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International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

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EVAPOTRANSPIRATION PREDICTION BASED ON CHEBYSHEV INTERPOLATION

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ABSTRACT

This paper considers the possibility of applying the methods of the Chebyshev interpolation theory in predicting evapotranspiration, which allows obtaining more accurate predicted values. As a result, it optimizes the parameters that provide significant savings of resources. Conducted theoretical studies let us propose a method for constructing a predictive indicator of evapotranspiration, based on the problem of Chebyshev approximation, and also construct the indicative curves for alfalfa. Comparing the results of traditional procedures based on classical regression methods with those calculated by the proposed method gives a good match. It confirms the accuracy of both the adopted method and the reliability of the dependencies obtained.

Keywords: Alfalfa evapotranspiration; Chebyshev interpolation theory; Mathematical models; Irrigation optimization.

1. INTRODUCTION

Evapotranspiration (total water consumption) is the most important characteristic of water management. Calculation of the evapotranspiration of irrigated crops is the most significant element of irrigated agriculture management at all its stages, including the planning of irrigation of new lands, design of irrigation systems, and their operation. Its value, along with other parameters, is the input information for most hydrological and water-balance models. Inaccuracies in the definition of evapotranspiration in systems design can lead to the death of major capital investments in the construction of excess capacity, the shortage of irrigated crop production, and failure to obtain the design yield due to the inability to ensure optimal water regime.

The development of evapotranspiration models is widespread in most developed countries. The most common method is that of Penman-Monteith [1]. The method is recommended as the standard by the International Organization for Food, and Agriculture of the United Nations (FAO UN). In Russia, with significant soil-climatic diversity, the Penman-Monteith method is difficult to apply, as it requires long-term data on the solar radiation entering the earth's surface in a particular area (these data are not always available). It also does not sufficiently take into account the biological characteristics of cultivated plants at different periods of their growth and development. Therefore, for most regions of Russia, empirical methods of determining evapotranspiration, developed by various research organizations, have become widespread along with deterministic methods [2, 3].

2. ESTIMATION OF EVAPOTRANSPIRATION

Regardless of the method of calculation of evapotranspiration, its prediction, occurs using the classical regression methods.

The emergence and development of modern tools and data collection methods, along with the development of the mathematical apparatus for their analysis, allows the use of a more sophisticated mathematical apparatus for predicting the quantitative characteristics of evapotranspiration. The

application of the methods of the Chebyshev interpolation theory that are proposed by us, allows us to obtain more accurate predicted values of evapotranspiration. As a result, it allows us to optimize the parameters and yields significant savings of resources. The aim of the research is the prediction of evapotranspiration based on the method of constructing its predictive polynomial using the Chebyshev interpolation method of a discretely given function.

The International Organization for Food and Agriculture of the United Nations (FAO UN) recommended the Penman-Monteith method as a standard method of calculation of evapotranspiration [1]:

$$ET_0 = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T + 273} u_2 d_a}{\Delta + \gamma(1 + 0.34u_2)}, \quad (1),$$

where ET_0 – evapotranspiration, mm/day; R_n – solar radiation on the surface of plants, Joule/m²day; G – heat flow from the soil, Joule /m²day; T – the average daily temperature at altitude 2 m, °C; u_2 – wind speed at altitude 2 m, m/s; d_a – lack of air humidity Pascal; Δ – vapor pressure gradient curve, Pascal/°C; γ – psychrometric constant, Pascal /°C.

In Russia, along with the deterministic methods of evapotranspiration calculations, empirical methods are widespread, especially those based on the functional dependence of evapotranspiration on temperature or humidity [4]. Among them are:

- Bioclimatic method of Alpat'eva and Alpat'eva [5], according to which evapotranspiration is directly proportional to the deficit of air humidity, given as

$$ET = k_{\bar{a}} \sum d \quad (2).$$

Bioclimatic method of G.K. Lgov [6], according to which evapotranspiration is directly proportional to the average daily air temperature as

$$ET = k_{\bar{t}} \sum t, \quad (3)$$

where ET – evapotranspiration, mm or m³/ga; $k_{\bar{a}}$ – bioclimatic coefficient, mm/°C or m³/ga·°C; d – the amount of average daily air humidity deficit, t – the amount of average daily air temperatures °C.

3. CHEBYSHEV INTERPOLATION

Along with the above methods for calculating evapotranspiration, there are others developed by scientists from different countries (for example, [7-10] and others). Regardless of the method of calculation of evapotranspiration, its prediction occurs using the classical regression methods [11]. We suggest using the more advanced mathematical apparatus of the Chebyshev interpolation theory as a basis for predicting evapotranspiration. Compared to the regression and mean square approximation methods, the Chebyshev interpolation method is the most efficient and versatile. It also has a special property not only to obtain high approximation accuracy at discrete representation points of functional dependencies but also to provide the required guaranteed approximation accuracy.

Consider the data of quantitative assessment of evapotranspiration of ET, calculated by one of the methods, and the course of the vegetation period. For the beginning of the period, we take the third decade of April, for the end of the second decade of October.

Thus, the values of evapotranspiration of ET can be specified in the form of a discrete series:

Table 1: Evapotranspiration ET values

t	t_1	t_2		t_N
y	y_1	y_2		y_N

Here, t is the decades, numbered in ascending order from 1 - the third decade of April, 2 - the first decade of May, etc. N - the second decade of October, a $y_k = f(t_k)$, $k = 0, 1, \dots, N$ accordingly, the value of ET in the corresponding period.

3.1 POLYNOMIAL FUNCTION FOR CHEBYSHEV APPROXIMATION

The task of the Chebyshev approximation of a function by a polynomial

Let the function $f(t)$ be given by the table of its values $y_k = f(t_k)$, $k = 1, 2, \dots, N$ (Table 1).

Without loss of the generality, we can assume that $t_1 < t_2 < \dots < t_N$. Any polynomial (for example, trigonometric) $P_n(\vec{a}, t) = a_0 + \sum_{i=1}^n a_i \sin i * t$, the order of which $n \leq N$, in relation to a given table $\{t_k, y_k\}$ has a natural characteristic of proximity - maximum dodge:

$$\varphi(\vec{a}) = \max_{0 \leq k \leq N} |y_k - P_n(\vec{a}, t_k)| \quad (4)$$

Consider a fixed value of the order of the polynomial (n)

$$\min_{\vec{a}} \varphi(\vec{a}) = \rho \quad (5)$$

Then, polynomial $P_n(\vec{a}^*, t)$, for which the condition is met:

$$\phi(\vec{a}^*) = \rho \quad (6)$$

This is called **the best approximation polynomial of the table** $\{t_k, y_k\}$.

The solution of the best approximation problem (the construction of a polynomial $P_n(\vec{a}^*, t)$) significantly depends on the ratio between the values of the order of the polynomial (n) and the "length" of the table (N). Therefore, if $n = N$, then the task of constructing the polynomial of the best uniform approximation is transformed into the classical interpolation problem, for which $\rho = 0$. The first nontrivial version of the best approximation problem occurs when $N = n + 1$. This task is known as **the Chebyshev interpolation problem**. Known methods can be applied to solve the problem (5) (see, for example, [12-14]). In particular, it can be solved through reduction to the linear programming problem [15]. We introduce the notation:

$\vec{a} = (a_0, a_1, \dots, a_n) \in R^{n+1}$, $B_i = (1, \sin t_i, \sin 2 t_i, \dots, \sin n t_i) \in R^{n+1}$, $b_i = -y_i, i \in [1: N]$. Given that the polynomial $P_n(\vec{a}, t)$ can be represented as a scalar product $P_n(\vec{a}, t) = \langle \vec{a}, (1, \sin t, \sin 2 t, \dots, \sin n t) \rangle$, task (6) can be written in the form:

$$\max_{i \in [1:2N]} \{ \langle B_i, \vec{a} \rangle + b_i \} \xrightarrow{\vec{a} \in R^{n+1}} \min \quad (7)$$

Then, according to [10], the problem (5) is equivalent to the linear programming problem of the following form:

$$\begin{cases} a_{n+1} \rightarrow \min \\ a_{n+1} - \langle B_i, \vec{a} \rangle - b_i \geq 0, i \in [1: N] \end{cases} \quad (8)$$

4. THE METHOD OF CONSTRUCTING A PREDICTIVE POLYNOMIAL BASED ON THE CHEBYSHEV APPROXIMATION PROBLEM

We believe that we are given the tabular values of evapotranspiration *of ET* (in the table is *y*) in accordance with the decades of the growing season *t* (Table 1).

Stages of construction include:

Block 1- “The degree of the polynomial”: Set the degree of the polynomial

$$n < N, m \geq n + 2.$$

Block 2- “Constructing a polynomial”:

For a given degree of a polynomial, choose the number of nodes used $m \geq n + 2$ to solve the auxiliary problem.

Suppose $i = 0$.

Solve the problem:

$$\max_{i+1 \leq k \leq i+m} |y_k - P_n(\vec{a}, t_k)| \xrightarrow{\vec{a} \in R^{n+1}} \min \quad (9).$$

Assume that the vector of coefficients $\vec{a}_i^*$ is a solution to the problem (9), where $P_n(\vec{a}, t) = a_0 + \sum_{i=1}^n a_i \sin i * t$.

Block 3- “Building a series of polynomials”: we are conducting a series of experiments for $n = 1, 2, 3$ и $m = n + 2, n + 3, n + 4$.

