Application of neural networks in evaluation of key factors of knowledge management system, Case Study: Iranian Companies Based in Alborz Province

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Abstract. Nowadays, when executives talk about "knowledge management", the discussion is usually prompted by the problem of big data and analytics. Of course, this is not surprising. Extraordinary amounts of complex, rich data on customers, operations, and staff are now available to most managers, but it is difficult to turn that data into useful knowledge. In today's world, knowledge is regarded as one of the essential assets of any organization and organizations invest heavily in the acquisition, creation, storage, conversion and updating of knowledge. It is thought that if the right experts and the right tools are used for this volume of data, we will have tremendous strategic information. In fact, the ever-changing business environment has led organizations to increasingly strive to promote knowledge and make optimal use of organizational knowledge as a competitive advantage. In this regard, the knowledge management system and its infrastructure play a significant role in maintaining and updating the knowledge-based assets of the organization and valuable experiences of its role in the organization's performance have been reported. However, investing and deploying a knowledge management system in an organization requires that the factors affecting its success in an organization be properly identified and appropriate programs are developed to foster it, especially given the different organizational culture of development. In the present article, the problem of identifying these factors was presented based on the experience of implementing a knowledge management system in the research community, namely Iranian companies. In this paper, the neural network was used as a reference for deciding on the importance of these factors due to its ability to discover the relationships between available data.
Keywords: Knowledge Management System, Neural Network, Evaluation, Company, Organization…

1. Introduction

A key feature of today’s world is the rapid transfer of knowledge across geographical boundaries by the Internet. The result of this globalization is the emergence of knowledge-based economies, where the focus is on the efficient management of human capital to ensure the continuous creation of knowledge for the creation of sound economic values. Today, organizations do not compete solely on the basis of physical capital, and knowledge is considered a competitive advantage in businesses. In fact, GDP growth rate (GDP) is also determined by other factors such as the quantity and size of knowledge-based capital (such as intellectual property) used in the production processes of different sectors of the economy. These knowledge-based communities need a strong knowledge management system to improve the efficiency and productivity of their communities. So it can be said that knowledge creates power and knowledge management is the key to it. Knowledge management has been a key focus of studies over the past two decades. The importance of knowledge in recent years has led the basis of industrial economies to shift from natural resources to intangible assets. In the present study, by reviewing the research literature, we identify the most important factors affecting the success of the knowledge management system as inputs to the neural network and the output of the neural network is the degree of success of the knowledge network in the organizations considered as the research sample. And mark it with a 5-point Likert scale. On this scale 1 means very low, 3 means low, 5 medium, 7 high and 9 very high. This scale is one of the most common measurement scales in research based on a questionnaire and was developed by Rensis Likert (1932). In this scale or spectrum the researcher, according to the subject of his / her research, gives a number of items to the participants to determine their tendency based on multiple answers and answers. The answers are multiple-choice, for example in the 2-point mode the options include "completely disagree, disagree, disagree, agree and disagree". Questionnaires based on the Likert scale usually use the five-item scale, but many psychrometers also use the seven- and nine-item modes. Recent studies, however, show that the 1 and 2 point scales have more reliable results than the 9 point scale. Each of the items is then numerically valued. The sum of these values gives a score on this scale that reflects the respondents’ tendency, which is why it is also called the sum of the scores.

By identifying the inputs and outputs of neural network research and training we can use it to predict future data by introducing new inputs. Therefore, in this study, using neural networks, we will be able to achieve the desired goal of prioritizing the factors that influence the success of KM implementation. The neural network also enables the identification and prioritization of network inputs. We consider a certain percentage of the data used in neural network training as performance data. Then, for each performance data and each criterion, we calculate the grid output for -25% of the corresponding benchmark value and + 25% of the corresponding benchmark in that data, and then calculate the grid output difference for these two values. We do. We then calculate the average of this value for all performance data sets and consider the mean as the criterion of significance.

2. Knowledge management

A key feature of today’s world is the rapid transfer of knowledge across geographical boundaries by the Internet. The result of this globalization is the emergence of knowledge-based economies where the focus is on the efficient management of human capital to ensure the continuous creation of knowledge to create the right economic values. Today, organizations do not compete solely on the basis of physical capital, and knowledge is considered a competitive advantage in businesses. In fact, GDP growth rates are also determined by other factors such as the quantity and size of knowledge and the knowledge-based capital used in the production processes of different sectors of the economy. These knowledge-based societies require a management system. Knowledge is strong to improve the efficiency and
productivity of their communities. So it can be said that knowledge creates power and knowledge management is the key to it.

