

With the growth of knowledge economy, studies on intellectual capital and cost and its added value have been considered in Iranian companies in recent years. In a large amount of research, the relationship between intellectual capital and value added of organizations has been investigated. With this in mind, the importance of the role of cost indicators of intellectual capital in improving organizational performance and management is not at stake. Intellectual capital indexes and their priorities in each organization or industry are different and belong to the same organization. The educational industry in Iran is no exception. Given the importance of this industry in Iran and its role in economic development, it cannot be ignored. Therefore, paying attention to intellectual capital cost indicators leads to the optimal use of resources in order to increase productivity and value added in this industry. Therefore, the identification of intellectual capital indices in this industry requires careful examination. Accordingly, the categorization and presentation of appropriate cost variables would be helpful in order to plan for the use of those intangible resources.

OBJECTIVES

In this research, considering the importance of calculating the cost of intellectual capital and its role in calculating the value added of educational technology in Iran, in order to avoid overlapping of these costs, dimension reduction is attempted through exploratory and confirmatory factor analysis, so as to eventually present a model for calculating the impact of intellectual capital on the value added of Iran's educational technology with cost approach. The purpose of this study is to identify the intellectual capital variables in Iran's educational technology using exploratory factor analysis and identify its dimensions using confirmatory factor analysis.

1. What are the factors of intellectual capital in Iran's educational technology?
2. How much do supposed factors explain observations?
3. How much of the specific variance is covered by the observed variable?
4. What are the factors associated with intellectual capital measurement in producing educational technologies?
5. What is the effect of each of the factors associated with intellectual capital assessment?

THEORETICAL FOUNDATIONS AND RESEARCH LITERATURE

Intellectual Capital

By entering the knowledge economy, the role of intangible assets has become more important than the past, so that future competitive advantage in all organizations, including sports organizations, is based on the effective and appropriate use of these types of intangible assets (Hofmann, Schneider, & Walter, 2005). Organizations often have limited resources and facilities; therefore, identifying, defining and prioritizing elements and indicators that are more important in their performance and productivity will lead to a guidance for decision making and planning and enables managers to understand the most important and effective indicators of intellectual capital in order to invest on them. As a result, taking advantage of the intellectual capital benefits and their management is the first step in identifying their dimensions and indicators (Bozbura, Beskese, & Kahraman, 2007).

The scholars have considered three types of intellectual capital for organizations, including human, structural and relational capital. Human capital refers to a set of knowledge, skills, competence, problem-solving capabilities, and decision-making in human resources (Curado, Henriques, & Bontis, 2011). Relational capital emphasizes the organization's ability to interact with the business environment. The third type of intellectual capital is structural (organizational) capital (María Viedma Marti, 2001). If we deduct human from an organization, what remains is structural capital (Baker, 2008).

RESEARCH LITERATURE

Table 1 presents researches and literature on the topic of identifying intellectual capital indicators. Initially, the dimensions of intellectual capital along with the indicators identified by the authors of each research are presented separately.

Table 1. Intellectual capital and firm performance indicators/elements

Dimension	Author(s)	Comments
1. Human capital	Kim & Kumar; F-Jardon & Martos; Chen et al.; Bontis; Sveiby; Brooking; Kaplan and Norton; Kim & Kumar; F-Jardon & Martos; Wang and; Chen et al.; Bueno et al. Bontis Asonitis & Kostagiolas; Chen et al.; Brooking F-Jardon & Martos; Edvinsson and Malone; Kaplan and Norton; Asonitis & Kostagiolas; Kim & Kumar	Comprises knowledge, skills, abilities, qualities, talents etc. of employees.
a. Employees' competence		Includes employee level of satisfaction, turnover rate, and corporate values.
b. Employees' attitude		Comprehends employee specialty and his ability for continuous innovation.
c. Employees' creativity		Encompasses motivation for work and satisfaction for work. Comprises staff experiences comprises role clarity, perception, their general well-being, and stress experienced.
d. Motivation of the personnel		
e. Staff's experience		
2. Structural Capital	Kim & Kumar; F-Jardon & Martos; Wang and Chang; Chen et al.; Bueno et al.; Moon and Kym; Chen et al.	Includes ethics, faith, behavior criterions approved and shared by all the staff.
a. Corporate culture	Sveiby; Brooking	Encompasses the policy-making, leading, controlling, and the information structure.
b. Organizational structure	Asonitis & Kostagiolas; Chen et al.	Involves utilization of inner information and repository of the firm. Comprises operational tasks, working methods of the firm. Comprises Storage, transmission and disposal of inner information of firm.
c. Organizational learning	Asonitis & Kostagiolas; Chen et al.	
d. Operation process	Asonitis & Kostagiolas; Kim & Kumar; Chen et al.	Includes copy rights, new products, and technologies obtained through the technical innovation.
e. Information system		Involves the investment, operation, cooperation, and motivation mechanism.
f. Innovation achievements	Asonitis & Kostagiolas; Chen et al.	Includes support and encouragement to employees' innovational mechanism.
3. Relational Capital	Asonitis & Kostagiolas; Kim & Kumar; F-Jardon & Martos;	Incorporates brand is worth in terms of income, status, and market value.
a. Brand value	F-Jardon & Martos	Helpful in reshaping the relationship with suppliers can create win-win situation and increase the profitability of both parties.
b. Relationship with suppliers and competitors	Bueno et al.; Kaplan and Norton	Includes customer expectations, perceived quality, and perceived value.
c. Customer satisfaction	Asonitis & Kostagiolas; Kim & Kumar; Bontis; Roos and Roos	Involves cooperation with other bodies and sharing similar aims for future development activities.
d. Relationship with other organization	Asonitis & Kostagiolas; F-Jardon & Martos; Bueno et al.	Encompasses identifying ability of customer needs, serving capability, and the capability of collecting and utilizing customers' data. Contains market share, potential, brand and trademark reputation. Includes customer satisfaction, outflow, complaint, price tolerance, and customer relationship. Encompasses customer expectations of a firm's service, and the element of customer satisfaction and market orientation.
e. Marketing capability	F-Jardon & Martos; Chen et al.	
f. Market intensity	Asonitis & Kostagiolas; Chen et al.	
g. Customer loyalty	Kim & Kumar; F-Jardon & Martos ; Chen et al.; Cohen & Kaimenakis Mayo ; Bontis; Roos and Roos	
h. Customer appropriateness		