Block 4- “Optimization of the polynomial”: Analyze the results obtained and choose the optimal polynomial.

Implementation of the proposed interpolation algorithm will be carried out by using the example of alfalfa. Alfalfa has a high potential for increasing yields with sufficient irrigation.

We carry out computational experiments using a program that implements obtaining the values of the coefficients of polynomials based on solving the problem of the Chebyshev

approximation. This program was implemented in the Matlab environment [16], and used to build indicators of commodity markets (for example, [17]). The program code element has the following form:

```
Function program = program
n=input ('Enter value n='); {Enter the degree of a polynomial}
m=input ('Enter value m=');
maxi= load('max.txt'); { Array of values }
k = 0;
....
y = linprog(q, G, H);{ Finding optimal coefficients for the Chebyshev
approximation}
u(l,l) = 1;
for j = 2:(n+1)
u(j,l) =sin(k*(j-l));
end
...
time = ((m+1):18);      {Plotting graphs}
plot(time,maxi((m+1):18),'b',time,mini((m+1):18),'k',time,v,'ro-',time,w,'g',time,z,'y');
grid on;
end
```

5. CONSTRUCTION OF A PREDICTIVE POLYNOMIAL OF EVAPOTRANSPIRATION OF ALFALFA BASED ON THE PROBLEM OF THE CHEBYSHEV APPROXIMATION

We set the table of values $y_k = y(t_k)$, $k \in [1:N]$ evapotranspiration of *ET* alfalfa during the t_k decades of the growing season, numbered in ascending order. Where t_1 - the third decade of April, t_{18} - the second decade of October. The data are given for the Saratov region [18].

Table 2: Numerical values of ET evapotranspiration

t	1	2	3	4	5	6	7	8	9
y	11,78	15,8	28,1	54,3	67,1	22,5	31,8	33,1	37,3
t	10	11	12	13	14	15	16	17	18
y	44,2	18,2	24	25,2	28,6	39	18,4	7,8	7,5

The discrete graph is shown in Figure 1.

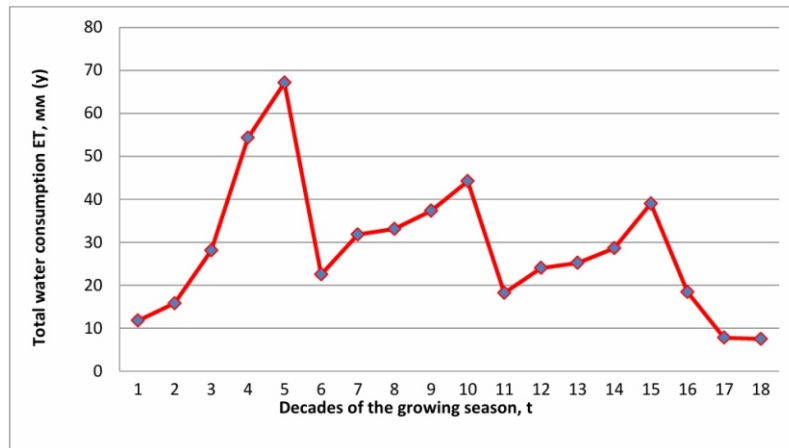


Figure 1: Discrete graph of the evapotranspiration function of the $ET(y)$

Based on the above method, it is possible to build a forecast polynomial over the entire growing season. However, as it is known that [19], the average daily water consumption of alfalfa increases with the development of plants: in the “regrowth – branching” period, it is in the range of $10\text{--}30 \text{ m}^3/\text{ha}$, “Branching – budding” $30\text{--}50 \text{ m}^3/\text{ha}$ and in the “budding – flowering” period $50\text{--}70 \text{ m}^3/\text{ha}$. Besides, the magnitude of the total water consumption of alfalfa has certain dynamics in mowing: the highest water consumption is the first mowing (36.3 - 38.7%) of the total water consumption; slightly lower water consumption was the second (31.1 - 33.1%) and the third cut was characterized by a decrease in crop productivity (27.5 - 28.9%) of the total water consumption [18]. That is, in alfalfa, the value of evapotranspiration substantially depends on the stages of development and cutting. So, for greater accuracy, it is desirable to consider shorter intervals when constructing a predictive polynomial. In addition, the value of evapotranspiration depends on climatic conditions. In this regard, we have considered the numerical parameters for years with different climatic characteristics: medium-arid (y_{MD}) and moderately humidified (y_{MM}).

We will analyze the two periods. 1-5- $th(t_1 - t_5)$ and 6-10- $th(t_6 - t_{10})$.

First, we construct a graph of the function y (evapotranspiration of the ET) together with the graph of the linear regression equation over the gap (Figure 2).

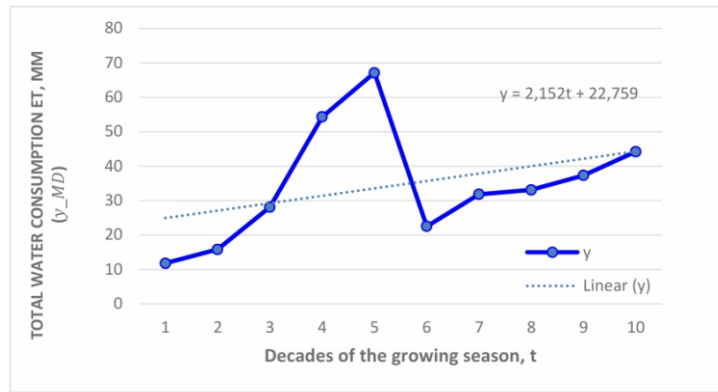


Figure 2: Graph of the evapotranspiration function $ET(y)$ together with the linear regression equation

As forecast polynomials, we will consider trigonometric polynomials of the first degree $P = a_0 + a_1 \sin t$ and second degree $Q = a_0 + a_1 \sin t + a_2 \sin 2t$. As practice shows, an increase in the degree of a polynomial only leads to an increase in the number of calculations without improving the accuracy of the forecast.

Having conducted numerical experiments according to the proposed method, we find that for the specified period, the predictive polynomials of the first and second degree, for medium-dry years respectively have the following form:

$$P = 34,08 - 23,3 \sin t, \quad Q = 34,39 - 33,14 \sin t - 0,67 \sin 2t.$$

For moderately moisturized:

$$P = 30,29 - 20,4 \sin t, \quad Q = 30,5 - 27 \sin t - 0,5 \sin 2t.$$

Evapotranspiration ET schedules together with graphs of forecast polynomials of the first (P) and second (Q) degrees for medium-arid (y_{MD}) and moderately moist (y_{MM}) years are shown in Figures 3 and 4. Values are for 1–5th periods (decade of the growing season, numbered in ascending order).

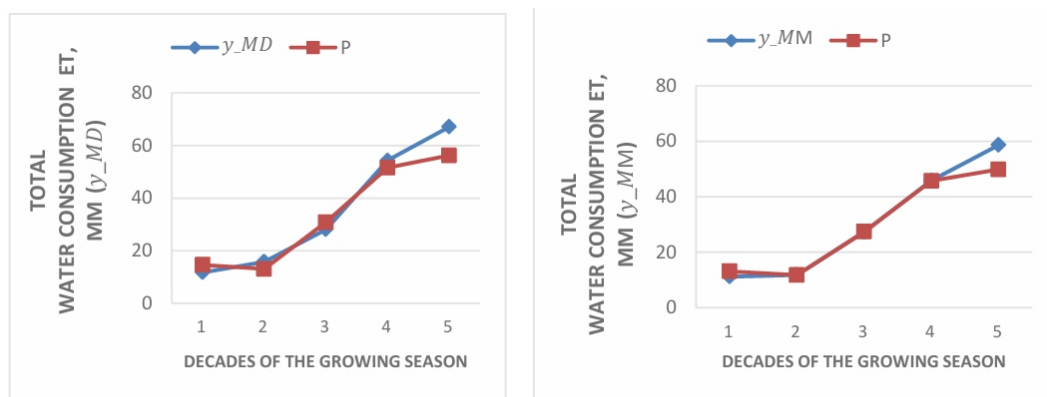


Figure 3: Graphics of evapotranspiration of ET together with graphs of predictive polynomials of the first degree P for medium-arid (y_{MD}) and moderately moisturized (y_{MM}) years, period 1–5th

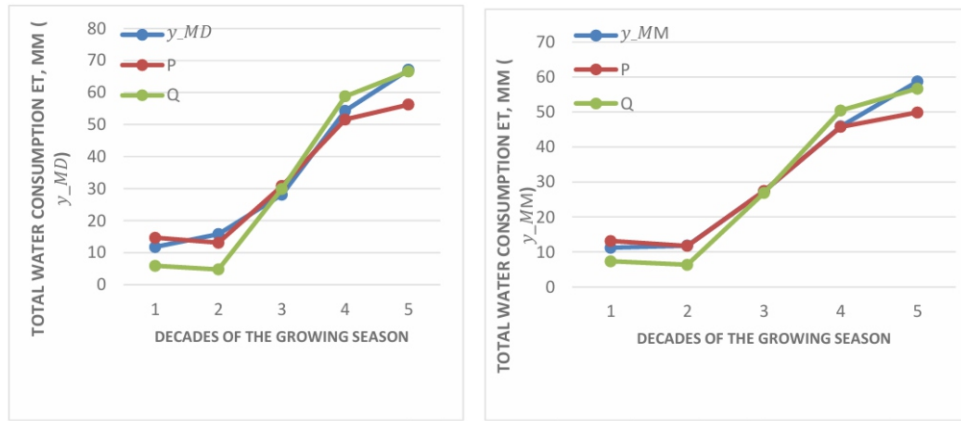


Figure 4: Evapotranspiration ET schedules together with graphs of forecast polynomials of the first (P) and second (Q) degrees for medium-arid (y_{MD}) and moderately humidified (y_{MM}) years, period 1–5th

Similarly, we will conduct numerical experiments according to the proposed method for the 6th-10th periods. We find that for the specified period, the predictive polynomials of the first and second degree, for medium-dry years respectively have the following form:

$$P = 50,9 - 22,46 \sin t, \quad Q = 40,3 - 8,7 \sin t + 0,25 \sin 2t.$$

For moderately moisturized:

$$P = 48,6 - 16,7 \sin t, \quad Q = 38,3 - 3,4 \sin t + 0,28 \sin 2t.$$

Evapotranspiration ET graphs together with the graphs of the forecast polynomials of the first (P) and second (Q) degrees for medium-arid (y_{MD}) and moderately humidified (y_{MM}) years are shown in Figures 5 and 6. The values are for 6th–10th periods.

