Int. J. Nonlinear Anal. Appl. 14 (2023) 5, 49–62
ISSN: 2008-6822 (electronic)
http://dx.doi.org/10.22075/ijnaa.2022.28364.3869

Use of ISM technique to designing human capabilities development model

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(Communicated by Ehsan Kozegar)

Abstract

Man is the tool of development, the axis and goal of development. Human resources are the greatest potential and the most important resource in organizations and institutions, so the most important role in the development of any institution is to identify the human capabilities of that institution. The main approach in this research is to build a multi-level structural model using the practical experience and knowledge of experts, which is extracted by breaking down a complex system into several subsystems. In the qualitative part, the fuzzy Delphi technique and taxonomy model originating from the fuzzy mean method have been used to identify, screen and evaluate the variables, and in the quantitative part, the (ISM) and (SEM) techniques, as well as the (MICMAC) diagram, have been used to analyze the power of penetration and dependence of research variables. The validation of the model has been derived from the partial least squares (PLS) method and from three indices: AVE, CR and Cronbach's alpha. In this study, to fit the structural model, the coefficient of determination index (R^2), the Stone-Geiser index (Q^2) and the goodness of fit index (GOF) have also been used. The results of bootstrapping at the level of 5% error, assuming that the value of the bootstrapping statistic t-value is greater than 1.96, indicate the correlations observed and the significance of the Variables in the proposed model.

Keywords: Capability, Structural Equations, Human Resources
2020 MSC: 68V30

1 Introduction

The success of private sector organizations and public sector organizations lies in human resources [19]. Today, organizations have found that human resources are very important in achieve a sustainable and effective competitive advantage [24]. In terms of human resources, financial resources, communication and organizational culture, knowledge-oriented organizations are usually different from other organizations. The most important aspect of these organizations, i.e. human resources, due they are creative, self-motivated, learning, independent, thoughtful, flexible, and self-confident and introverted, can be useful in the success of the organization, provided that these capabilities are encouraged and optimally used by the organization [13]. Therefore, work force is not considered as an expensive asset; rather, it is considered as productive assets [14]. Managers always try to control their employees and pay less attention to their internal needs in human resource strategies [12]. Some managers consider employee satisfaction

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Received: July 2022 *Accepted:* September 2022

in increasing rewards and encouraging them to do work, while material needs are not their only needs [27]. In fact, improving human resources capabilities is considered a new and effective technique to improve the productivity of the organization and helps to achieve its goals and strategies [22]. Therefore, human resources are not the only resources under the ownership or control of organizations, but they are the most important ones that should be given a lot of attention in order to develop and achieve organizational goals [25]. Therefore, it can be said that human resources is the most important asset of an organization and a source of creativity and innovation, which includes all the individual capabilities, talents, knowledge of employees, skills, abilities, attitudes and experience of employees and managers of the organization [4]. Today, with the help of human resource management tools, organizations can keep employees satisfied and take an important and effective step towards improving the performance of the organization [29]. Research shows that human capabilities play an important role in improving the performance of organizations and institutions [28]. Therefore, human resources capabilities development along the organization's macro strategies can be considered as a right solution to achieve a competitive advantage for organizations in the complex environment [1]. Since the process of this research has different layers, the summary of the layers of the research process is presented in Table 1.

Table 1: The structure of research process layers

component	**Type**
nature of research	exploratory-fundamental
how to conduct research	qualitative-quantitative
research paradigm	interpretive-structural
research approach	Inductive
research strategy	data-based theory
source of data collection	in-depth interviews, focus groups, existing theoretical studies
data analysis method	data-based/structural oriented

Fuzzy Delphi technique is one of the methods in acquisition the group knowledge [3]. In this technique, first a questionnaire containing the desired criteria is sent to each member of the group separately and confidentially. Members are asked to assign a score from 1 to 10 to each criterion. In the second step, the questionnaires are collected and the criteria whose average score of opinion is less than 7 are removed. The remaining criteria are sent in a new questionnaire. These steps continue until a set of criteria have obtained scores above seven. In this study, triangular fuzzy numbers (fuzzy average method) have been used to fuzzify the experts' opinion. The opinion of experts about the importance of each index has been compiled with a 7-degree fuzzy spectrum.

Table 2: The spectrum of 7-degree fuzzy for the evaluation of indices

Linguistic variable	**fuzzy value**	**fuzzy number scale**
fully insignificant	$\widetilde{1}$	(0, 0, 0.1)
very insignificant	$\widetilde{2}$	(0, 0.1, 0.3)
insignificant	$\widetilde{3}$	(0.1, 0.3, 0.5)
average	$\widetilde{4}$	(0.3, 0.5, 0.75)
significant	$\widetilde{5}$	(0.5, 0.75, 0.9)
very significant	$\widetilde{6}$	(0.75, 0.9, 1)
fully significant	$\widetilde{7}$	(0.9, 1, 1)

The steps of implementing the fuzzy Delphi technique are actually a combination of the implementation the Delphi method and the analysis of information using the definitions of the fuzzy sets theory. The algorithm of implementing fuzzy Delphi method is shown in Figure 1.