CONCEPTUAL UNDERSTANDING OF FACTOR ANALYSIS AND ITS APPLICATION

Factor analysis is a technique that enables reducing the number of dependent variables into a smaller number of hidden or latent dimensions. Its main purpose is to adhere to the principle of economics and saving through the use of the smallest explanatory concepts in order to explain the maximum amount of common variance in the correlation matrix. The basic assumption of factor analysis is that the underlying factors of variables can be used to explain complex phenomena and the observed correlations between variables are the result of their sharing in these factors. The objective of the factor analysis is to detect these unobservable factors based on a set of observable variables. The factor is a new variable that is estimated by linear combination of the main scores of observed variables on the basis of formula (1):

$$F_j = \sum W_{ji}X_i = W_{j1}X_1 + W_{j2}X_2 + \cdots + W_{jp}X_p \quad (1)$$

where, W denotes factor coefficients and P represents the number of variables. These factors, in themselves, are hypothetical or theoretical structures that contribute to the interpretation of consistency and harmony in the data set. Therefore, the value of factor analysis is that it provides a useful organizational design that can be used to interpret a large amount of behavior with the greatest savings in explanatory constructions.

The hope is that a small number of these factors (that is, linear combinations of the main scores of observed variables) can cover almost all the information obtained by a larger set of variables and as a result, simplify describing the characteristics of the individual. Moreover, we hope that with the proper development of the factors, we create variables that imply a clear structure with a psychological meaning in such a way that our description of the person is not only simpler, but also clearer and more decisive (Hair Jr et al., 2016).

Smart PLS version 2.0 was used for data analysis. It is a second-generation tool, referred to as partial least squares structural equation modeling (PLS- SEM) (Hair Jr et al., 2016).

METHODOLOGIES

This research is a descriptive correlational and applied research study in which exploratory and confirmatory factor analysis of intellectual capital in the educational technology of Iran has been addressed. In this research, from the one hand, the analysis of the contents of articles related to the subject of research and, on the other hand, the questionnaire has been used for data collection. This questionnaire contains 57 questions that have been prepared for modeling and determining factors and indicators of intellectual capital. To achieve this goal and validate it, the most important factor is reliability and validity. In this research, content validity (confirmed by 8 experts of intellectual capital in the educational technology) and construct validity, and for determining the reliability, the Cronbach Alpha reliability coefficient were used. The statistical population of this research included: presidents, vice presidents, teachers, principals of educational centers, students and experts of educational technology. From this, 340 people were selected as a sample of research using random sampling. Of the whole sample, 32 questionnaires were not returned and 8 questionnaires lacked the required accuracy; therefore, 300 questionnaires had the necessary conditions for the analysis. Statistical analysis of exploratory and confirmatory factor analysis have been used to analyze the data. The findings of exploratory factor analysis led to identification of 9 factors of job satisfaction, human abilities and skills, job competency and level of personnel training on human capital dimensions, information technology systems, process and brand of structural capital dimensions, customer information and customer satisfaction of the dimensions of relational capital. By looking at the literature on intellectual capital, three general categories are considered for its variables. In this research, this has been addressed to explore and identify the dimensions of intellectual capital in this technology using confirmatory factor analysis. Findings of the confirmatory factor analysis showed that the intellectual capital model in the Iranian educational technology is fitted and applicable.

IDENTIFYING INTELLECTUAL CAPITAL INDICES IN IRAN'S EDUCATIONAL TECHNOLOGY

In the first step, by studying authoritative and scientifically valid sources, while familiarizing with the concepts and definitions of intellectual capital components and intellectual capital models in education, a preliminary list of suitable indicators for measuring intellectual capital in educational technologies was identified. **Table 1** shows a number of these indicators.

In the second step, using the opinions of the experts working in the educational technology of Iran, a number of the most appropriate indicators of intellectual capital were extracted from the preliminary list, which is presented in **Table 2**. It should be noted that this step was aimed at identifying indices appropriate to the structure of the Iranian educational technology.

Table 2. Indices of intellectual capital proportional to research

No.	Indices of intellectual capital	No.	Indices of intellectual capital
1	The cost of training	30	The cost of facilitating services to students
2	The cost of organizing courses outside the organization	31	The cost of providing effective services
3	The costs of conferences	32	The cost of customer perception of the actual services provided
4	The cost of publishing domestic and foreign papers	33	The cost of personal services to customers
5	The cost of employee knowledge, skills and attitude to issues	34	The cost of production of custom goods in accordance with customer's request
6	The cost of estimating innovations and creativity	35	The cost of designing information infrastructures and the architecture of information networks
7	The cost of improving capabilities	36	The cost of supporting informatics and networking systems
8	The cost of implementing scientific and technological advantages	37	The cost of outsourcing, providing and supporting the information systems required for organization mechanization.
9	The cost of transferring high-level training skills to organizations	38	The cost of central server maintenance
10	The cost of maintaining laboratories and workshops	39	The cost of identifying processes and analyzing the flow of information and operations along mechanization
11	The cost of treatment and psychology	40	The cost of maintenance of communication networks
12	The cost of festive and occasions	41	The cost of information retrieval
13	The cost of compassionate help in personal problems	42	The cost of implementing an information system in the field of CRM
14	The cost of bonus package (Stock)	43	The cost of implementing the information system in the field of communication and interaction with suppliers
15	The cost of purchasing employees' consumables	44	The cost of launching search engines
16	The cost of interest-free gratuitous loans	45	The cost of measuring process adaptation
17	The cost of receiving a car insurance benefit	46	The cost of process audit results
18	The cost of supervisory loan	47	The cost of implementation of management systems
19	The cost of recreational programs	48	The cost of process monitoring
20	The cost of cash or non-cash rewards of the organization to the person for motivation	49	The cost of measurement of Process Indicators (KPIs)
21	The cost of developing integrated information systems to improve the cost of processes and the effective interaction of staff	50	The cost of designing process models such as: Customer-oriented process reference model (CPRM) Event-driven process chain (EPCs) Medical process models (MoBimeP)
22	The cost of providing facilities to superior staff		
23	The cost of human capital development through incentive schemes and staff incentives	51	The cost of documenting and archiving
24	The cost of organizing workshops on effective communication and creativity and innovation in work	52	The cost of independent performance assessment
25	The cost of collecting customers' sales records by type of product, customer, geographical area	53	The costs of creating software systems mechanisms
26	The cost of collecting and reviewing new customers' needs and requirements	54	The cost of ten-year trademark renewal
27	The cost of data mining as a useful tool for identifying customer behavior patterns	55	The cost of examining an international registration application as a source office
28	The cost of collecting potential customer profiles	56	The cost of logo design
29	The cost of attending exhibitions	57	The cost of brand research