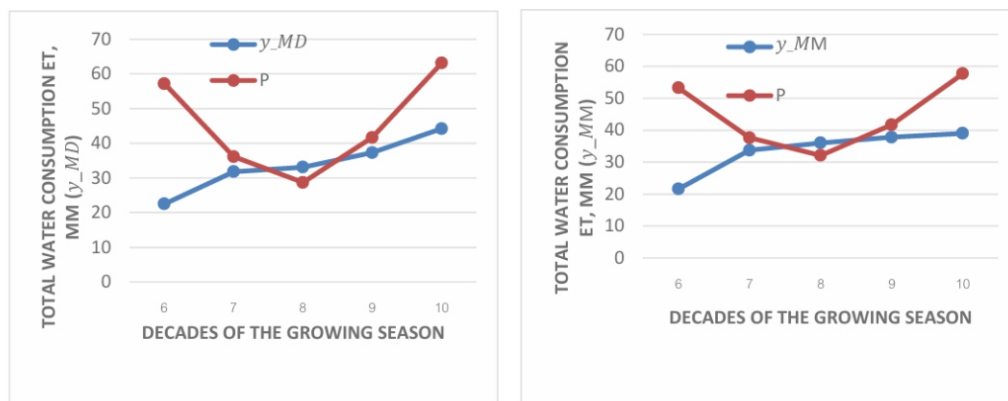


Figure 5: Evapotranspiration of ET charts in conjunction with the graphs of forecast polynomials of the first degree P for medium-arid (y_{MD}) and moderately wetted (y_{MM}) years, period 6–10th

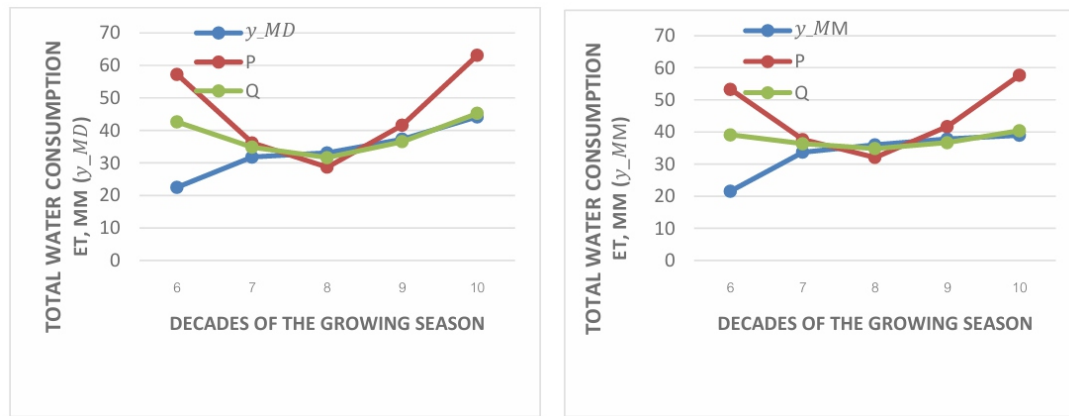


Figure 6: Evapotranspiration ET schedules together with the graphs of forecast polynomials of the first (P) and second (Q) degrees for medium-arid (y_{MD}) and moderately humidified (y_{MM}) years, period 6–10th

Analyzing the obtained results, we find that for the period of the 5th–10th, the total deviations of the predicted polynomials of the first degree from the actual evapotranspiration values are 4–8% less. Meanwhile, the corresponding total deviations of the predicted polynomials of the second degree are 6–12% less than the total deviations from the calculated evapotranspiration values calculated by other methods. Thus, for this period, it is advisable to choose a polynomial of the first degree as a predictive polynomial, calculating its coefficients by the proposed method.

For the same period, the 6th–10th total deviations of the predicted polynomials of the first degree from the actual values of evapotranspiration are one third larger, corresponding to the total deviations of the predicted polynomials of the second degree. The total deviations from the calculated evapotranspiration value calculated by other methods are greater than the total deviations of the predicted polynomials of the second degree and less than those of the first-degree polynomials. Thus, for this period, it is advisable to choose a second-degree polynomial as a predictive polynomial. The dependency graphs shown in Figures 5 and 7 demonstrate this well. Moreover, as we can see, the forecast trend is maintained for years of different humidity (in our example, medium-dry (y_{MD}) and moderately wetted (y_{MM}) years, the coefficients of polynomials will be different.

6. CONCLUSION

On the basis of the Chebyshev interpolation theory of a discretely given function, a method for constructing a predictive polynomial for predicting evapotranspiration has been proposed. A program has been developed on the basis of the proposed algorithm (implemented in the Matlab environment) that is implemented, obtaining the values of the coefficients of polynomials.

Comparison of the prediction research results with those calculated by the proposed method, based on the example of alfalfa, gives a good match. It also indicates the correctness of the adopted methodology and reliability of the dependences obtained. This technique can be extended to different climatic conditions and crops while maintaining the accuracy of the approximation.

7. AVAILABILITY OF DATA AND MATERIAL

Data used or generated from this study can be requested to the corresponding author.

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A FOCUS ON FORMATION OF FINANCIAL RESOURCES OF AGRICULTURAL ORGANIZATIONS, RUSSIA

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ABSTRACT

Financial resources always occupy an important place in the economic mechanism of enterprises, while being a source of coverage, both current costs and purchased fixed assets. At the same time, for a more dynamic development of agriculture, there are not enough financial resources. There are several reasons for that. On the one hand, the growth of own sources is limited by the disparity of prices for the products sold, on the other hand, the availability and low cost of credit resources have not been ensured yet. State support, as an attracted source of financing, occupies a small share in the structure of financing sources of agricultural organizations. The current system of withdrawal of part of the profits due to the disparity of prices for products sold and purchased means of production limit significantly the reproductive potential of agricultural organizations. Despite the positive changes the current system of lending also does not contribute to the development of the reproductive function of agricultural organizations, not to mention the creation of new industries. In the developed countries of the world, credit issues contribute to both the availability of credit resources and the cheapening of the cost of finished products. It is obvious that in this regard, it is necessary to compensate fully the cost of credit resources by the state, increase support amount and availability.

Keywords: Credit resources; Agricultural investment; Agritech support; Cost of credit resources; Availability of loans; Government support; Structure of investments in fixed assets; Agrifood.

1. INTRODUCTION

Reforms in the agroindustrial complex of the Russian Federation are in accordance with the adopted federal legal documents and regional programs of agricultural development. The result of an active agrifood policy was an increase in the value and amount of gross agricultural output, an increase in the export potential of the industry. At the same time, the products produced could be cheaper and the products would be more competitive if the state took a more active part in the formation of the cost of financing sources of investments in agricultural production. In modern conditions, such participation is limited by compensatory measures on attracted credit resources. Despite the implemented measures, the cost of credit resources affects largely the increase in creditor debt of agricultural producers [3–10].

Financial resources always occupy an important place in the organizational and economic mechanism of management, and the efficiency of agricultural production depended on their structure and cost. In the developed countries of the world, considerable attention is paid to this issue, while focusing significant efforts on the availability and cost of credit resources, conditions for refinancing profits, creating other conditions for the successful functioning of agricultural production.

In Russia, a multi-layered agrarian economy is still being formed, while the state has practically no influence on the structure of financial resources and their cost. In fact, their cost is formed spontaneously under the influence of price and organizational factors. This situation does not contribute to more dynamic and systematic development of agricultural production, the creation of new workers, whom the agricultural economy need now. And in general, in modern conditions, the state is not focused on reducing the cost of financial resources of agricultural organizations, which ultimately has a negative

impact on the purchasing power of the population.

2. METHODS AND MATERIALS

The paper used the system, comparative, economic-mathematical, economic-statistical and other research methods. Federal laws, decrees of the President of the Russian Federation, resolutions of the Government of the Russian Federation, published works of research institutions of the Russian Academy of Sciences, statistical materials at the federal and regional levels were used as materials.