This research is based on a basic research because it seeks to find a model to analyze and explain the human resources capabilities development model. On the other hand, due to the fact that library study methods and field methods such as interviews and questionnaires were used in this research, it can be stated that this research based on the method of data collection is a survey-cross-sectional research and a kind of mixed research. The algorithm of the present research was designed through systematic steps and based on the scientific research method. In order to achieve the goal of the research, each of the steps carried out is shown in Figure 2.

In the present study, the statistical population is experts and managers of universities in Khorasan Razavi province. In studies based on the opinions and judgments of experts, the number of people in the statistical sample is not very important, but since the answers of the experts, which consist of 12 people, to the questions raised in relation to the main criteria and sub-indices depends on the degree of importance of each of them, so choosing the people who participate in group decision making is important. The involvement of the unrelated people to the decision will cause problems in the decision-making process, and not using experts and experienced will also reduce efficiency. Therefore,

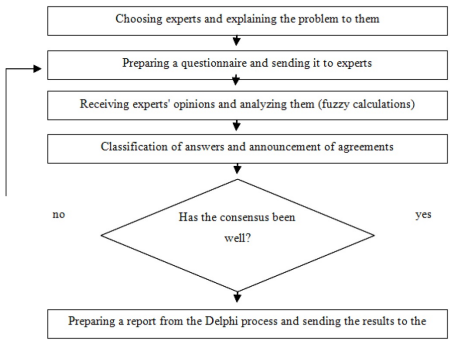


Figure 1: Delphi method implementation algorithm

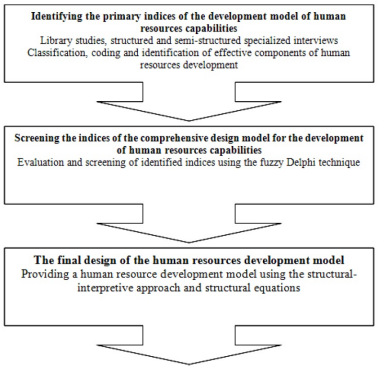


Figure 2: Research Algorithm

in this study, the opinion of 12 experts and administrators of universities in Khorasan province has been used with the criteria listed in Table 3.

Table 3: Determination of research experts

expertise indices	symbol	Condition	eligible experts
the amount of related experience	α	above 15 years or $\alpha \geq 15$	22
education level	β	postgraduate education (master's degree $\leq \beta$)	16
final experts	$\alpha \cap \beta$	experience over 15 years and postgraduate degree	12

2 Constituent factors of model of human resource capabilities development

1. Open coding (initial coding): naming, classifying, conceptualizing and labeling data concepts through a detailed review of the interviews text and background notes and finally collecting the coded data from the interviewees in order to identified similarities and differences easily, which consists of 80 indices.
2. Axial coding: the purpose of axial coding is to create a relationship between the generated categories (in the open coding stage). This action is usually done based on a paradigm model and helps the theorist to carry out the theorizing process easily. The basis of connecting in axial coding is based on the expansion one of the categories. This stage of coding consists of 23 components.
3. Selective coding: selective coding is based on the results of open coding and central coding and is the main stage of theorizing. Since it is possible that some categories or relationships between them are not well analyzed in the model resulting from axial coding, the researcher in the stage of selective coding removes the excesses and expands and generalizes those categories and relationships that were previously not well addressed. The researcher does this by validating the categories and the relationships defined between them. For this purpose, the researcher constantly refers to the books and articles published in the field of human resource capabilities, as well as the various examples mentioned by people during the interviews, and evaluate the ability of his model by referring to them and whenever necessary expands and deepens the elements and relationships of this model

The results of the fuzzy Delphi analysis for 80 indices were evaluated based on the views of 12 experts and finally 9 variables including employment potentials, specialized potentials, organizational potentials, cognitive characteristics, performance improvement, motivational and emotional characteristics, competitive advantage, productivity capabilities, and psychological characteristics were extracted as components of the human resources capabilities development model and the factors affecting the human resources development model were drawn according to Table 4.

Table 4: Factors affecting the model of human resources development

Axis	**Description**
employment potentials	This factor is formed due to the potential capabilities of people outside the organization and organizational needs.
specialized potentials	This factor is created based on educational needs, the status of skills and expertise of human resources.
organizational potentials	This factor is formed based on the desire for stability and non-change of people and lack of motivation and negative feelings of them in the organizational environment.
Cognitive strategies	This strategy is created with the aim of selecting and hiring human resources with specialized and professional capabilities. Organizational costs are reduced by investing in the quality of recruitment.
Optimization strategies	This strategy is the main factor in improving the efficiency of organizational resources, increasing innovation and centralizing resources.
Motivational and emotional strategies	This strategy deals with individual feelings and increases motivation, and it improves the condition of human resources and eliminates the level of incompetence by strengthening motivation and correct management of emotions.
Competitive consequences	The competitive advantage of the organization is improved by attracting specialized forces. Establishing organizational justice and increasing organizational competitive advantages helps the organization to achieve its predetermined goals.
productivity consequences	This consequence is with the aim of developing the skill dimensions and specialization of employees in order to increase individual agility and creativity. Also, this is favorable for creating a career path.
psychological consequences	This is the result of improvement of interpersonal communication and the reduction of conflicting behaviors to increase the trust and security of employees