Peter Drucker points out that before the outbreak of the World War, farmers were the largest group of workers in any country who went to the factories by leaving the farm. In 1900, they became a major social and organizational force and rapidly increased in number, forming the largest industrial organization community until the late 1950s. In the last decades of the twentieth century, the industrial labor force declined, and this time the work on the basis of knowledge and knowledge became of particular importance.

Based on the Drucker classification, Professor Weig (1999) proposed the position of knowledge around the following axes:

- Industrial Revolution: During the eighteenth and nineteenth centuries, natural resources were converted into mass-market and mechanized products that required high prices and quality using higher technology. The importance of knowledge had become apparent during this period, but it was only among some scholars.
- Agricultural Economics: With the discovery of human agriculture, the early man left hunting and with the production of resources and agriculture the first economic stage of the societies of that time was formed.
- Natural Resources Economics: During this period, human beings discovered and extracted natural resources. At this stage, the need for knowledge became evident and a small community of experts was formed.
- Product revolution: In the first half of the twentieth century, the need to provide better after-sales and service delivery came at a time of competitive advantage, of offering more affordable, more affordable products. The product was more discussed in organizations.
- Information revolution: In the second half of the twentieth century, there were issues such as optimization, product attention along with market advantage and providing more functional and better-performing products. With the advent of information technology and the possibility of rapid exchange of information, "comprehensive quality management systems" and "on-time production", automated controls, etc. were practically observed, and the form of business transactions was changing with the advent of credit cards, and the labor force's role. Changed from manual work to desk work, however, the scientific and intellectual work had not yet found its place.
- Knowledge revolution: In the last two decades the basis of competition has changed and the success of organizations has been dependent on their emphasis on knowledge. This has led many leading organizations to manage and exploit knowledge in the best possible way. Therefore, more attention has been paid to the human resources that are the main producers and carriers of knowledge.

In 1979, a Swedish accountant named Karl-Erik Sievby, when examining the financial balance sheet of the company where he worked, found that accounting offices only displayed the value of its physical assets (including several desks and typewriters, etc.). While the true value of the organization was far greater than that! That is, the true value of the organization depends on the competence of the organization's employees and on what the whole staff constituted as a collective mind and brain. Sievby introduced this finding as "intellectual property" and intangible property "and put it alongside tangible assets.

With the growth of the idea of knowledge as a strategic resource, knowledge has become an important competitive advantage in leading organizations. Therefore, efforts to systematize knowledge in organizations began by creating a chapter in management called "knowledge management".

2.1. Factors Influencing Knowledge Management

The literature reviewing the factors influencing KM can be shown in Table 1
| Success Factors                                                                 | Number |
|--------------------------------------------------------------------------------|--------|
| Awareness of the role of KM and the use of KM                                  | 1      |
| Organizations have specific goals and strategies for using the knowledge       | 2      |
| Communication tools including intranet, website, email, phone, internal        | 3      |
| newsletter, portal, chat, social network, ...)                                 |        |
| E-learning and backup technologies (including e-learning systems, database      | 4      |
| management, documentation, operating systems and decision support, internal     |        |
| portals, and automated data collection)                                        |        |
| Motivation and Commitment of Users Using Rewards and Training                 | 5      |
| Creating an organizational culture that supports learning, sharing and the use | 6      |
| of knowledge.                                                                  |        |
| The role of the knowledge management system for the organization includes      | 7      |
| efficient improvement in search, classification, ranking and knowledge         |        |
| management of the organization                                                |        |
| Stability and Effectiveness of Knowledge Management System                     | 8      |
| High-level management support and knowledge management system                  | 9      |
| Organizational structure and leadership                                        | 10     |
| Human Resource Management Plans                                               | 11     |
| Knowledge Management System Users                                              | 12     |
| Knowledge Management Resources                                                 | 13     |
| Decentralized management                                                       | 14     |

Table 1: factors influencing KM

Therefore, based on the literature review of the conceptual model that illustrates the factors influencing the implementation and implementation of knowledge management, it can be illustrated in Figure (1).
Figure 1. Factors Influencing the Knowledge Management System Success
3. Neural Networks

An artificial neural network (ANN) is an idea for information processing that is inspired by the biological nervous system and processes information like the brain. A key element of this idea is the new structure of the information processing system. It consists of a large number of highly interconnected processing elements that work together to solve a problem. ANNs, like humans, learn by example. An ANN is set up to perform specific tasks, such as identifying patterns and categorizing information, during a learning process. In biological systems, learning is accompanied by adjustments in the synaptic connections between the nerves.