3. RESEARCH RESULTS

In 2010, agriculture produced a gross output of 2.6 trillion rubles, in 2017 – 5.1 trillion already. This was largely due to the creation of conditions for the effective functioning of agriculture, including a favorable investment climate and an increasing level of state support. The volume of investments in agriculture over the past 7 years has increased by 36%. One ruble of investments in agriculture brings from 8 to 12 rubles of the gross output value, and from 11 to 60 kopecks of profit. In modern conditions, agriculture is a beneficial highly profitable business. It should be noted that the inflow of investments in different years varies, which is largely due to foreign policy factors, such as world crises, sanctions policy, etc. During the analyzed period, the yield of grain crops increased by 1.6 times, sugar beet by 1.8 times, sunflower by 1.5 times, milk yield per feed cow increased by 35.1%, and this is not the limit. There is a need for new investments and innovations. The net financial result of agricultural organizations increased by 4.1 times, and the level of profitability and return on assets – by 1.8 times. The profitability of agricultural production in 2017 was 16%, and the return on assets was 5.4%. At the same time, if we compare the profit amount with the amount of state support, it turns out that the level of profitability is comparable to zero. Nevertheless, in this regard, there is a positive, but not a turning point trend yet. In 2010, the amount of state support was 107.3 billion rubles, profit – 61 billion rubles, in 2014 the amount of state support was 186.6 billion rubles, profit – 160.9 billion rubles, in 2016 the amount of state support was 218.1 billion rubles, profit 246.8 billion rubles, in 2017 the amount of state support was 233.8 billion rubles, profit – 246.9 billion rubles. Over the past two years, the profit of agricultural producers is greater than the amount of state support, and this despite the fact that in agriculture there is a disparity in prices for products sold. A significant part of the profits is still received by processing enterprises and trade.

Table 1: The main production and economic indicators of agricultural organizations in Russia [1]

Indicators	Years						2017 to 2010 i %
	2010	2013	2014	2015	2016	2017	
Gross output, billion rubles	2587.8	3687.1	4319.1	5164.9	5119.2	5119.9	by 2 times
The arable land area, million ha	75.2	74.9	78.5	79.3	79.3	80.0	106.7
Investments in fixed capital - total, billion rubles	303.6	487.7	510.3	505.8	611.2	412.5	135.9
State support from the federal budget, billion rubles	107.3		186.6	222.3	218.1	233.8	by 2.2 times
Investments per 1 ha of arable land, RUB	1427	6511	6499	6378	77.9	5156	by 3.6 times
Gross output per 1 ha of arable land, thousand rubles	34412	49227	55020	65131	64555	63999	by 1.9 times
Received gross output for 1 investment ruble, RUB	8.52	7.56	8.46	10.21	8.37	12.41	145.7
State support from the federal budget for 1 ha of arable land, RUB	1427		2377	2803	2750	2923	by 2 times
The profits on 1 investment ruble, RUB	0.20	0.11	0.32	0.51	0.40	0.60	by 3 times
Yield c/ha: grain and bean	18.3	22	24.1	23.7	26.2	29.5	by 1.6 times
sugar beet	241	442.1	370.1	387.8	470.4	442.1	by 1.8 times
sunflower seed	9.6	14.5	13.1	14.2	15.1	14.5	151.0
Milk yield per 1 feed cow, kg	4189	4519	4841	5140	5370	5660	135.1
Net financial result, billion rubles	61.0	51.6	160.9	256.8	246.8	246.9	by 4.1 times
The level of profitability taking into account state support, %	9.1	5.2	17.4	20.7	15.7	16.0	by 1.8 times
Return on assets, %	2.9	1.7	4.9	6.9	6.0	5.4	by 1.8 times

In modern conditions processing enterprises use the following advantages:

1. Monopoly position in the market of purchase of agricultural products and raw materials.

Despite the presence of Antimonopoly legislation, the financial condition of agricultural organizations depends on the price set by processing organizations. In this case, it seems to us that direct state regulation of pricing for purchased agricultural raw materials and products is necessary.

2. The effect of the maximum number of consumers. The essence of the effect of the maximum number of consumers is the mandatory daily satisfaction of needs for finished food products from wholesale and retail consumers, which is explained by the physiological needs of the person. In the modern agricultural economy, this effect is inherent in trade and processing organizations, as they offer consumers a ready-made product, while the agricultural producer sells raw materials to a limited number of processing enterprises that have the ability to collude about the price.

The implementation of the above advantages determines a stable part of the profitable food industry enterprises with a high share of profits and the disparity of relations in agriculture (Table 2). The price disparity is also due to the increase in the cost of energy, fertilizers, works, services, etc., from the enterprises of the first sphere of agriculture. Profit from the activities of the food industry exceeds the same figure in agricultural organizations in different years from 2 to 5 times! In 2017 one profitable agricultural organization had 87.7 million rubles of profit, while on processing one – 161.1 million rubles. The positive trend here is an increase in the share of profitable agricultural organizations and an increase in the profit amount attributable to one agricultural organization. At the same time, as practice

shows, agricultural organizations do not have enough net profit to carry out the process of reproduction.

Table 2: Profit from the results of agricultural and processing organizations activities [2]

Year	Agriculture	Food and beverage production	Among them, products of the milling industry, starches, and starch products
Share of profitable organizations, %			
2006	67.7	65.2	57.6
2007	74.4	69.8	69.1
2008	81.6	74.9	73.9
2015	77.9	75.2	76.7
2016	78.8	78.1	79.0
2017	82.3	81.9	79.8
Account for profits per 1 enterprise, thousand rubles			
2006	6645	33156	13260
2007	9842	36733	20765
2008	16273	49303	29670
2015	87720	123595	78990
2016	83571	148080	156910
2017	87666	161157	108710

As a result, the current economic conditions are pushing agricultural producers to use loans actively and use them to purchase new equipment and technologies, while intensifying production. In this regard, labor costs for the production of 1 c of products are reduced; the financial condition of agricultural organizations from the implementation of such measures is not improved. The purchasing power of the population and the competitiveness of agricultural products also suffer. This is due to the unprocessed approaches and constant reform of agricultural production, which led to the loss of priorities of state regulation in the first and third spheres of agriculture, the rupture of industrial relations, reducing the share of agricultural production produced by large-scale agricultural organizations, the bankruptcy of a significant number of agricultural organizations, deformation of intersectional proportions, the formation of the institute of intermediary organizations. Moreover, as foreign practice shows, constant organizational changes in any of the spheres of the economy have only a negative impact on its effectiveness.

Every year the share of agricultural organizations with overdue payables decreases slowly (Table 3).

Table 3, over the past three years, the share of agricultural organizations that had overdue credit indebtedness decreased by two times and amounted to 12.3% of the total number of agricultural organizations. At the same time, a significant part of the debt falls on payments to suppliers. 20% of agricultural organizations have overdue debtor indebtedness. A significant share of debtor indebtedness accounts for the debt of buyers 17.4-18.9%. It should be noted that in the food industry the situation with credit and debtor indebtedness is much worse than in agricultural organizations.

Table 3: The share of organizations with overdue credit and debtor indebtedness, % [2]

The share of organizations with	Agriculture			Food and beverage production			Among them, products of the milling industry, Starches, and starch products		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
overdue credit indebtedness	17.2	13.8	12.3	9.9	9.5	9.2	16.0	11.9	12.6
overdue indebtedness to suppliers	14.3	11.8	10.8	9.1	8.9	8.5	14.0	10.4	11.8
overdue indebtedness to the budget	8.1	5.4	4.1	2.7	2.4	2.4	2.7	1.5	1.7
overdue indebtedness on loans and borrowings	4.0	3.0	2.5	1.7	1.5	2.1	1.3	1.5	3.4
overdue debtor indebtedness	20.0	18.4	19.1	20.0	20.5	19.8	26.7	27.6	24.4
overdue buyers' indebtedness	18.9	17.4	17.9	19.3	19.5	18.8	26.7	25.4	23.5

Thus, the state economic policy of restructuring the debt of agricultural organizations is actively carried out at the present time. Conditions were created, relevant regulations were adopted, procedures were carried out and as a result, up to 20% of agricultural organizations have overdue credit indebtedness, although 10 years ago this figure was three times more.

On the other hand, good solvency helps to attract a larger amount of bank loans, and as a result, an increase in overdue debts. Approximately 75% of the total debt of agricultural organizations accounts for loans received from banks. In 2017, the total debt of agricultural organizations was 2.2 trillion rubles or 43.1% of gross agricultural output. Among them, 1.6 trillion rubles is the debt on bank loans and borrowings or 29.4% of gross agricultural output. If you think about it, these are catastrophic figures, at least for the reason that the service of overdue debts sometimes exceeds the increase in the wage fund for agriculture for the year. Thus, the money of the rural workers flows to service the debt on bank loans.

Table 4: Total debt of agricultural organizations [2]

	Total	including loans to banks on received borrowings	Overdue indebtedness to banks on received borrowings
2014, million rubles	1811699	1351021	20671
%	100.0	74.6	1.1
2015, million rubles	2114475	1541890	18428
%	100.0	72.9	0.9
2016, million rubles	2150513	1578459	19197
%	100.0	73.4	0.9
2017, million rubles	2205799	1611055	15806
%	100.0	73.0	0.7

This situation is also due to the high-interest rate on loans. Excluding subsidies, the average interest rate on loans in Russia in 2017 amounted to 10.57%, while in China 4.35%, and has not changed in the last 3 years, and in the US – 3.9%. Of course, the low-interest rate on loans in the US and China does not contribute to the growth of the cost of products, including agriculture.