The next step is to aggregate the opinion of the experts. The aggregation of the average triangular and trapezoidal fuzzy numbers is summarized by a definite value which is the best average. Therefore, the following method is used for de-fuzzification:

$$x_m^1 = \frac{L+M+U}{3};\ x_m^2 = \frac{L+2M+U}{4};\ x_m^3 = \frac{L+4M+U}{6} \tag{2.1}$$

$$F_{AVE} = (L, M, U) \tag{2.2}$$

$$\text{Crisp number} = Z^* = \max(x_{\max}^1, x_{\max}^2, x_{\max}^3) \tag{2.3}$$

The values of $x_{\max}^i$ do not differ much and are always close to M. M means the average result of aggregation the possible values of m from different triangular fuzzy numbers. However, the deterministic value of the largest $x_{\max}^i$ calculated is considered.

$$DF_{ij} = \frac{[(u_{ij} - l_{ij}) + (m_{ij} - l_{ij})]}{3} + l_{ij} \tag{2.4}$$

The main idea of the ISM technique is to build a multi-level structural model using the experience and knowledge of experts, which is extracting through the breaking down of a complex system into several sub-systems [20]. This method is an interactive learning process in which a set of different and interrelated elements are structured in a comprehensive systematic model [31]. This methodology helps to create and direct complex relationships between the elements of a system [7]. The model that obtained by this methodology indicate a structure of a complex problem or subject, a system or a field of study, which is a carefully designed model. As a result, we can say that interpretive structural modeling not only provides an insight into the relationships between different elements of a system, but also provides a structure based on the importance or effecting of elements together (depending on the type of defined content relationship) and illustrate a visual representation [5]. This is an interpretative method because the judgment of a group of people determines whether there are relationships between these elements or not. This method is structural because the basis of relationships is an overall structure that is extracted from a complex set of variables. This method is a modeling technique that the specific relationships and the overall structure are showed in a diagram model. Therefore, in the Interpretive Structural Modeling (ISM) method, the effective and essential factors are first

identified, and then the relationships between these factors and the way to achieve progress are presented by these factors. Structural-interpretive modeling helps in identifying the internal relationships of variables and is a suitable technique for prioritizing and analyzing the effect of a variable on other variables [2]. This methodology is a tool by which the group can overcome the complexity between the elements. The steps of implementing the ISM technique are as described in Figure 3.

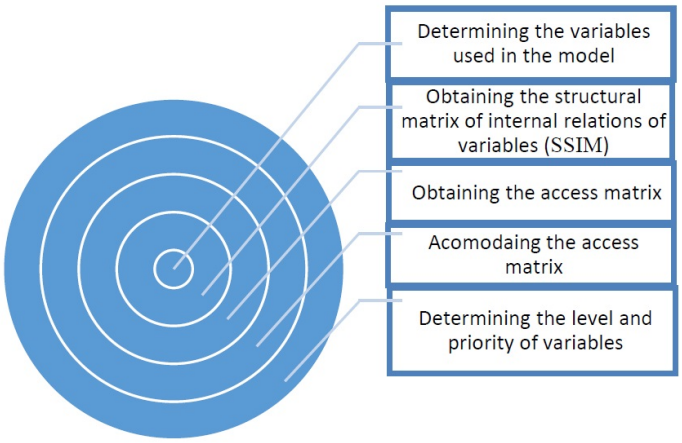


Figure 3: Steps to implement ISM technique

First step: Determining the variables used in the model: The interpretive structural modeling technique begins by identifying the variables that are relevant to the topic of discussion. In this research, our variables for designing the model are the same as main factors of comprehensive quality management, which are extracted from the fuzzy Delphi technique.

Table 5: Variables of human resources capabilities development model

row	variable	Symbol
1	Employment potentials	C1
2	specialized potentials	C2
3	organizational potentials	C3
4	cognitive characteristics	C4
5	performance improvement	C5
6	motivational and emotional characteristics	C6
7	competitive advantages	C7
8	productivity capabilities	C8
9	psychological characteristics	C9

Second step: Forming the structural self-interaction matrix (SSIM): After identifying the variables, it is time to enter these variables in the structural self-interaction matrix (SSIM). This matrix is a matrix with the dimensions of the variables, which the variables are mentioned in its first row and column in order. Then the two-by-two relationships of the variables are specified by symbols. The structural self-interaction matrix is formed by the dimensions and indices of the study and their comparison using four modes of conceptual relations. This matrix is completed by process-oriented experts and specialists and the resulting information is summarized based on the interpretive structural modeling method. The matrix obtained in this step shows which variables a variable affects and from which variables it is affected. The states and signs used in this conceptual relationship are:

V: The row factor (i) can be the basis of reaching the column factor (j) (one-way connection from i to j).

A: The column factor (j) can be the basis of reaching the row factor (i) (one-way connection from j to i).