The third step is identifying the variables of intellectual capital using exploratory factor analysis. For this purpose, a questionnaire was prepared for the experts to identify the variables. Questionnaire questions were created based on the Likert scale. Subsequently, the questionnaires were gathered and observed. Only 300 questionnaires had the necessary conditions for exploratory factor analysis. In order to verify the reliability of the questionnaire, GUTTMAN method was used in this section. If the Lambda coefficient is higher than .7, then the reliability of the questionnaire is confirmed. The results of this test are presented in **Table 3**.

Table 3. Reliability statistics

Lambda	1	.802
	2	.852
	3	.816
	4	.858
	5	.830
	6	.896
N of Items		57

Table 4. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.859
Bartlett's Test of Sphericity	Approx. Chi-Square	11087.341
	df	1596
	Sig.	.000

Table 5. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.665	15.202	15.202	8.665	15.202	15.202	7.248	12.716	12.716
2	6.538	11.471	26.672	6.538	11.471	26.672	5.841	1.247	22.963
3	5.103	8.953	35.625	5.103	8.953	35.625	4.273	7.497	3.460
4	4.258	7.470	43.096	4.258	7.470	43.096	3.989	6.999	37.459
5	3.892	6.829	49.925	3.892	6.829	49.925	3.578	6.278	43.736
6	2.323	4.076	54.000	2.323	4.076	54.000	3.466	6.081	49.818
7	2.119	3.718	57.719	2.119	3.718	57.719	2.739	4.805	54.623
8	1.948	3.418	61.137	1.948	3.418	61.137	2.729	4.788	59.411
9	1.638	2.873	64.010	1.638	2.873	64.010	2.621	4.599	64.010

Extraction Method: Principal Component Analysis

Data Normality

One of the presumptions of factor analysis is data normality. For this purpose, Skewness must be between (3, -3) and Kurtosis must be between (5, -5). In **Appendix 1**, the results of this test are presented (Hair Jr et al., 2016).

Exploratory Factor Analysis

To this end, two tests are necessary before doing this analysis. The first test is the KMO, which is performed to verify the adequacy of the sample size, if the KMO value is greater than .7, this test is confirmed (Kaiser, 1974). But another test that expresses spatiality and symmetry of relationships is the Bartlett test. This test is based on observations and if it is meaningful, spatiality is confirmed and exploratory factor analysis is allowed (Bartlett, 1954). To perform exploratory factor analysis in this research, Principal component and VARIMAX rotation were used. In **Table 4**, the results of this test are presented.

In **Table 5**, the number of factors extracted by the exploratory factor analysis and the degree of variance explained by each of the factors before and after the rotation are shown. The results show that 57 surveyed indicators are classified into 9 factors. These 9 factors account for 64.010 percent of the total variance.

Rotated Component Matrix

The results in the Rotated Component Matrix are presented in the table in **Appendix 2**. Using this table, indicators with a factor loading of higher than 0.5 for each factors are assigned to that factor. Therefore, the indices 4, 21, 28, 39, 40, 43, 44, 46, 57 are in the first factor, the indices 2, 13, 24, 33, 34, 36, 38, 42, 45, 54 are in the second factor, the indices 6, 7, 11, 23, 25, 26, 41, 48, 50 are in the third factor, the indices 1, 5, 9, 15, 20, 47 are in the fourth factor, the indices 19, 27, 37, 49, 53 are in the fifth factor, the indices 14, 17, 29, 32, 35 are in the sixth factor, the indices 3, 16, 18, 30 are in the seventh factor, the indices 10, 12, 31, 51, 55 are in the eighth factor, and the indices 8, 22, 52, 56 are placed in the ninth factor.

Table 6. Naming factors

Factor	1	2	3	4	5	6	7	8	9
Symbol	A	B	C	E	G	H	L	O	M
Name	Brand	Employees' training level	Job competency	Customer satisfaction	Customer information	Processes	Human capabilities and skills	IT systems	Job satisfaction

Naming Factors

Regarding the category in the Rotated Component Matrix, the names of the factors are shown in **Table 6**.