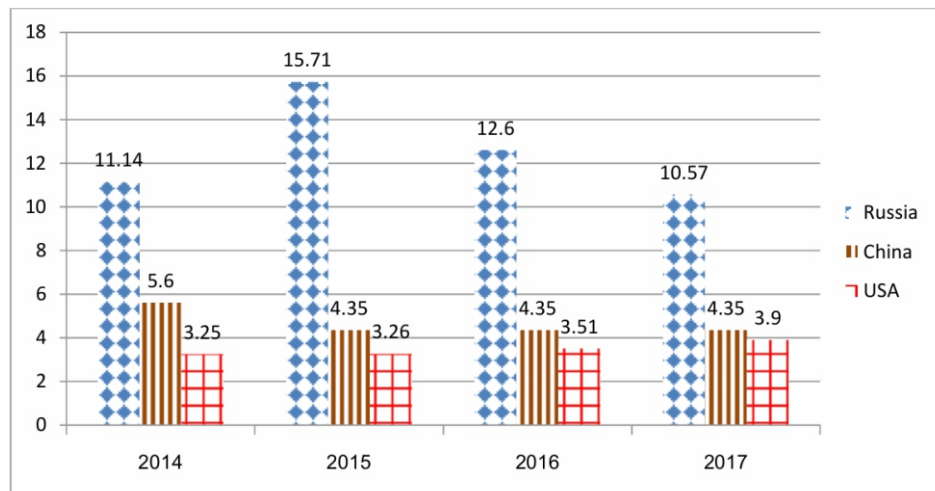


Figure 1: Interest rates on loans in Russia, China, and the USA in 2014-2017 [2].

The system of lending to agricultural organizations also cannot be called effective. It still does not provide access to cheap credit for agricultural producers. This is evidenced by the growing amount of accounts payable on loans received in the national currency. Debt on loans exceeds the amount of loans granted and has a clear growth trend. Here the state needs to work out the issue of reducing the cost of loans for agricultural producers. Attracting credit resources, agricultural organizations, as a rule, create new jobs, increase the amount of taxes and fees paid, solve a number of social issues, and the bank provides a loan at 5-7% per annum! Subsidized credit resources are clearly insufficient for agricultural organizations. This factor is a constraint for the development of the entire agro-industrial complex. This is evidenced by the growing amount of loans granted to agricultural organizations, which has increased almost by 3 times over the past 7 years, while gross output by 2 times. With such growth rates of gross output at the agricultural organizations, the overdue accounts payable on the credits will always be formed. Therefore, it is necessary to introduce compensatory measures to subsidize the 100% interest rate on loans for agricultural organizations. The dynamics of the demand for credit resources from the part of agricultural producers is increasing. Thus, in 2010 agricultural producers were granted 435.1 billion rubles, in 2016 – already 639.8 billion, in 2018 – 1174.9 billion. Of course, in recent years, the subsidy mechanism of credit resources has undergone major changes. The system of reporting and documentation on the requested credit resources has changed radically. The scientists-economists of RAAS repeatedly, even during the implementation of the PNP “Development of agriculture”, made proposals to change the scheme of subsidizing loans for agricultural producers. And only a few years ago their proposals were implemented in practice.

Table 5: The loans amount and debt on loans of agricultural organizations of Russia [2], (Billion rubles)

	As of 1.01.2010	As of 1.01.2013	As of 1.01.2016	As of 1.01.2017	As of 1.01.2018	As of 1.01.2019
Amount of granted loans	435.2	532.0	639.8	809.0	950.4	1174.9
Debt on loans	849.2	1203.1	1431.6	1538.8	1644.5	1881.4

All of the above has a fundamental impact on the structure of investments in fixed capital of agricultural organizations, which has no clear trends. From the above data, it can be seen that the share of the state in the structure of investments in fixed capital decreases. In some years, the share of subjects of the Russian Federation exceeds the share of the federal budget in the financing of agriculture, which, in our opinion,

is unacceptable and limits the budgetary opportunities of subjects of the Russian Federation, including in the field of social and engineering infrastructure in rural areas. For 2010-2017, the participation of the state in investments in fixed capital is not more than 3%.

Table 6: Structure of investments in fixed capital aimed at the development of agriculture, classified by sources of financing [2]

Indicators	Years							
	2004	2009	2010	2013	2014	2015	2016	2017
Investments in fixed capital - total	100	100	100	100	100	100	100	100
own assets	63.1	44.5	49.3	44.8	52.8	59.2	58.5	61.1
borrowed funds	36.9	55.5	50.7	55.2	47.2	40.8	41.5	38.9
among them budgetary funds	8.9	3.6	2.3	2.3	3.3	1.8	2.5	...

This is clearly not enough to implement a fully-fledged agrifood policy. State participation in the formation of fixed capital should be increased at least by 30% in the structure of sources of financing. Only in this case, a fully-fledged agrifood policy will be clearly presented, and the effect of updating fixed assets and attracting modern technologies will not long in coming. Up to 53% of investments in fixed assets are borrowed funds. As mentioned above, in real conditions it is necessary to reduce their cost, to ensure price and organizational accessibility.

Table 7: Investments in fixed capital aimed at the development of agriculture and commissioning of production facilities [1]

Indicators	Years				
	2005	2010	2014	2015	2016
Investments in fixed capital for the development of agriculture (in actual prices): million rubles	79089	201846	313516	304670	364685
percentage of total investment in fixed assets	2.7	3.0	3.0	2.9	3.3
percentage to the previous year (constant prices)	no	97.8	97.5	87.3	110.4
Commissioning of production facilities through construction and reconstruction: livestock facilities. thousand places:	27.5	111.1	104.1	102.6	120.7
for cattle					
for pigs	60.7	603.3	1322.4	877.3	775.7
for sheep	6.2	6.3	11.9	9.8	14.2
poultry farms: egg direction, thousand laying hens	1150.0	702.7	222.4	248.0	1420.2
meat production, mln heads of poultry meat per year	8.9	122.5	11.1	11.0	35.5
elevators. thousand tons of one-time storage	2.4	56.0	147.7	301.0	224.5
high-quality grinding mills. thousand tons of grain processing per day	1.2	0.2	1.4	0.5	0.06
feed mills, thousand tons of feed per day	0.2	0.8	2.3	3.1	2.5
warehouses mechanized for storage of mineral fertilizers. pesticides. microbiological agents and lime materials, thousand tons of one-time storage	2.4	-	2.0	-	11.5
storage for potatoes. vegetables and fruits in agriculture, thousand tons of one-time storage	13.3	138.1	116.5	182.5	112.7

In dynamics, the amount of investments in fixed capital of agricultural organizations is increasing. Over the past 9 years, the amount of investments in fixed assets has increased by 9 times! This increase was due to the introduction of new production capacities in animal husbandry, mainly at the expense of own funds and credit resources. Since 2010, at least 100 thousand places for cattle and up to 1300 thousand places for pigs have been implemented annually. But this is not enough. In 1990, the number of cattle was 57 million heads, in 1995 – 39.7 million heads, and in 2016 – slightly more than 18 million heads. In order to resume the production of milk and breeding in dairy cattle, the number of livestock facilities must be introduced in millions, and for this, it is necessary to ensure the profitability of production of dairy cattle at least at 25% and the availability of credit and other tools for the development of livestock. As for pig breeding, in modern conditions, it is necessary to continue the aggressive expansion of conquest of own market of meat, reduction of its cost price for receiving availability of broad masses of the population to this product.

The commissioning of elevators, mills, feed mills, warehouses for storage of mineral fertilizers and pesticides, warehouses for storage of potatoes and vegetables and fruits are proceeding slowly. The conditions for the work of the livestock and crop sub-sectors are not fully created, which in turn does not ensure the implementation of a competent agri-food policy.

4. CONCLUSION

Despite the implementation of the measures of the state program, it has not been possible to achieve the availability of credit resources for agricultural organizations yet. Demand for them is growing; new production requires significant investment at a low-interest rate. In modern conditions, the state is not ready to ensure the deficit-free credit resources at a low-interest rate for the dynamic development of agriculture. In this regard, it is necessary to revise the measures to subsidize the interest rate on loans to agricultural organizations, increase the amount of lending and a significant reduction in the cost of credit resources.

5. AVAILABILITY OF DATA AND MATERIAL

Data used or generated from this study can be requested to the corresponding author.

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FACTORS AFFECTING EFFECTIVE IMPLEMENTATION OF TECHNOLOGICAL VENTURE CAPITAL (VC) STRATEGIES AT AYANDEH BANK, IRAN

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ABSTRACT

As VC is an emerging industry in Iran, there is little research on it. This study explores the important factors for effective implementation of technological VC strategies. The statistical population of this applied-descriptive study covers all the experts of Ayandeh Bank. Grounded theory (GT) was employed in NVIVO11 to extract components and factors. The research data is collected using semi-structured interviews. This study extracts a total of 10 core categories and 45 subcategories as the factors, by comparing and synthesizing the results from the content analysis of expert interviews. The result includes a wide range of factors including those directly related to investors in the active VC businesses, factors pertaining to the selected VC plans, and non-VC factors such as political and individual indices affect venture capital. All these factors can be identified as indices affecting the effective implementation of VC strategies.

Keywords: Grounded theory; Banking system; Modernization of VC; VC strategies; Long-term VC; Axial Coding.

1. INTRODUCTION

Investment as an important and effective determinant of economic growth plays a key role in increasing the employment rate and reducing unemployment by increasing national productivity (Wright, Robbie & Ennew, 2017). Different factors affect investment, among which income, interest rate, security, proper business environment, the participation of governments and non-governmental public institutions in economy and governance play a more important role in this regard (Chitsazan, 2015).