X: There is a two-way relationship between the row factor (i) and the column factor (j). In other words, both can be the basis of reaching each other (two-way connection from i to j and vice versa).

O: There is no relationship between two elements (i j).

The logic of Interpretive Structural Modeling (ISM) is according to non-parametric methods and based on mode in frequencies. For this purpose, first a questionnaire was designed, in such way that 9 selected factors were placed in the

rows and columns of a 9×9 matrix, and the respondent was asked to determine the type of two-by-two connections of the factors according to the introduced symbols (V, A, X, O). In other words, in this matrix, the experts consider the criteria in pairs and respond to the pair wise comparisons accordingly.

Table 6: SSIM structural self-interaction matrix

SSIM	C1	C2	C3	C4	C5	C6	C7	C8	C9
employment potentials		A	A	A	V	V	O	V	V
specialized potentials			V	V	V	V	V	V	V
organizational potentials				O	V	V	V	V	O
cognitive characteristics					V	V	V	V	V
performance improvement						V	V	O	X
motivational and emotional characteristics							X	V	A
competitive advantages								V	A
productivity capabilities									A
psychological characteristics									

The third step: Forming the Reachability matrix (RM): The reachability matrix is obtained by transforming the structural self-interaction matrix into a two-valued matrix of zero and one. In the reachability matrix, the entries of the main diameter are equal to one. To extract the reachability matrix, in each row of the self-interaction matrix the number one is used instead of X and V symbols and zero is used instead of A and O symbols. The obtained matrix is called the initial reachability matrix. Also, to be sure, the secondary relationships must be controlled. That is, if A leads to B and B leads to C, then A must leads to C. Therefore, if the direct effects should have been included based on the secondary relationships, but this did not happen in practice, the structural self-interaction matrix table 6 should be corrected and the secondary relationship should also be shown.

Table 7: Reachability matrix (RM)

RM	C1	C2	C3	C4	C5	C6	C7	C8	C9
employment potentials	1	0	0	0	1	1	0	1	1
specialized potentials	1	1	1	1	1	1	1	1	1
organizational potentials	1	0	1	0	1	1	1	1	0
cognitive characteristics	1	0	1	1	1	1	1	1	1
performance improvement	0	0	0	0	1	1	1	0	1
motivational and emotional characteristics	0	0	0	0	0	1	1	1	0
competitive advantages	0	0	0	0	0	0	1	1	0
productivity capabilities	0	0	0	0	0	0	0	1	0
psychological characteristics	0	0	0	0	0	1	1	1	1

Fourth step: Creating the final access matrix (TM): After the initial access matrix is obtained, the final access matrix is obtained by transferability in the relationships of the variables. It is a square matrix, that each of its entries is one when the element to element has access of any length, and otherwise zero. The way of obtaining the access matrix is by using Euler's theory, in which we add the adjacency matrix to the unit matrix. Then, if the entries of the matrix do not change, we raise this matrix to the power of n. The following formula shows the method of determining accessibility using adjacency matrix.

Equation (2.5): Determining the final access matrix

$$\begin{aligned} &A + I \\ &M = (A + I)^n \end{aligned} \tag{2.5}$$

Matrix A is the initial access matrix of the identity matrix and of the final access matrix. The operation of raise to the power of the matrix is done according to Boolean rules (relationship).

Relationship (2.6): Boolean laws

$$1 \times 1 = 1; \quad 1 + 1 = 1 \tag{2.6}$$

Therefore, secondary relationships should be controlled to be sure. That is, if A leads to B and B leads to C, then A must leads to C. That is, if direct effects should have been included based on secondary relationships, but did not occur in practice, then the table of reachability matrix 7 should be corrected and the secondary relationship should also be shown.

One of the possible strategies to calculate different paths from i to j is to access the T matrix.

$$T = (I + D)^{n-1};\ t_{ij} = \begin{cases} 1; & \text{if there exists a path from the variable one to variable two} \\ 0; & \text{in otherwise} \end{cases}$$

Table 8: The final access matrix

TM	C1	C2	C3	C4	C5	C6	C7	C8	C9
employment potentials	1	0	0	0	1	1	1*	1	1
specialized potentials	1	1	1	1	1	1	1	1	1
organizational potentials	1	0	1	0	1	1	1	1	1*
cognitive characteristics	1	0	1	1	1	1	1	1	1
performance improvement	0	0	0	0	1	1	1	1*	1
motivational and emotional characteristics	0	0	0	0	0	1	1	1	0
competitive advantages	0	0	0	0	0	1	1	1	0
productivity capabilities	0	0	0	0	0	0	0	1	0
psychological characteristics	0	0	0	0	1	1	1	1	1

Fifth step: Determining relationships and dimension levels: In order to determine the relationships and leveling of dimensions and indices, the outputs set and inputs set for each dimension/index of the reachability matrix should be extracted. The set of outputs includes the dimension/index and the dimensions/indices that are affected by it. The set of inputs includes the dimension/index and set of dimensions/indices that are affecting it. Then, the set of two-way relationships of each dimension/index is determined; i.e. the number of dimensions/indices that are repeated in two sets of input and output. The dimensions/ indices are leveled based on the resulting sets. Normally, the dimensions/indices that have the same output set and the two-way relations set constitute the dimensions/indices of the upper level of the hierarchy. Therefore, the dimensions/indices of the top level will not be the source of any other dimension/ index. Once the top level is defined, it is separated from other dimensions/ indices. Then, through a similar process, the next levels are determined.