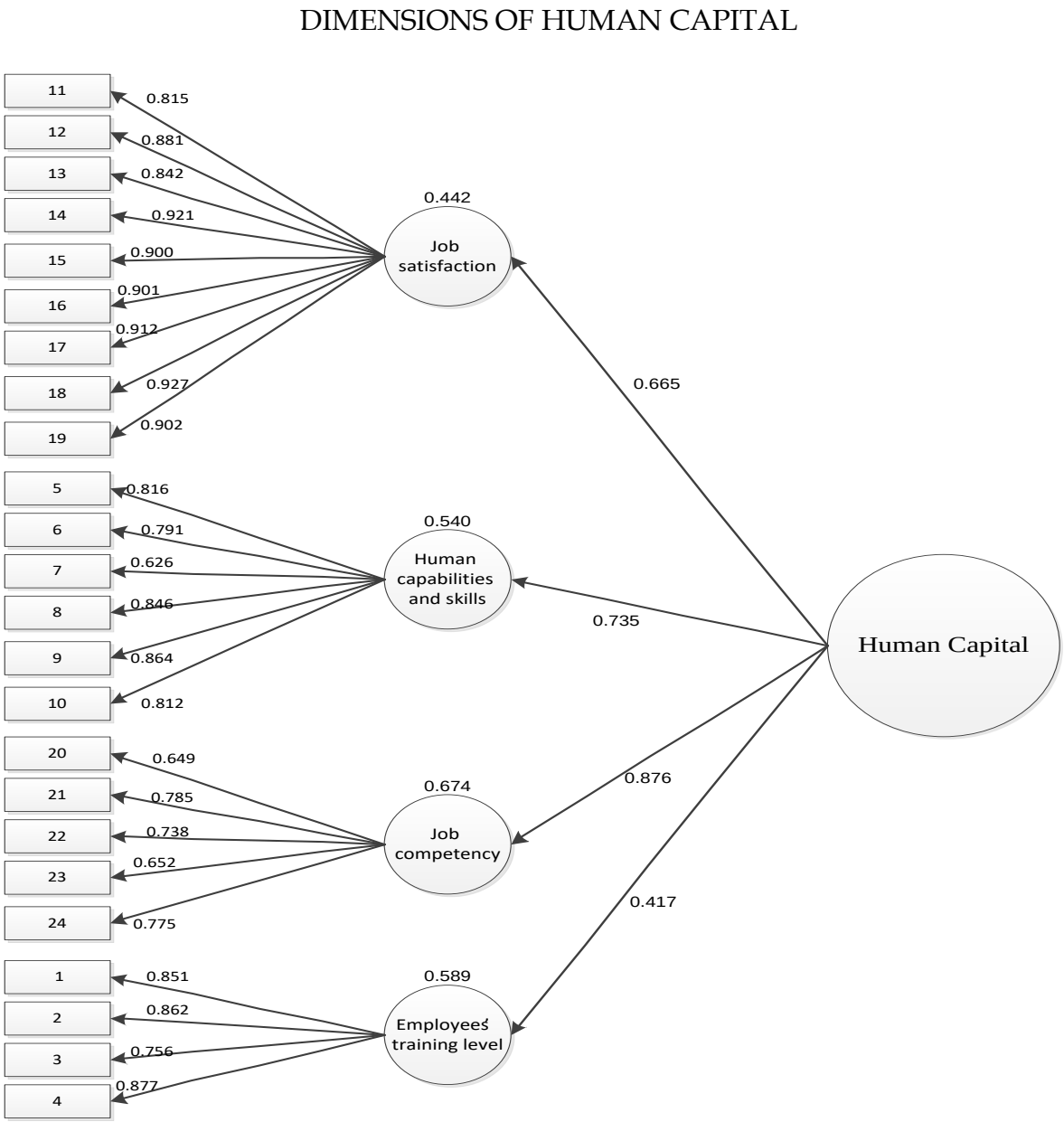

Figure 1. Dimensions of human capital

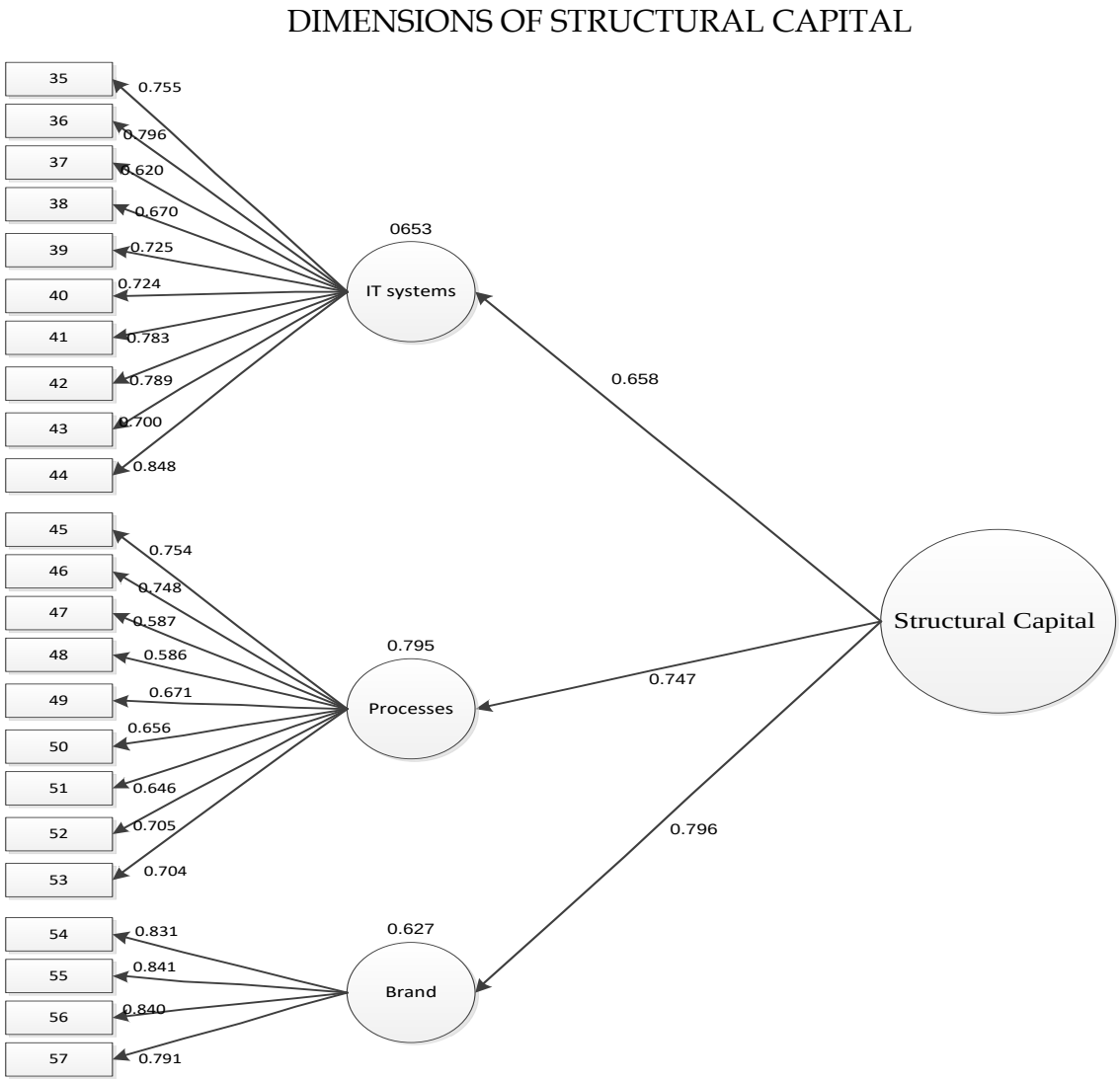

Figure 2. Dimensions of structural capital

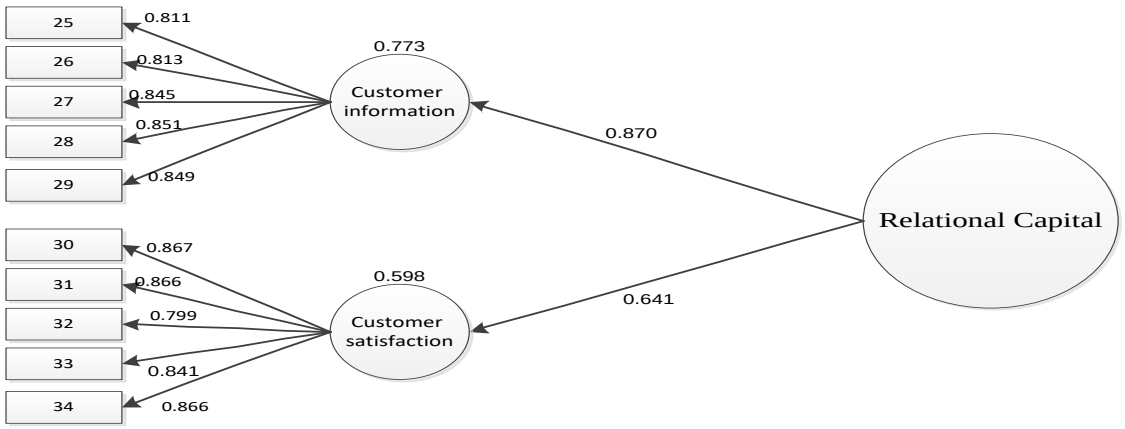

Figure 3. Dimensions of relational capital

CONFIRMATORY FACTOR ANALYSIS

Validity of the Measurement Model for Reflective Structure

Validity is the effectiveness of the instrument for measuring the desired variable which is considered in two types of convergent validity and divergent validity in the literature. Convergent validity is calculated through the outer loading of the indicators on the structure, which should be sufficiently high and at a satisfactory level (T test). Factor load in optimal mode should be greater than .7, and if it is smaller, then that index should be deleted from the model. Also, the factor loads should be significant at 95% level. And the average extracted variance (AVE) that should be greater than .5 and the composite reliability (CR), which should be greater than (AVE) for each structure, are measured. Divergent validity is also measured through the method of cross-loading and Fornell and Larcker Test (Fornell & Larcker, 1981; Hair Jr et al., 2016).

Reliability of the Measurement Model for Reflective Structure

Cronbach's alpha shows the degree of (internal consistency) reflection. Values higher than .7 are considered as optimal. For the composite reliability test, the internal correlation of the questions within the CR model should be above .7 and the communality reliability that considers the model's generalizability must be above .5 for each variable (Hair Jr et al., 2016).

It should be noted that AVE, CR, Cronbach's alpha, cross-load matrix, and correlation matrix of structures are in the output of Smart PLS software (Hair Jr et al., 2016).

Model Quality Testing

This test is evaluated by cross validity communality, which according to the software results, should be above .35 for all variables in order to confirm the quality of the model (Hair Jr et al., 2016).

Considering the extracted variables of intellectual capital and literature review, intellectual capital is classified into three categories of human capital, structural capital and relational capital. Therefore, four factors of job satisfaction, human capabilities and skills, job competency, and employees' training level are human capital dimensions, three factors of information technology systems, process and brand are structural capital dimensions, and two factors of customer information and customer satisfaction are dimensions of relational capital. Confirmatory factor analysis is used to ensure this categorization.

Confirmatory Factor Analysis of Intellectual Capital Dimensions