Each of these extra processing elements is called a neuron. Each natural neuron consists of three main parts:
1. Cell body
2. Dendrites
3. Axon

Dendrites, as areas of electrical signal reception, are networks of cellular fibers that have irregular surfaces and numerous branching branches. Dendrites transmit electrical signals to the cell nucleus. The cell body provides the necessary energy for neuron activity and operates on the received signals, which is modeled by a simple operation and compared to a threshold level.

Axon unlike dendrites has a smoother surface and fewer branches. Axon is longer and transmits electrochemical signals from the nucleus to other neurons. The location of the crossing of an axon from one cell to the dendrites of other cells is called synapses. By synapses, our connections between neurons are established. The space between the axon and the dendrites is called the synaptic space. In fact, the dendrites as neuron and axon inlet are the output and synaptic space of the two. When the nerve signals from the axon to neurons and other elements of the body, such as muscles, they stimulate them. Neurons receive a low voltage from each of their input connections (by input neural signals) and aggregate them. If this sum reaches a threshold value, the neuron fires a voltage on its oxen. The output sends out that this voltage reaches the dendrites that are attached to this axon, causing a number of chemical interactions at the synaptic junctions and can fire other neurons. All human brain activity is done by the same fires. Human short-term memory is instantaneous electrical sparks, and long-term memory is stored as electrochemical changes in synaptic junctions, which generally cause ions to change.

3.1. The structure of an artificial neural network

Neural networks can be triangulated with the following three conceptual sides:
A- Data analysis system
B- Neurons or neurons
C. The Law of Neuron Teamwork (Network)

Each neural network has three stages of training, validation and implementation. In fact, neural networks can be used to solve problems that do not have exact mathematical relationships between inputs and outputs. Learning to see neural networks in a timing is nothing but adjusting the communication weights of these neurons to obtain different examples to converge the network output to the desired output.

The body of each artificial neuron consists of two parts. The first part is called the composition function. The task of the composition function is to combine all inputs into a single number. In the second part of the cell there is a transfer function, also called a stimulation function. In fact, just as a biological cell needs to reach a certain threshold level to produce a signal, the stimulus functions also produce a very small output until the combined and weighted inputs reach a certain threshold. When the combined inputs reach a certain threshold, the nerve cell is stimulated and produces an output signal. By comparing the output of the network with the desired value, the error vector is calculated, and the vector is propagated from the end to the beginning of the network using different algorithms so that the error is reduced in the next cycle.
The neural network thinks for a while, analyzes the available data, discovers the complex relationships between the parameters, and provides an acceptable accuracy response. Here is no news of sophisticated statistical tests.

To create a neural network, we need to organize the appropriate topology. The relative status of cells in the network (the number and grouping of their connections) is called network topology. Topology is actually a system of connecting neurons to each other's hardware, which together with the related software (mathematical information flow and weight calculation method) determines the type of neural network function. In this topology there is an input layer that receives the information, there are some hidden layers that take the information from the previous layers and finally there is an output layer where the result of the computation goes and the answers they take. Figure 2 shows a topology of a neural network.

![Figure 2 Artificial neural network topology](image)

As shown in Figure (1), the topology consists of the input layer, the hidden layer, and the output layer.
- Input layer: Receives raw data fed to the network.
- Hidden layers: The performance of these layers is determined by the inputs and the weight of the connection between them and the hidden layers. The weights between input and hidden units determine when a hidden unit should be activated.
- Output layer: The output of the output unit depends on the activity of the hidden unit and the weight of the connection between the hidden unit and the output.

There are also single-layer and multi-layer networks where single layer organization where all units are connected to one layer is most used and has more computational potential than multi-layer organization. In multilayer networks, units are numbered by layers (instead of following global numbering). Both layers of a network are linked together by weights and in fact connections. In neural networks, there are several types of connectivity or weight gain:
- Forward: Most links are of this type where the signals move in one direction only and there is no feedback from the input to the output. The output of each layer does not affect the same layer.
- Background: Data is fed back from the top layer nodes to the bottom layer nodes.
- Lateral: The outputs of each layer's nodes are used as inputs to the same layer's nodes.