Table 9: Inputs and outputs set to determine the level

Dimensions	Output: affected	Input: affecting	sharing	Level
employment potentials	C1,C5,C6,C7,C8,C9	C1,C2,C3,C4	C1	4
specialized potentials	C1,C2,C3,C4,C5,C6,C7,C8,C9	C2	C2	7
organizational potentials	C1,C3,C5,C6,C7,C8,C9	C2,C3,C4	C3	5
cognitive characteristics	C1,C3,C4,C5,C6,C7,C8,C9	C2,C4	C4	6
performance improvement	C5,C6,C7,C8,C9	C1,C2,C3,C4,C5,C9	C5,C9	3
motivational and emotional characteristics	C6,C7,C8	C1,C2,C3,C4,C5,C6,C7,C9	C6,C7	2
competitive advantages	C6,C7,C8	C1,C2,C3,C4,C5,C6,C7,C9	C6,C7	2
productivity capabilities	C8	C1,C2,C3,C4,C5,C6,C7,C8,C9	C8	1
psychological characteristics	C5,C6,C7,C8,C9	C1,C2,C3,C4,C5,C9	C5,C9	3

2.1 Analysis of the power of penetration dependence (MICMAC chart)

Process oriented indices can be based on the penetration power of each index on other indices, and the degree of dependence of each index on other indices can be classified into four levels of autonomous, dependent, linked (interface) and independent.

Autonomous: Autonomous variables have a low degree of dependence and direction power. These criteria are generally separated from the system because they have weak connections with the system. A change in these variables does not cause a serious change in the system.

Dependent: Dependent variables have strong dependence and weak direction. Basically, these variables have high affectability and little affecting on the system.

Independent: independent variables have low dependence and high direction, in other words, high affecting and low affectability are the characteristics of these variables.

Linked: Link or interface variables have high dependence and high direction power, in other words, the affecting and affectability of these criteria is very high, and any small change on these variables causes fundamental changes in the system.

Table 10: The power of penetration and the degree of dependence of research variables

research variables	**Symbol**	**degree of dependence**	**power of penetration**
employment potentials	C1	4	6
specialized potentials	C2	1	9
organizational potentials	C3	3	7
cognitive characteristics	C4	2	8
performance improvement	C5	6	5
motivational and emotional characteristics	C6	8	3
competitive advantages	C7	8	3
productivity capabilities	C8	9	1
psychological characteristics	C9	6	5

Validation of the model with partial least squares method: The partial least squares technique was used to validate the model. In the partial least squares technique, several points are very important: the strength of the relationship between the factor (hidden variable) and the observable variable that is shown by the factor load. Factor loading is a value between zero and one. The reliability of each item refers to the value of factor loadings of each of the observed variables, and has been used to determine how the measurement indices (observed variables) for measuring hidden variables are acceptable, and its minimum acceptable value is 0.3 and the factor loadings 0.4 show an average level of significance. In the confirmatory factor analysis, the values factor loading higher than 0.5 show a strong significance level and high correlation between the observed variables and the factor, and also indicate that the structure is well defined.

To evaluate the validity of the external model, three indices of convergent validity, composite reliability and Cronbach's alpha were used.

Convergent validity (CV) shows how the variables of a construct are aligned with each other. Convergent validity is checked based on the external model and by calculating the average variance extracted (AVE). The AVE measure represents the average variance shared between each construct with its indices. In simpler terms, AVE shows the degree of correlation of a structure with its indices, the higher the correlation, the more the fit. Fornell and Larker [8] believe that if the AVE criterion is higher than 0.5, the measurement model has convergent validity.

Composite reliability (CR) in structural models is considered a better and more valid criterion than Cronbach's alpha, because in the calculation of Cronbach's alpha for each structure, all indices are calculated with the same importance, but in the calculation of the composite reliability the indices with higher factor loadings are more important and caused the CR values, the indices with higher factor load be more important and CR values of the constructs have a more realistic and accurate measure than Cronbach's alpha.

The following relationships should hold for convergent validity, and composite reliability (CR):

$$CR > 0.7;\ CR > AVE;\ AVE > 0.5 \tag{2.7}$$

Table 11: Internal validity of research constructs

Main constructs	**Convergent validity (AVE)**	**Composite reliability (CR)**	**Cronbach's alpha**
employment potentials	0.892	0.674	0.839
specialized potentials	0.927	0.808	0.881
organizational potentials	0.927	0.760	0.895
cognitive characteristics	0.914	0.727	0.875
performance improvement	0.805	0.516	0.681
motivational and emotional characteristics	0.851	0.592	0.765
competitive advantages	0.936	0.786	0.909
productivity capabilities	0.852	0.590	0.768
psychological characteristics	0.844	0.542	0.764

The average variance extracted (AVE) is greater than 0.5, so there is convergent validity.