To find appropriate investment opportunities in a region, alternatives should be properly identified first. Existing opportunities can be then evaluated (Gompers & Lerner, 2016). Relevant factors and components should be properly identified first to search for appropriate investment opportunities in a region. Existing opportunities can be then taken into account (Zutshi, Tan, Allampalli & Gibbons, 2017).

The income level of individuals, companies, and countries as an effective determinant of investment is positively related to the investment rate. In other words, the investment rate increases with an increase in the income level of individuals, companies, and countries (in proportion to the marginal prosperity to invest) (Guo & Jiang, 2013).

Venture capital (VC), as a type of investment, has recently received much attention by economists, investors, and researchers (Gladstone, 2014). The VC process refers to a series of actions taken by funds or venture capitalists to implement an investment plan thoroughly. Developed countries have experienced detailed VC processes because of relatively numerous advantages and market-oriented economics (Ortt & Scholten, 2013). The VC industry is considered a major capital provider for

entrepreneurs. It usually focuses on newly-growing and high-risk businesses before public supply (Cumming, 2015).

Entrepreneurs search for venture capitalists to develop their businesses, and venture capitalists search for risky and highly profitable opportunities (Derakhshan & Muhammadi, 2014). Venture capitalists play a key role in the process of entrepreneurship by providing managerial support and capitals for newly-emerging companies which are growing rapidly, entailing high risks and employing advanced technologies with the potential to turn into global businesses. Accordingly, venture capitalists are also known as experts in the identification of new high-potential businesses (Ranjbar, Rostami & Padam, 2015).

VC has gained more importance in developing economic organizations and making future advances because of the key role of VC funds in developing the most famous companies employing advanced technologies (Rakhman & Evans, 2015).

Venture capitalists usually employ no complicated financial prediction techniques, but try to protect their capitals from uncertainty through contractual rights such as control and economic rights. They also try to decrease the failure rate by supporting certain businesses in which they have invested through certain activities such as financial supply, employment, and communication with potential customers (Ang & McKibbin, 2017).

Modernization of VC has turned this investment method into an independent business. This, in turn, has resulted in the emergence of specialized companies which operate similar to venture capitalists to compensate for the lack of traditional financing channels. They also provide sufficient financial resources for long-term VC in modern technologies (Burgess, 2016, Abbasi, 2019).

The banking system is considered an organization facilitating investments, especially VC. In fact, the banking system of any country acts as the heart of its economic system. As the heart guarantees the life of other organs and cells by pumping blood throughout the body, the banking system should also guarantee the life of economic sectors and activists in a country through proper operations. However, this is not the case because the banking system is driven solely by self-interest. The economic sectors and activists will gradually perish if they are not supplied and supported properly by a healthy banking system. However, a healthy banking system is able to guarantee proper operation of economic sectors and activists (Sohrabi, Fayazi & Shah Hosseini, 2015). In parallel with VC companies, banks as VC financing organizations should take the right and timely decisions to be implemented properly (Hellmann, Lindsey & Puri, 2015).

Decision-making is an important managerial task, and decision-making for the future determines the operational strategies and plans of organizations for future actions. Moreover, no certainty can be imagined for the future. Therefore, managers need to process information and benefit from knowledge to be proud of their decisions. Managerial decisions are of great importance especially when limited financial and nonfinancial resources are used to obtain the best results (Shepherd, Ettenson & Crouch, 2016). If parent organizations and companies make the right decisions on their subsidiary businesses, they need to implement their strategies efficiently and properly to achieve preplanned goals (Hartman, 2017).

Numerous studies have been conducted on different types of investments such as foreign investment and the factors affecting such investments as well as identification of factors and components affecting the attraction of foreign capitals and investors. However, there are few studies on VC and identification of components, indices, and factors affecting the successful implementation of VC strategies. Given the fact that VC is a newly-emerging industry in Iran, few domestic studies are available in this regard. Identification of VC components can be considered the first step of future studies for the development of this industry in Iran. Thus, this study aims to analyze and identify the factors affecting effective VC strategy implementation.

2. METHODOLOGY

This descriptive applied study was conducted by the mixed method. The statistical population (for the identification of components and variables) included managers and experts at Ayandeh Bank. Given the size of the statistical population (30 individuals), the Cochran formula was employed to select 27 participants. The purposive and snowball sampling methods continued until theoretical saturation. Theoretical saturation is used in qualitative studies to determine sampling quality. Data saturation point in this study was obtained when the researcher realized that new data led to no new insight and information through frequent questions. Finally, data saturation was reached after conducting 24 interviews, each of which lasted 75 minutes on average. Components, indices, and factors affecting effective VC strategy implementation were extracted by Grounded theory (GT) with the help of NVIVO 11. GT and NVIVO 11 are powerful tools for analyzing qualitative data capable of accelerating and facilitating coding, multiple classifications, concept categorization and analysis of relations and patterns in textual data, especially when information is collected through fully structured and semi-structured interviews (and not only standard and quantitative interviews). The results of software, content and thematic analyses were then used to extract and identify factors affecting effective VC strategy implementation.

2.1 DATA COLLECTION TOOLS

This study aimed at analyzing the factors affecting effective VC strategy implementation by Grounded theory. Therefore, the required data including 11 primary items and 25 secondary items were collected through semi-structured interviews to identify, analyze and extract components, indices, and factors affecting effective VC strategy implementation at Ayandeh Bank.

Eleven primary items extracted from interviews were as follows:

- o What are the economic factors and indices affecting effective VC strategy implementation at Ayandeh Bank?
- o What are the prerequisites for selection and assurance of successful VC at Ayandeh Bank?
- o What are the factors pertaining to VC resources for the effective VC strategy implementation at Ayandeh Bank?
- o What are the factors and indices for evaluation of investment plans affecting effective VC strategy implementation at Ayandeh Bank?
- o What are the market factors and indices affecting effective VC strategy implementation at Ayandeh Bank?
- o Which legal factors and indices affect effective VC strategy implementation at Ayandeh Bank?
- o Which political factors and indices affect effective VC strategy implementation at Ayandeh Bank?

- o Which individual factors and indices of investors influence effective VC strategy implementation at Ayandeh Bank?
- o What are the financial factors and indices influencing effective VC strategy implementation at Ayandeh Bank?
- o Apart from the abovementioned factors, which factors influence effective VC strategy implementation at Ayandeh Bank?
- o How one should prioritize the influential factors for effective VC strategy implementation at Ayandeh Bank?

The validity and the reliability of interviews were confirmed respectively by expert opinion and general agreement. Data collected from the semi-structured interviews were then statistically analyzed.

3. RESEARCH FINDINGS

STEP1: OPEN CODING

(A) Initial Coding of Interviews (GT Initiation)

The data extracted from the interviews were analyzed by content and thematic analyses (principal components and indices and organizing indices (primary and operational) and comprehensive components and indices (result)). To this end, the interview texts were opened as Word files and were reviewed several times in NVIVO 11. Then the keywords were saved as codes. In other words, the interview texts were first reviewed to start coding and identify similar codes with respect to the research objective. A recursive identification process was used in this study. In other words, the literature was first reviewed to analyze primary and general concepts pertaining to components, indices, and factors affecting effective VC strategy implementation. The interviews were then analyzed to identify newer and more detailed concepts.

Similar or repetitive concepts observed in the next interviews were coded in the existing codes. Thus, some of the allocated codes with multiple frequency rates were considered to be principal components and indices. In the next step, the extracted codes were thoroughly analyzed and categorized as more abstract classes for the development of organizing components and indices. Coding and analysis were carried out after transcribing each interview in a separate Word file. Finally, 275 resultant codes were combined to obtain around 93 indices, sub-indices, components, and factors, which were then divided into 10 basic indices and 93 organizing (primary and operational) indices including components, indices and factors affecting effective VC strategy implementation at Ayandeh Bank based on the importance, frequency, conceptual similarity and researcher expectation of final indices.

In addition, some useful actions were taken to analyze the credibility of data analyzed by the researcher (extraction of components, indices, and factors affecting effective VC strategy implementation at Ayandeh Bank). For instance, the extracted and identified findings, components and indices were given to 5 experts in the sample (including managers, experts and researchers in the Investment Deputy at Ayandeh Bank) to analyze the researcher interpretation and analysis and state their own opinions on the analysis of data and results to prevent any bias.

Content and thematic analyses of interviews by experts resulted in 10 core categories and 45 subcategories known as the factors affecting effective VC strategy implementation at Ayandeh Bank.

(B) Secondary Coding and Concept Categorization (GT Continuation)

In the next step, the primary codes were converted into secondary codes (because of a large number of primary codes). Some secondary codes were then converted into a conceptual code. The following tables summarize the results of open coding based on categories, conceptual codes, and secondary codes.