First, the homogeneity test, in which all factor loads should be above .7, is implemented. The results of this test are shown in **Appendix 3**.

Then items whose factor load is less than .7 are deleted. In the human capital, items 9, 10, and 55 are eliminated, in the structural capital, items 33, 34, 7, 50, 41, 26 and 23 are eliminated, and all factor loads are above .7 in the relational capital. After removing the items, we run the software again and we are going to look at the reliability of the model.

Model Reliability Tests

Cronbach's alpha test, which should be above .7 for all variables, and the composite reliability test, which is the internal correlation of questions inside the model with a CR index and should be higher than .7, and the communality reliability that takes into account the model's generalizability and should be above .5 for any variable are implemented. **Table 7** shows the results of these tests.

Table 7. Intellectual Capital reliability test

	Cronbach's Alpha	Composite reliability	Communality
Job satisfaction	.967	.971	.791
Human capabilities and skills	.891	.920	.697
Job competency	.737	.851	.655
Employees' training level	.858	.904	.701
IT systems	.904	.923	.601
Processes	.769	.856	.544
Brand	.845	.896	.682
Customer satisfaction	.890	.919	.695
Customer information	.882	.914	.682

Table 8. AVE and CR test results

	AVE	Composite reliability
Job satisfaction	.79	.97
Human capabilities and skills	.70	.92
Job competency	.66	.85
Employees' training level	.70	.90
IT systems	.60	.92
Processes	.58	.86
Brand	.68	.90
Customer satisfaction	.70	.92
Customer information	.68	.91

According to the survey of three indicators, the reliability of the model is established.

Model Validity Test

Convergent validity test

To test the convergent validity, the first test is the significance test, whose results are presented in **Appendix 4**.

According to the significance test results presented in **Appendix 4**, all coefficients of the items are significant. The second test of convergent validity is now being examined. Considering that some questions were removed due to low factor load, the factor loads are reviewed again after implementation of the model. As in **Appendix 5**, all factor loads are above .7.

The third test with the condition of (AVE> .5) and the fourth test with the condition of (CR> AVE) are shown in **Table 8**.

Given the correctness of the four tests, the convergent validity is confirmed.

Divergent validity test

The first test is cross load test in which the factor load of each question for its corresponding variable is at least .1 more than the factor load in the same row (Hair Jr et al., 2016). The results of this test for human capital are presented in **Appendix 6**, for the structural capital in **Appendix 7**, and for the relational capital in **Appendix 8**.