Cronbach's alpha of all variables is greater than 0.7, so the reliability is confirmed.

The value of composite reliability (CR) is also greater than the AVE and in all cases it is greater than the threshold of 0.7, so the third condition is also met.

3 Internal research model (hypothesis testing)

The relationship between the investigated variables in each of the research hypotheses has been tested based on a causal structure with the partial least squares PLS technique. The general research model is shown in Figure 4. In this model, which is Smart PLS software output, a summary of the results related to the standard factor load of the variables is presented. The t statistic and bootstrapping value to measure the significance of relationships are also shown in Figure 5.

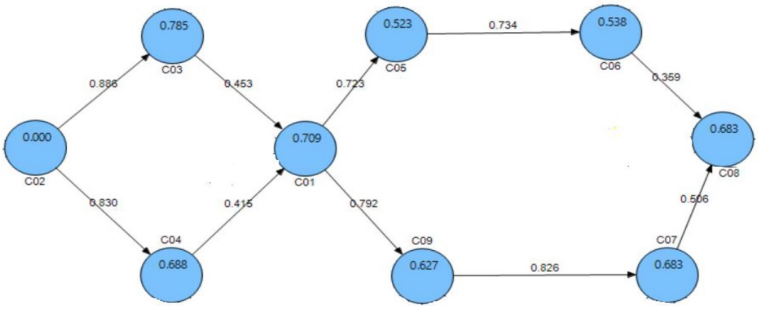


Figure 4: Model validation output with partial least squares method

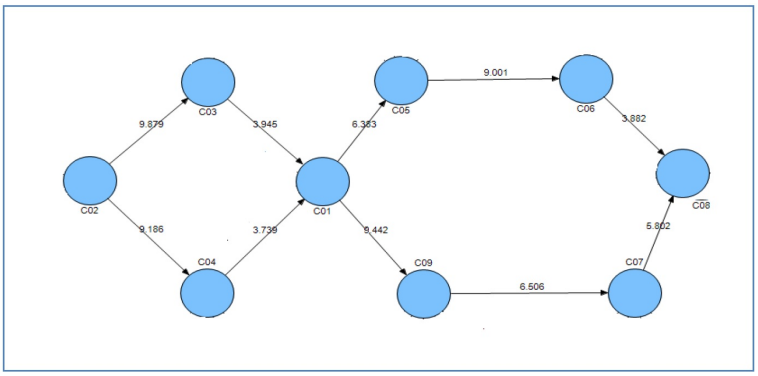


Figure 5: Significance of variable relationships with partial least squares method (bootstrapping)

Table 12: Summary of research hypothesis test results

Hypotheses	independent variable	dependent variable	factor load	t statistic	result
Hypothesis 1	specialized potentials	organizational potentials	0.885	9.879	confirmed
Hypothesis 2	specialized potentials	cognitive characteristics	0.830	9.186	confirmed
Hypothesis 3	organizational potentials	employment potentials	0.453	3.945	confirmed
Hypothesis 4	cognitive characteristics	employment potentials	0.415	3.739	confirmed
Hypothesis 5	employment potentials	motivational and emotional characteristics	0.723	6.383	confirmed
Hypothesis 6	employment potentials	psychological characteristics	0.792	9.442	confirmed
Hypothesis 7	motivational and emotional characteristics	performance improvement	0.734	9.001	confirmed
Hypothesis 8	psychological characteristics	competitive advantage	0.826	6.506	confirmed
Hypothesis 9	performance improvement	productivity capabilities	0.369	3.882	confirmed
Hypothesis 10	competitive advantage	productivity capabilities	0.506	5.802	confirmed

4 Assessment of model fit

Finally, the fit of the external model has been examined. The structural part of the model, unlike the measurement models, does not deal with the obvious questions and variables of the model and only deal to the hidden variables and the relationships between them. In this research, to fit the structural model, the indices of coefficient of determination (R^2), Stone-Geisser (Q^2), and goodness of fit of GOF have been used.

The coefficient of determination index (R^2): it is a measure that expresses the amount of changes in each of the dependent variables of the model, which is explained by the independent variables. It should be mentioned that the value of R^2 is provided only for the endogenous variables of the model and its value for the exogenous structures is equal to zero. The higher the value of R^2 related to the endogenous constructs of the model, the better the fit of the model. Chin [6] has defined three values of 0.19, 0.33 and 0.67 as criteria values for weak, medium and strong values of the fit of structural part of the model by means of the coefficient of determination criterion. In other words, R^2 indicates the ability of the model in the description of the structure.