Table 1: Classification of the responses of interviewees to the items on economic factors and indices

No.	Conceptual Codes	Frequency	Percentage
1	Economic security	13	0.54
2	The attractiveness of investment environment and supply of mutual interests	18	0.75
3	Up-to-date economic policies	6	0.25
4	Appropriate investment infrastructures	15	0.63
5	Competition facilitation and exclusion prevention	21	0.89
6	Business environment evaluation	8	0.34
7	Inflation rate volatility	11	0.46
8	Fluctuations in the banking interest rate	14	0.58
9	The volatility of parallel markets	16	0.67
10	Global economic developments	9	0.38

Table 2: Categorization of the responses of interviewees to the items on prerequisites to the selection and success assurance of investment

No.	Conceptual Codes	Frequency	Percentage
1	Investment team	12	0.50
2	Investment business model	22	0.92
3	Value addition capability	16	0.67
4	Consistency with fund's size and goals	17	0.71
5	VC participation and protection right	9	0.38
6	Redemption right	13	0.54
7	Cumulative interests	14	0.58
8	Protection from value reduction	15	0.62
9	A specialty of the selected syndicate company for investment	6	0.25
10	The success of selected syndicate company for investment in previous participations	8	0.33
11	Reputation of the selected syndicate company for investment	21	0.88
12	Records of investment in the selected syndicate company for investment	17	0.71
13	Capital of the selected syndicate company for investment	8	0.33

Table 3: Categorization of the responses of interviewees to the items on VC resources

No.	Conceptual Codes	Frequency	Percentage
1	Identification of professional networks	9	0.38
2	Resources generated by VC actively	16	0.67
3	Resources recommended by other investors	6	0.25
4	Resources recommended by VC management	12	0.50
5	Resources recommended by the invested companies	13	0.54
6	Paying attention to the values of VC resources	15	0.62
7	Paying attention to the scarcity of VC resources	15	0.62
8	Paying attention to the imitability of VC resources	12	0.50
9	Paying attention to the replaceability of VC resources	19	0.75

Table 4: Categorization of the responses of interviewees to the items on the factors and indices for evaluation of VC plans

No.	Conceptual Codes	Frequency	Percentage
1	VC innovation	20	0.83
2	Paying attention to planning to progress investor commitments	6	0.25
3	Identifying potential options of VC plans	13	0.54
4	Planning for predicting cash flows	9	0.38
5	Evaluating VC risks	18	0.75
6	Evaluating investment profitability	22	0.92
7	Partners (VC experience, competitive strategy type, size of partners)	15	0.62
8	VC ownership (ownership distribution and establishment method)	14	0.58
9	Relationships of partners (relationship management, control mechanism, concentration, commitment, and trust)	19	0.75

Table 5: Categorization of the responses of interviewees to the items on market factors and indices

No.	Conceptual Codes	Frequency	Percentage
1	Access to market	10	0.42
2	Identifying current markets of a business	19	0.80
3	Paying attention to business risks in current markets	16	0.67
4	Identifying the risks of potentially attractive markets	14	0.58
5	Evaluating the business risks of potential markets	18	0.75
6	Discovery of strategically potential businesses	19	0.75
7	Market size	6	0.25
8	Market complexity	9	0.38
9	Market unpredictability	11	0.46

Table 6: Categorization of the responses of interviewees to the items on lawful and legal factors and indices

No.	Conceptual Codes	Frequency	Percentage
1	Stability of VC rules and regulation	21	0.88
2	The complexity of the financial system	13	0.54
3	Bureaucracy and office work	8	0.34
4	Governmental concern for the elimination of complicated administrative rules	11	0.46
5	Legal contexts required for venture capital	13	0.54
6	Paying attention to the existing legal VC infrastructures	18	0.75
7	Economic openness degree	6	0.25
8	VC freedom and flexibility	17	0.71
9	VC supportive rules	20	0.83

Table 7: Categorization of the responses of interviewees to the items on political factors and indices

No.	Conceptual Codes	Frequency	Percentage
1	Political and social security and stability	14	0.58
2	Evaluation of imposed sanctions	5	0.21
3	Domestic and international political changes	7	0.29
4	Governance risk evaluation	7	0.29
5	Legislation policy	12	0.50
6	Paying attention to exclusion reduction	15	0.62
7	Support and maintenance of private-sector ownership	17	0.70
8	Governmental actions to fight economic rent opportunities in VC	15	0.62
9	Supply of required VC infrastructures and equipment	19	0.79
10	Governmental attention to the proper development of the financial market	13	0.54
11	Governmental interventions in venture capital	7	0.29

Table 8: Categorization of the responses of interviewees to the items on individual factors and indices

No.	Conceptual Codes	Frequency	Percentage
1	Individuals needs of investors	15	0.62
2	Expectations of investors	19	0.79
3	Investment intentions	13	0.54
4	Motivation for venture capital	14	0.58
5	Investor satisfaction with VC	9	0.38

Table 9: Categorization of the responses of interviewees to the items on financial factors and indices

No.	Conceptual Codes	Frequency	Percentage
1	Expected rate of return	16	0.67
2	Availability of information on the previous performance of VC companies	19	0.79
3	Items recorded on financial statements (budget, cost, and income)	7	0.29
4	Seasonal reports	5	0.21
5	Coverage of VC interests in financial reports	14	0.58
6	Availability of proper tools for financial supply	17	0.71
7	Reliability of capital return rate	8	0.33

Table 10: Categorization of the responses of interviewees to the items on other factors and indices

No.	Conceptual Codes	Frequency	Percentage
1	Physical VC infrastructures	13	0.54
2	Recommendations of friends and brokers	5	0.21
3	Evaluating the interests of external stakeholders	7	0.29
4	Rate of business strategies in VC	15	0.62
5	Access to technical and technological experts	18	0.75
6	Access to VC infrastructures	14	0.58
7	Specialties of experts	14	0.58
8	Accurate VC resourcing	20	0.83
9	VC prioritization	17	0.71
10	Strategic resource allocation	10	0.42
11	Financial security and insurance status of investors	15	0.62
12	Investment encouragement and enhancement	16	0.67
13	Availability of expert human resources and labor force	16	0.67
14	Paying attention to the efficiency of research and development in VC	8	0.33

According to Tables 1-10, different qualitative indices were identified by the sample members. The identified indices were considered to be the factors and components affecting effective VC strategy implementation at Ayandeh Bank.

(C) Development of Primary Classes

As discussed earlier, qualitative data were statistically analyzed with the help of NVIVO 11. However, the content and thematic analyses indicated that 10 core categories and 93 secondary factors and components could affect effective VC strategy implementation at Ayandeh Bank. Finally, the identified indices and components were placed in 10 primary classes, extracted and finally named through data analysis. Given the frequency of items, 45 factors (out of 93 secondary factors and indices) were finally selected as the primary factors affecting effective VC strategy implementation at Ayandeh Bank.

Primary classes shown in Table 11 were then developed.

Table 11: The results on the development of primary classes

Core Classes	Categories
Economic factors	- Providing economic security for VC businesses - Efficient enforcement of economic policies - Paying attention to economic developments - Increasing governmental attention to the development of financial markets
Prerequisites to Selection and Assurance of Investment Success	- Evaluating necessary VC factors - Maintaining the structures of contracts - Evaluating the important factors in selecting syndicate partners
VC Resources	- Evaluating resources generated by VC actively and resources recommended by other investors - Paying attention to the value of VC resources - Paying attention to the scarcity of VC resources - Paying attention to the imitability of VC resources - Paying attention to the replaceability of VC resources
VC Plan Evaluation	- Creating innovation in VC - Identifying potential options for investment plans - Evaluating the risk and profitability of VC - Evaluating partners available for VC businesses - Evaluating active businesses in VC
Market Factors	- Identifying and evaluating VC markets - Identifying current markets of active businesses in VC - Paying attention to the business risk of current markets - Identifying and evaluating VC risk in strategically potential markets - Market dynamism evaluation
Legal Factors	- Stability of VC rules and regulations - Setting VC facilitating rules in financial agencies - Creating legal contexts required for supporting VC - Increasing VC freedom and flexibility
Political Factors	- Providing VC infrastructures and equipment - Protecting and maintaining the ownership of active businesses in VC - Analyzing political changes in the economy - Fighting economic rents in VC

Individual Factors	- Evaluation of the individual needs of investors - Determination of expectations and intentions of investors in VC - Improvement of investment motivations for VC
Financial Factors and Indices	- The expected return rate of VC - Availability of proper tools for liquidity supply - VC interest coverage in financial reports of businesses - Availability of information on previous performances of VC companies
Other Factors	- Access to expert and elite human resources in VC - Improvement of financial security and investor insurance - Determination of VC priorities - Rate of business strategies in VC

Step 2: Axial Coding

Axial coding is the second analysis step in the grounded theory aiming at establishing relationships between the classes generated by open coding. Axial coding based on the paradigm model helps theorists to facilitate the theory process. The correlation process in axial coding is carried out by the development of each class. Therefore, data obtained from upstream document review and in-depth interviews were taken into account in the second step to obtain 10 core categories and 45 subcategories regarded as the factors affecting effective VC strategy implementation at Ayandeh Bank.

4. DISCUSSION

In order to succeed in achieving financial goals in the field of venture capital, organizations must choose a specific strategy and model for themselves. One way to achieve success in different organizations is to identify, apply and implement an effective strategy. Funding for innovative technology development activities is possible through a variety of mechanisms, among which, venture capital funds are extremely important. Because of the inherent risk in innovative projects and the nature of long-term investment in such activities, the common financial and credit mechanisms used to finance them are not appropriate.

5. CONCLUSION

The results of the sub-indices of risky investment in developing a native model for effective implementation of risky investment strategies in Ayandeh Bank included the motivation for profitability, risk-taking, ownership structure and participation in management. The sub-criteria for assessing VC projects include financial management ability, financial market acceptance, financial development potential, service diversity and differentiation, and the creation of new financial markets. Commercial and operational features of investment projects also included modeling of competitors, operational performance assessment, executive capability, service supply chain evaluation, and customers' analysis. Finally, entrepreneurship indices included entrepreneurial personality characteristics, entrepreneurial abilities, and financial considerations.