The second test is the Fornell and Larcker test. Squared AVE is presented in the diameter of the matrix and its other components are the correlations of the variables. The numbers on the diameter should be greater than the corresponding row (Hair Jr et al., 2016). **Table 9** shows the results of this test.

Model Quality Test: According to the software results, the index for all variables is higher than .35, which indicates the high quality of the model. **Table 10** shows the results of this test.

Table 9. Fornell and Larcker test

	Job satisfaction	Human capabilities and skills	Job competency	Employees' training level	IT systems	Processes	Brand	Customer satisfaction	Customer information
Job satisfaction	.89	.14	-.2	.31					
Human capabilities and skills	.14	.83	-.27	.45					
Job competency	-.2	-.27	.81	-.31					
Employees' training level	.31	.45	-.31	.84					
IT systems					.78	.15	.47		
Processes					.15	.76	.08		
Brand					.47	.08	.83		
Customer satisfaction								.83	.38
Customer information								.38	.83

Table 10. Cross validity communality

Variables	CROSSVALIDITY COMMUNALITY
Job satisfaction	.78
Human capabilities and skills	.69
Job competency	.54
Employees' training level	.70
IT systems	.58
Processes	.60
Brand	.64
Customer satisfaction	.67
Customer information	.65

CONCLUSION

The new economic growth comes from knowledge and information. This has increased the importance of Intellectual capital as a research and economic category. In this paper, exploratory and confirmatory factor analyses were used to identify and categorize intellectual capital indices. In this research, we first studied the literature of the subject and extracted items related to intellectual capital indices. Then, a questionnaire was developed to examine the relationship between these items and their categorization. The statistical population of the research consisted of researchers and experts in the educational technology of Iran. Finally, 300 people responded to the research questionnaires. In this research, the validity of the questionnaire was confirmed by experts and the Guttman method was used. The number of statistical samples in the exploratory factor analysis method was determined based on the number of items (questions). The results of Factor Analysis showed that 57 indicators are suitable for the separation of questions and compliance with the basics. The reliability of the Guttman test for each case was higher than .7, indicating a good reliability. To use the exploratory factor analysis, data normality was examined. For this purpose, the KMO coefficient was used for data adequacy, the Bartlet test was used for spatial and symmetry, and principal component method was used to extract the factors, and the VARIMAX rotation was used. After performing factor analysis, the indices were classified into nine categories. It was found out that the intellectual capital indices were classified into three categories of human capital, structural capital and relational capital, and, according to the factors extracted, the nine factors were classified into these three groups. Confirmatory factor analysis was used to confirm this categorization. For this purpose, all the statistical indices introduced by the experts in this field were presented to confirm the model. The results of this research showed that human capital dimension included 4 factors of job satisfaction, human capabilities and skills, job competency and employees' training level, structural capital dimension included 3 factors of information technology systems, process and brand, and the dimension of relational capital included 2 factor of customer information and customer satisfaction in intellectual capital of Iran's educational technology.

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APPENDIX 1

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
1	300	2	5	4.0333	.96367	-.654	.141	-.612	.281
2	300	2	5	4.1967	.93142	-.901	.141	-.217	.281
3	300	2	5	4.3433	.79218	-1.181	.141	1.039	.281
4	300	2	5	4.14	1.26189	-.94	.141	-.953	.281
5	300	2	5	3.8	.92891	-.272	.141	-.832	.281
6	300	2	5	3.46	.92263	.015	.141	-.832	.281
7	300	2	5	3.99	.80751	-.327	.141	-.616	.281
8	300	2	5	4.0667	.9723	-.64	.141	-.743	.281
9	300	2	5	4.11	.94563	-.675	.141	-.665	.281
10	300	2	5	3.7967	.80258	-.436	.141	-.117	.281
11	300	2	5	4.0067	.84598	-.213	.141	-1.119	.281
12	300	2	5	4.0967	.83445	-.705	.141	-.03	.281
13	300	2	5	4.3167	.90505	-1.186	.141	.446	.281
14	300	2	5	4.4267	.97354	-1.533	.141	.994	.281
15	300	2	5	4.0333	.96367	-.586	.141	-.763	.281
16	300	2	5	4.5867	.67131	-1.689	.141	2.687	.281
17	300	2	5	4.5567	.85002	-1.905	.141	2.567	.281
18	300	2	5	4.4067	.72321	-1.166	.141	1.206	.281
19	300	2	5	4.5267	.75133	-1.687	.141	2.492	.281
20	300	2	5	4.1433	.934	-.785	.141	-.413	.281
21	300	2	5	3.4767	1.17789	.019	.141	-1.491	.281
22	300	2	5	3.8167	.97273	-.328	.141	-.919	.281
23	300	2	5	3.7567	.84449	.084	.141	-.932	.281
24	300	2	5	3.8267	1.10485	-.401	.141	-1.206	.281
25	300	2	5	3.78	1.0008	-.232	.141	-1.08	.281
26	300	2	5	3.7	.93787	-.005	.141	-1.019	.281
27	300	2	5	4.47	.79026	-1.374	.141	1.043	.281
28	300	2	5	3.8467	1.18088	-.571	.141	-1.195	.281
29	300	2	5	4.4167	.93056	-1.322	.141	.389	.281
30	300	2	5	4.36	.75651	-1.126	.141	1.016	.281
31	300	2	5	3.7367	.87743	-.148	.141	-.736	.281
32	300	2	5	4.5033	.85972	-1.616	.141	1.491	.281
33	300	2	5	3.9833	1.05202	-.591	.141	-.944	.281
34	300	2	5	4.4533	.80622	-1.467	.141	1.506	.281
35	300	2	5	4.2433	.85629	-.94	.141	.122	.281
36	300	2	5	4.03	1.02597	-.696	.141	-.726	.281
37	300	2	5	4.0933	.82476	-.571	.141	-.354	.281
38	300	2	5	4.1533	.93061	-.886	.141	-.139	.281
39	300	2	5	3.8067	1.17781	-.497	.141	-1.261	.281
40	300	2	5	3.6533	1.19355	-.254	.141	-1.463	.281
41	300	2	5	3.7233	.86561	-.056	.141	-.778	.281
42	300	2	5	4.5433	.75056	-1.606	.141	1.86	.281
43	300	2	5	4.09	1.25984	-.858	.141	-1.062	.281
44	300	2	5	4.1067	1.27306	-.887	.141	-1.047	.281
45	300	2	5	4.2667	.91561	-1.08	.141	.204	.281
46	300	2	5	3.7467	1.16347	-.392	.141	-1.315	.281
47	300	2	5	4.36	.90911	-1.259	.141	.513	.281
48	300	2	5	3.6733	.85775	.171	.141	-.877	.281
49	300	2	5	4.3267	.79712	-1.015	.141	.387	.281
50	300	2	5	3.3133	.84708	.383	.141	-.379	.281
51	300	2	5	3.47	.92662	.152	.141	-.824	.281
52	300	2	5	4.1333	.93727	-.833	.141	-.269	.281
53	300	2	5	4.4333	.74884	-1.19	.141	.808	.281
54	300	2	5	4.17	.92951	-.823	.141	-.364	.281
55	300	2	5	3.9733	.87665	-.458	.141	-.585	.281
56	300	2	5	4.3467	.90326	-1.207	.141	.405	.281
57	300	2	5	4.0933	1.26092	-.872	.141	-1.039	.281
Valid N (list wise)	300								