Stone-Geisser criterion or Q^2 index: it is determines the predictive power of the model. Blindfolding is a reuse technique of the sample. This technique allows the calculation of Stone-Geisser index (Q^2). Stone-Geisser index is a measure to evaluate the cross-validity in the partial least squares model. The coefficient of determination index (R^2) determines the accuracy of the prediction and the index (Q^2) determines the correlation of the prediction. If the value of Stone-Geisser index is positive, the validity of the prediction is confirmed [10]. Models that have an acceptable structural fit should be able to predict indices related to the endogenous constructs of the model [9]. This means that if in a model, the relationships between the structures are defined correctly, the structures can sufficiently affecting each other's indices and in this way, the hypotheses can be correctly verified. Regarding predictive power of the model regarding endogenous structures, [11, 15] have determined three values of 0.02, 0.15 and 0.35 as weak, medium and strong. If the value of Q^2 becomes zero or less than zero in the case of an endogenous construct, it indicates that the relationships between other constructs in the model and endogenous construct are not well explained [23]. To calculate the value of Q^2 in PLS software, the blindfolding technique is used. By using this technique, two validity indices are obtained.

Cross-validated Redundancy (CV-Red) and Cross-validated Communality (CV-Com).

Table 13: Redundancy values of Cross-commonality and Cross-validity

Main constructs	**symbol**	**Cross-validated Communality**	**Cross-validated Redundancy**	**Coefficient of determination**
employment potentials	(C01)	0.421	0.285	0.709
specialized potentials	(C02)	0.555	0.419	–
organizational potentials	(C03)	0.507	0.371	0.785
cognitive characteristics	(C04)	0.474	0.338	0.688
performance improvement	(C05)	0.263	0.127	0.523
motivational and emotional characteristics	(C06)	0.339	0.203	0.538
competitive advantage	(C07)	0.533	0.397	0.683
productivity capabilities	(C08)	0.337	0.201	0.582
psychological characteristics	(C09)	0.289	0.153	0.627

Based on the results of Table 13, the coefficient of determination (R^2) of the endogenous structures of the research model is favorable. The value of the coefficient in the form of escape stairs (emergency exit) has been reported as 0.582, which is an acceptable value. Positive numbers indicate good quality of the model. As can be seen in the figure, these values have been obtained for all research constructs. Also, the values of variables are generally obtained in the range of 0.15 to 0.35 or greater than 0.35. Therefore, the predictive power of the research constructs is estimated as moderate to strong. The most important model fit index in partial least squares technique is the GOF index [26]. This index is used to check the fit of the overall model, which evaluates both the measurement and structural model parts. This index is calculated by using the product of two roots of "R^2 average index" and "average redundancy indices".

$$GoF = \sqrt[2]{(\overline{R^2}) \times (\overline{\text{Communality}})} \tag{4.1}$$

The GOF index was invented by Tenenhaus et al. [30] and is calculated according to the relationship. Wetzles et al. [32] have introduced three values of 0.01, 0.25 and 0.36 as weak, medium and strong values for Gof. Therefore, the value of goodness of fit in this study is equal to:

The average values of the coefficient of determination index $(\overline{R^2}) = 0.642$

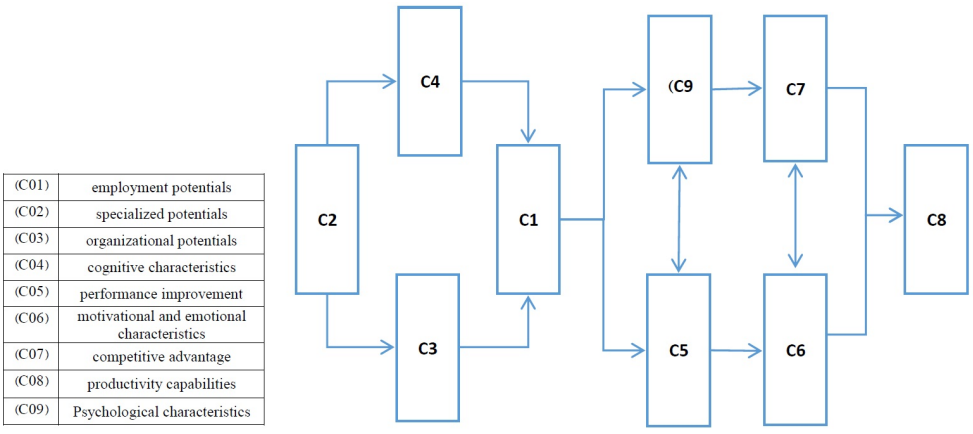
The average values of redundancy index $(\overline{\text{Communality}}) = 0.413$

$$GoF = \sqrt[2]{0.642 \times 0.413} = 0.515$$

The GOF index is equal to 0.515, so the model has a good fit.