The results showed that in order to develop a native model for effective implementation of VC strategies in Ayandeh Bank, the sub-indices of VC, evaluation of relevant projects, commercial and operational characteristics, and entrepreneurial indices play a key role.

6. AVAILABILITY OF DATA AND MATERIAL

Data used or generated from this study can be requested to the corresponding author.

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RELATIONSHIP BETWEEN LEARNING ORGANIZATION AND CREATIVITY IN TEACHING HOSPITALS

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ABSTRACT

Since the learning organization welcome changes along with new and innovative ideas, this study aims to determine the status of the learning organization component and creativity, as well as the relationship between these two aspects. This study, the population consists of 2970 persons from public teaching hospitals of Shiraz in Iran. The sample size was selected 237 people, by stratified random sampling. Reliability of Learning Organization and creativity questionnaire was 0.91 and 0.72 using Cronbach's alpha. The data analyzed by Pearson correlation and regression test. The mean scores of learning organization and creativity are 3.18 and 3.58 of 5, respectively. Also, a direct correlation between these two variables was observed with a correlation coefficient of 0.575. Whenever employees recognize their abilities and start developing themselves, they become permanently creative and a learning organization is caused by such people.

Keywords: Team learning; Creativity and personal ability; System thinking; Organizations success; Survival of organization; Organizational culture.

INTRODUCTION

The world is changing and neglecting lead to backwardness. The current environment of organizations is affected by the evolutionary processes, and every day new features are achieved that are different from past properties. But the administration of government agencies has not been changed and this will lead to major problems, because change and adapt to changes in the environment is necessary for survival and if an organization fails to follow the developments in environment, certainly will be failed. [1]

One way to cope with change is to move organizations to learn. In a learning organization, individuals are continually developing their capacity to achieve the results they really want, that new thinking patterns are developed, group desires are realized, and finally, the collection in which people learn continuously how to learn together [2]. Organizational learning also assesses the way an organization learns and adapts to environmental changes. It is defined as the ability of an organization to change structure, values, and goals in response to environmental changes. [3]

Organizations are required to strengthen the processes of creativity and innovation in their adaptation to change. [4] Because the learning organization is innovative, flexible, and responsive to change, so the organization's longevity increases by seeing changes and making innovations to understand how they can learn better [5, 6]

Creativity is largely based on collective knowledge about the existing technology of an organization, the research carried out on it, the design and development unit's activities, and the interaction of the organization with the external environment. Therefore, it can be said that these organizations are highly flexible in confronting the crises caused by organizational competition [7]. The learning organization

also welcomes new ideas and creates new perspectives. They therefore continually seek to increase their capabilities in terms of creativity, innovation, and evolution [8]. This organization considers learning as a creative and ongoing process for its members and enables individuals to be creative [9].

As mentioned, knowledge helps the process of organizational learning by enhancing the effectiveness of organizational activities. Valuing organizational learning and innovation are necessary to prepare for a change in organizations. A significant amount of research has shown that there can be a positive relationship between organizational learning and creativity. This means that by increasing creativity in staff, learning Organization also increases [10].

Hence, considering the mentioned explanation and the vital role of the learning organization and creativity in the success and survival of organizations in the present era, the researcher examined the relationship between the dimensions of learning organization and creativity in hospitals, which in fact is one of the most important organs of a country health system in providing health care and education services.

RESEARCH HYPOTHESIS

Main Hypothesis

There is a correlation between creativity and learning organization

Sub-hypotheses

1. There is a correlation between creativity and system thinking component.
2. There is a correlation between creativity and personal mastery component.
3. There is a correlation between creativity and mental model component.
4. There is a correlation between creativity and shared vision component.
5. There is a correlation between creativity and team learning component.

METHOD

This is a cross-sectional and correlational study. The statistical population of this study included 2970 staff members of Shiraz general teaching hospitals in Iran. A sample of 237 people was selected through stratified random sampling. The data collection tools in this study was a researcher-made survey questionnaire of learning organization with 25 questions and creativity with 16 questions, their validity and reliability were measured by the experts' opinions and Cronbach's alpha coefficient for each of them was 0.91 and 0.79, respectively. Data were analyzed by SPSS19 software, and the Pearson correlation coefficient of linear regression analysis was used.

RESULTS

Out of 237 questionnaires distributed among the personnel, 224 questionnaires were finally collected and analyzed. In terms of educational qualifications, most of the study samples had a bachelor's degree. (71.8%). The average age of the participants in this study was 37.4 years and 59.37% of the study population was women. Information about the status of the learning organization and creativity scores,

as well as the relationship between these two variables, is shown in Tables 1 & 2.

Table 1: Scores of the learning organization and its dimensions and creativity in Shiraz public teaching hospitals.

	Average of score	SD	Max.	Min.	Score of 5
System thinking	22.04	4.67	31	8	3.14
Personal mastery	12.92	2.75	17	6	3.23
Mental models	15.49	3.41	25	5	3.09
Shared vision	2.673	2.67	19	4	3.09
Team learning	16.33	3.75	23	5	3.26
Learning organization	79.31	15.22	115	28	3.18

As it is shown the scores of learning organization and creativity in public teaching hospitals are moderate and more than the average score. Among the dimensions of the learning organization, the highest score is related to the team learning component with a score of 3.26, and the least score is for mental models and shared vision's components with a score of 3.09. The scores for system thinking and personal mastery dimensions are 3.14 and 3.23 respectively, and at the end, the learning organization and creativity gained the score of 3.18 and 3.58 respectively.

Table 2: The correlation between the Learning Organization and creativity of personnel in public teaching hospitals in Shiraz

	Creativity	
	Correlation coefficient	p-value
System thinking	0.520	0.001
Personal mastery	0.552	<0.001
Mental models	0.425	<0.001
Shared vision	0.401	<0.001
Team learning	0.550	0.001
Learning organization	0.575	<0.001

As it is illustrated in Tables 1 and 2, the correlation coefficients of all the data are determined. There is a direct and significant positive correlation between learning organization and creativity of personnel at public teaching hospitals. Therefore, the zero hypotheses are rejected at the 95% confidence level and the opposite hypothesis is based on the positive relationship between learning organization and creativity, is accepted.

DISCUSSION

The results obtained in this study were analyzed according to the goals. One goal of this study was to determine the average score of the learning organization and its 5 components based on the theory of Peter Senge [2] and the average score of creativity. Descriptive statistics were used to obtain these scores; the average score of these variables was moderate.

The result of this study is inconsistent with Solgi Research [11], Cheewaruengroj [12] and Maleki [13] and is consistent with Ghadamgahi and Ahanchian [14] and Garaei [15].

Garaei [15] found that the hospitals of Shiraz were considered to be undesirable in terms of learning. The reasons for this were weaknesses in factors such as organizational structure, management and leadership, and organizational culture.

Thus, considering the results obtained in this study, it can be said that public teaching hospitals of Shiraz are moving into learning after 2006.

In this study, there was a significant relationship between learning organization and creativity and findings of the study is consistent with Azizinejad [15] and Maria [16] and Kanto Gorges [17].

The learning organization has employees who continually develop their capacity and try to grow new patterns of thinking. People become more creative when knowing their abilities and constantly grow and develop them [15].

Therefore, it can be concluded that as far as an organization is learning, individuals become more creative in it. Whenever a person recognizes his abilities and starts developing them, he constantly learns and becomes more creative. Learning organizations are created by such peoples. Also, there was a significant relationship between systems thinking of learning organization and creativity. Since system thinking is concerned with a change in thought and helps to see macro patterns and improves the ability to change, then this ability is associated with creativity and leads to more creative people in the organization.

In addition, a statistically significant relationship between personal ability and creativity show that if an employee's personal ability is increased, creativity and innovation in an organization is also increased. The most important point in the component of personal capability is to understand the gap between the status of an organization's individual and the desired situation, which leads to a creative tension in the individual and organization that resulted in movement, taste, effort, creativity, and innovation.

A significant positive correlation between the two variables of mental models and creativity reflects the fact that mental models determine our behavior. In learning organizations, mental models are not static and unchangeable. People identify their mental models and assumptions about different issues and evaluate them continuously in relation to day-to-day issues, and if it is necessary to change them, which in turn leads to change and innovation in the behavior of the individual and the organization [15]. The findings of this study are consistent with Kantoghiorghes [17] and Azizinejad [15].

A significant positive correlation between the two variables of shared vision and creativity suggests that people with common goals apply high effort and energy, not because it was asked, but because they want and are willing to do it. A shared vision can connect employees' personal views and provide power for creativity.

A significant positive relationship between the two variables of teamwork learning and creativity indicates that higher teamwork learning increases creativity. In this regard, we can say: teamwork learning challenges individuals and creative ideas are sparked and common meanings emerge.

CONCLUSION

The analysis of data showed that the status of creativity and learning organization, as well as its component, are at a moderate level at teaching hospitals of Shiraz. Also, there was a significant relationship between learning organization and creativity. So, it can be concluded that as far as an organization is learning, individuals will become more creative. Therefore, whenever employees recognize their abilities and start developing them, they become permanently creative and a learning organization is caused by such people.

AVAILABILITY OF DATA AND MATERIAL

Data used or generated from this study can be requested to the corresponding author.

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