APPENDIX 2

Rotated Component Matrix[a]

	Component								
	1	2	3	4	5	6	7	8	9
1	.088	.059	-.053	.828	-.097	-.061	.16	-.077	-.007
2	-.065	.834	.101	-.016	.033	-.025	0	-.067	.12
3	.276	.05	-.007	.169	.115	-.059	.771	-.127	-.015
4	.92	-.065	-.022	.044	-.001	.018	.052	-.094	-.055
5	.032	.002	-.014	.826	.007	-.039	.175	-.074	.034
6	-.024	.023	.744	.053	-.017	-.044	-.135	.015	-.061
7	.001	-.09	.671	-.031	-.062	.021	.042	.072	.005
8	-.015	.331	-.018	.019	.056	.021	.05	-.055	.747
9	.021	-.035	.035	.624	.036	.04	.027	-.243	-.007
10	-.037	.071	-.11	-.096	-.09	.052	-.053	.659	-.137
11	-.061	.061	.661	.059	-.068	.014	.014	-.183	.071
12	-.131	.019	-.004	-.128	.019	.049	-.062	.744	-.064
13	-.03	.726	-.083	-.019	.026	-.024	.086	-.021	.08
14	-.004	-.006	-.081	.081	.219	.712	-.073	.081	.048
15	.038	.017	-.076	.795	.054	-.084	.139	-.08	.067
16	.158	-.004	.048	.284	.018	.018	.767	-.074	-.024
17	-.009	.022	-.052	-.043	.216	.832	-.088	-.018	-.01
18	.068	-.014	.029	.233	-.023	.062	.751	-.06	.034
19	.096	.01	-.018	0	.753	.259	.045	-.016	.016
20	.098	-.027	.019	.738	.009	-.031	.211	-.035	.09
21	.802	-.078	.013	.109	.005	-.02	.092	.005	.045
22	-.057	.21	.064	.105	.008	-.001	-.007	-.005	.822
23	-.082	.08	.624	-.052	.015	-.039	.03	-.06	-.072
24	-.096	.795	.071	-.008	-.015	.046	.008	.044	-.009
25	.078	.084	.728	.039	.01	.023	-.019	.028	.057
26	-.066	.047	.657	-.11	0	-.062	.047	.051	-.059
27	.053	.01	-.003	-.038	.768	.199	.03	-.025	-.023
28	.878	-.093	0	.133	.03	-.033	.053	-.087	-.018
29	.011	-.011	-.013	-.098	.066	.85	-.029	-.001	-.005
30	.198	.034	.039	.222	.076	-.072	.79	-.164	-.007
31	-.129	-.071	.054	-.121	.085	-.08	-.042	.703	.094
32	-.006	-.047	-.065	-.062	.181	.836	.032	.007	-.015
33	-.008	.603	.125	.027	-.043	.014	-.003	.065	.104
34	-.089	.636	-.052	.051	.026	-.003	-.006	-.036	.196
35	-.033	0	-.078	-.127	.128	.781	.119	.066	-.006
36	-.101	.726	.06	-.033	.06	-.033	-.071	-.056	-.042
37	.027	.004	-.047	-.031	.856	.069	.07	.011	.016
38	-.072	.685	.042	.035	-.03	-.039	.019	-.056	.205
39	.906	-.06	-.052	.088	.012	.004	.116	-.042	.037
40	.834	-.08	-.066	-.012	.046	-.007	.101	.005	.028
41	.012	-.015	.686	-.009	-.034	-.059	.038	.087	.089
42	-.07	.744	-.012	-.023	-.058	-.042	.076	-.019	.1
43	.891	-.088	-.032	-.031	.035	-.014	.081	-.089	-.088
44	.903	-.094	-.021	-.02	.043	-.019	.062	-.113	-.042
45	-.081	.756	.07	.023	.07	.039	-.046	.049	.196
46	.86	-.145	.031	.109	.013	.019	.08	-.044	.019
47	.055	.041	.026	.799	-.102	-.089	.11	-.06	0
48	-.019	.123	.68	.053	-.033	-.08	.079	-.051	.074
49	-.016	-.01	-.046	.035	.853	.124	.051	-.022	-.028
50	.029	.01	.649	-.028	.062	-.042	-.02	.031	-.077
51	-.06	-.077	.032	-.128	-.022	.05	-.267	.697	.039
52	0	.349	-.017	.018	-.029	-.042	-.034	-.016	.74
53	.016	.021	.003	-.045	.839	.148	-.045	-.044	.031
54	-.062	.771	.047	.015	-.023	.022	-.011	.078	.144
55	-.06	.027	.051	-.044	-.068	.051	.008	.692	.03
56	0	.289	-.034	.027	-.022	.034	-.011	.026	.736
57	.904	-.027	-.015	-.016	.019	.015	.056	-.078	-.033