5 Discussion and conclusion

The main goal of this research is to design and present the human capabilities development model with an interpretative structural approach. In order to achieve this goal, first, the affecting factors and effective indices on the human capabilities development of the organization's human resources have been identified, and then these factors and indices have been evaluated and screened. The library method and document studies were used to gather the theoretical basis of information regarding the explanation of the research subject literature. Considering that the purpose of this research is an exploratory combination of the sequential type and the tool making model, and the design and formulation of the model is based on the criteria of the model design, in the qualitative part, based on the content analysis technique, using the case study research method and semi-structured interviews with experts and professors led to the compilation of the criteria of the research model, and in the quantitative part, the descriptive-survey method and a researcher-made tool to measure its external effectiveness is used; in other words, the statistical population and the research sample of experts are include managers of medical sciences universities in Khorasan Razavi province with at least 20 years of experience and at least a master's degree in one of the fields of humanities. In this research, in order to select a suitable sample from the community of experts and university professors, the non-random sampling method of selective type of purposive sampling method (snowball) and theoretical saturation criterion is used, and the number of key people (experts) is 12. After that the fuzzy Delphi analysis was used in the qualitative part (the number of experts in the Delphi panel was 12, whose characteristics were the same as the qualitative panel) they were measured. Finally, using structural equation technique, the proposed model was measured. Interpretive Structural Modeling (ISM) is one of the methods for designing systems, especially management systems [17]. This approach was initially introduced and developed by Warfield [31] and is now increasingly used by various researchers. The ISM approach enables individuals and groups to map the complex relationships between a large numbers of elements in a complex decision situation and serves as a tool for ordering and directing the complexity of relationships between variables [16]. This technique begins by identifying the variables that are related to the subject or problem, and then contextual relationships between the variables are created using the experiences and practical knowledge of specific experts, and finally a multi-level structural model is created. The purpose of this article is to investigate the concept of ISM, to define its origin in terms of paradigm, to describe the steps of implementing the technique, and to present the key aspects of this approach and its application in the development of human resources capabilities.



(C01)	employment potentials
(C02)	specialized potentials
(C03)	organizational potentials
(C04)	cognitive characteristics
(C05)	performance improvement
(C06)	motivational and emotional characteristics
(C07)	competitive advantage
(C08)	productivity capabilities
(C09)	Psychological characteristics

Figure 6: Human resource capabilities development model

This research provides a model to determine causal relationships in the development of human resources capabilities. Using this model, cause and effect relationships between factors are determined in a systematic way. According to the human resources capabilities development model, productivity potentials (C8) are in the first level or dependent, performance improvement variables (C6) and competitive advantage (C7) in the second level, psychological characteristics (C9) and motivational and emotional characteristics (C5) in the third level, employment potentials (C1) in the fourth level, variables of organizational potentials (C3) in the fifth level, cognitive characteristics (C4) in the sixth

level, and finally specialized potentials (C2) the most basic element of the model in the seventh level. In addition to showing the relationships between the elements, the model classifies the factors in four categories.

The first category includes "autonomous variables" that have weak penetration and dependence. In the current research, no variable was included in this category; "Dependent variables" are the second category, which have low power of penetration but strong dependence. Productivity capabilities, competitive advantage and performance improvement are included in this category. These variables are mainly the results that in creating them many factors are involved, and they themselves can rarely become the basis of other variables. The third category is "linked variables" which have high penetration and dependence. These factors are non-static because any change in them can affect the system and finally the feedback of the system can change these factors again. In this research, motivational and emotional characteristics, psychological characteristics and employment potentials are included in this category. In today's world, most factors are non-static and dynamic. The factors used in this research are not excluded from this.

The fourth category includes "independent variables" that have strong penetration but weak dependence. These categories act as the foundation of the model and in order to start the system operation, first, they should be emphasized. Specialized potentials, organizational potentials and cognitive characteristics are included in this category.

This research has been confirmed by other researchers such as [18, 21]. The model built using the ISM approach shows that among the identified factors "specialized potentials" have the greatest affecting on other factors, that this should be given special attention. In this research, coefficient of determination index (R^2), Stone-Geisser index (Q^2), and GOF goodness of fit index were used in this research to fit the structural model. The results of the mentioned indices show that the validity of the prediction is confirmed. Therefore, the model has a good fit.

According to the results of the literature review and the findings of the analysis of the interviews and questionnaires and the limitations of the research, suggestions are proposed and presented so that on the one hand, the relevant officials and decision makers, while planning and making necessary policies, can use these suggestions and take the required implementing actions, and on the other hand, be a guide for the researchers who intend to conduct research in this field and examine the issues that have not been addressed in this research. The most important of these suggestions are:

- In order to strengthen the mentioned model and obtain a standard and more comprehensive scale, it is better to carry out the research on a wider level to increase the generalizability of the results.
- In order to identify the existing obstacles in the operationalizing the model of human resources development in universities, the necessary pathology is recognized.
- Evaluating the degree and the intensity of affecting on the proposed model can be a significant issue for a research, because constructing a human resources development model requires extensive investigations and research.
- Considering that regression analysis and structural equations were used in this research, other techniques can be used in other researches to rank the identified factors.
- The subject of the research can be done in other organizations and the results can be compared with the current research.
- The present research is the first on the providing a model for the development of human resources in Khorasan universities. Despite the maximum use of the capacities of experts in this field, it definitely has some shortcomings that it is suggested that the mentioned model be implemented in all universities and the situation of human resources be examined from the perspective of the obtained dimensions, components and indices and the gap between the current and the desired situation should be determined.
- Appointing competent managers based on expertise, commitment, integrity, passion and interest instead of relationships and characteristics unrelated to work and responsibility.
- Creating three research-interventional systems for monitoring implementation and evaluation in order to increase productivity and reduce existing damages and improving behavioral and mental health of employees and optimal services to the organization and reduce threatening and dangerous factors.

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