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

APPENDIX 3

Outer Loadings

	Job satisfaction	Human capabilities and skills	Job competency	Employees' training level	IT systems	Processes	Brand	Customer satisfaction	Customer information
21	.815								
46	.881								
40	.842								
39	.921								
28	.900								
43	.901								
44	.912								
4	.927								
57	.902								
15		.816							
20		.791							
9		.626							
5		.846							
1		.864							
47		.812							
10			.649						
12			.785						
31			.738						
55			.652						
51			.775						
16				.851					
3				.862					
18				.756					
30				.877					
42					.755				
45					.796				
33					.620				
34					.670				
13					.725				
38					.724				
24					.783				
54					.789				
36					.702				
2					.848				
48						.754			
25						.748			
7						.587			
50						.586			
41						.671			
26						.656			
23						.646			
6						.705			
11						.704			
8							.831		
52							.841		
22							.840		
56							.791		
19								.811	
27								.813	
53								.845	
49								.851	
37								.849	
17									.867
32									.866
35									.799
29									.841
14									.866

APPENDIX 4

Significance Test Results

	Job satisfaction	Human capabilities and skills	Job competency	Employees' training level	IT systems	Processes	Brand	Customer satisfaction	Customer information
21	41.0								
46	57.5								
40	44.5								
39	88.8								
28	71.2								
43	58.5								
44	67.8								
4	85.6								
57	6.5								
15		35.2							
20		3.0							
5		4.4							
1		47.1							
47		29.6							
12			4.3						
31			4.3						
51			4.3						
16				36.1					
3				45.4					
18				16.4					
30				49.0					
42					24.2				
45					28.2				
13					2.3				
38					22.8				
24					32.0				
54					32.8				
36					21.0				
2					56.4				
48						4.5			
25						3.4			
6						2.8			
11						3.5			
8							42.9		
52							38.1		
22							35.9		
56							25.9		
19								33.5	
27								32.3	
53								41.5	
49								45.4	
37								48.7	
17									35.8
32									52.2
35									3.7
29									42.6
14									19.9

40	**.842**								
39	.921								
28	.899								
43	.901								
44	.912								
4	.926								
57	.902								
15		.832							
20		.810							
5		.848							
1		.869							
47		.814							
12			.800						
31			.807						
51			.821						
16				.850					
3				.863					
18				.755					
30				.877					
42					.767				
45					.801				
13					.732				
38					.715				
24					.794				
54					.796				
36					.718				
2					.866				
48						.772			
25						.798			
41						.665			
6						.704			
11						.739			
8							.833		
52							.840		
22							.840		
56							.790		
19								.811	
27								.813	
53								.845	
49								.851	
37								.849	
17									.867
32									.866
35									.799
29									.841
14									.749

APPENDIX 5

Outer Loading

APPENDIX 6

Cross Load Test of Human Capital

	Job satisfaction	Human capabilities and skills	Job competency	Employees' training level	LARGE 1	LAEGE 2	DIFFRENCE
21	.814522	.170813	-.131336	.284256	.814522	.284256	.530266
46	.880835	.17088	-.174904	.292943	.880835	.292943	.587892
40	.842194	.088059	-.128507	.253434	.842194	.253434	.58876
39	.921264	.177438	-.196655	.320087	.921264	.320087	.601177
28	.899176	.189846	-.217924	.285805	.899176	.285805	.613371
43	.901049	.067818	-.203929	.268729	.901049	.268729	.63232
44	.91228	.077843	-.215756	.262581	.91228	.262581	.649699
4	.926488	.123949	-.187375	.277251	.926488	.277251	.649237
57	.902096	.0715	-.161653	.262793	.902096	.262793	.639303
15	.09923	.832115	-.22521	.35271	.832115	.35271	.479405
20	.154262	.809753	-.183044	.392561	.809753	.392561	.417192
5	.096271	.847701	-.244225	.389788	.847701	.389788	.457913
1	.141454	.869089	-.249509	.382571	.869089	.382571	.486518
47	.102092	.813587	-.208265	.336356	.813587	.336356	.477231
12	-.186626	-.198042	.799655	-.224364	.799655	-.186626	.986281
31	-.173151	-.190951	.80725	-.183412	.80725	-.173151	.980401
51	-.135865	-.254022	.82107	-.338458	.82107	-.135865	.956935
16	.241591	.405416	-.211755	.850042	.850042	.405416	.444626
3	.348225	.350404	-.270033	.862626	.862626	.350404	.512222
18	.154638	.360107	-.213541	.755377	.755377	.360107	.39527
30	.280884	.381592	-.335367	.876636	.876636	.381592	.495044

APPENDIX 7

Cross Load Tests of Structural Capital

	IT systems	Processes	Brand	LARGE 1	LAEGE 2	DIFFRENCE
42	.766857	.054317	.357729	.766857	.357729	.409128
45	.800462	.166607	.419061	.800462	.419061	.381401
13	.731966	.025951	.322221	.731966	.322221	.409745
38	.714836	.136132	.409231	.714836	.409231	.305605
24	.794312	.127556	.304881	.794312	.304881	.489431
54	.795718	.116761	.402794	.795718	.402794	.392924
36	.718331	.127896	.268953	.718331	.268953	.449378
2	.866245	.162423	.417322	.866245	.417322	.448923
48	.154334	.79531	.100073	.79531	.154334	.640976
25	.121827	.802821	.066195	.802821	.121827	.680994
6	.061561	.695396	-.032916	.695396	.061561	.633835
11	.09464	.760417	.081325	.760417	.09464	.665777
8	.43132	.062204	.832883	.832883	.43132	.401563
52	.421617	.072312	.839949	.839949	.421617	.418332
22	.325277	.123477	.839567	.839567	.325277	.51429
56	.369895	.023158	.790024	.790024	.369895	.420129

APPENDIX 8

Cross Load Test of Relational Capital

	Customer satisfaction	Customer information	LARGE 1	LAEGE 2	DIFFRENCE
19	.811109	.37984	.811109	.37984	.431269
27	.813018	.330087	.813018	.330087	.482931
53	.844818	.315715	.844818	.315715	.529103
49	.850629	.294969	.850629	.294969	.55566
37	.848922	.253593	.848922	.253593	.595329
17	.363943	.866528	.866528	.363943	.502585
32	.333526	.866184	.866184	.333526	.532658
35	.284566	.79867	.79867	.284566	.514104
29	.238112	.841366	.841366	.238112	.603254
14	.335567	.748986	.748986	.335567	.413419