3.2. Neural Network Mathematical Model

An artificial neural network (ANN) was developed as an extension of mathematical models of biological nervous systems. The main process elements are neural networks, artificial neurons, or nodes. In a simplified mathematical model of neurons the effect of synapses is presented by the communication
weights that model the effect of related signals and the nonlinear properties of neurons with conversion functions. The neural message is then calculated as the weighted sum of the input signals and modified by the conversion function. The learning capability of a neural network is obtained by matching the weights according to the applied learning algorithms. The purpose of neural network learning in artificial neural networks is to update the weights to obtain the desired outputs and the neural network to learn the correlation patterns between the input data and the target values. After the neural network training, new and independent input data is used to predict the output. Learning is a process that ultimately leads to learning. During training the weights between layers change until the difference between the predicted and target values is reduced to the permissible value. Memory weights and implicit memory knowledge make up a network. Once the network training is completed, the network can be used to predict new values. In this study, different types of neural networks are used. These networks are based on the forward propagation algorithm - back propagation error with different learning functions, which can be used to select the best learning functions using trial and error or experiment design principles. It consists of an input layer, one or more hidden layers, and an output layer. The error propagation algorithm is used to learn this network. This method first updates the output layer and then updates to the previous layers. In this algorithm, during the algorithm training, the computation is that the inputs first move to the bottom of the layers to obtain the network prediction and then the error is calculated and the error is used from the end of the network to the weights. Updates and output calculations are done layer by layer, so the output of each input layer is the next layer. The error propagation algorithm is described as one of the most widely used neural network learning algorithms.

4. Error post propagation algorithm

The general steps of the error propagation algorithm in the neural network are as follows:

Algorithm start

1. Initializing weights based on small random values.
2. Loop 1: Perform the following steps until the end condition is met.
   - Loop 2: Perform the following steps for each training example.
   1. Moving Forward to Find Network Output (Feed-Forward)
   2. Back-propagation Error
   3. Updating weights
   End of loop 2.
End of loop 1.
The end of the algorithm.

As explained, each neural network is composed of multiple layers and there are multiple neurons in each layer, and the input of each neuron is the sum of the outputs of the previous layer neurons, using the conversion function on this weighted sum, the neuron outputs.

![Figure 3 The structure of a neural network with a hidden layer](image-url)
This network consists of three neurons in the first layer, two neurons in the hidden layer, and one output neuron. The number of neurons in the first layer is the number of input components of the network samples and the number of neurons in the last layer is the number of output components of the samples. Also the number of hidden layers and the number of neurons are optional. For example, if the test specimens contain two inputs of temperature and pressure and the output of these specimens has a moisture conductivity coefficient, then the neural network used has two neurons in the first layer and one neuron in the output layer or the last layer. In the first layer of the network, no conversion function is used, i.e., the input and output of the start layer nodes are the same. Now in Fig. 2 we consider the second layer or the hidden layer. Node A in this network receives three inputs from nodes 1, 2 and 3. The weighted sum of node A entries is equal to.

\[
A_{net} = \sum w_{ij} \sigma_i
\]

This weighted sum is then used in the node A conversion function and produces the output of node A. For example, if we use the sigmoid conversion function,

\[
o_A = \sigma(\text{net}_A) = \frac{1}{1 + e^{-\text{net}_A}}
\]

Now by introducing synaptic weights from node j to node j in the next layer as Wij, output of node i as \(o_i\), and actual output of sample i th equal to \(t_i\), we can establish relationships to update weights in each iteration algorithm. The error is used to show the following relation:

\[
\delta_j = \begin{cases} 
\sigma_j (1 - \sigma_j) (t_j - o_j) & \text{for output layer nodes} \\
\sigma_j (1 - \sigma_j) \sum_{k \in \text{Downstream}} w_{jk} \delta_k & \text{for hidden layer nodes}
\end{cases}
\]

Also in this respect is a parameter called the learning rate that takes a value between zero and one. These relationships can be achieved using the Delta Education Act or the descending slope. In fact, in this way we define a neural network error using the following equation:

\[
E_j = \frac{1}{2} \sum_{k \text{ outputs}} (t_k - o_k)^2
\]

Therefore, by the descending slope method, we can obtain the direction in which the weight changes of the nodes are most likely to minimize the relationship, that is

\[
\Delta w_{ij} = -\eta \frac{\partial E_j}{\partial w_{ij}}
\]

So we can prove the following relation for the last layer nodes:
\[
\frac{\partial E_d}{\partial w_{ij}} = \frac{\partial E_d}{\partial \text{net}_j} \frac{\partial \text{net}_j}{\partial w_{ij}} = \frac{\partial E_d}{\partial \text{net}_j} \frac{\partial}{\partial w_{ij}} \left( \sum_{i=0}^{n} w_{ij} x_i \right) = \frac{\partial E_d}{\partial \text{net}_j} x_j
\]

\[
\frac{\partial E_d}{\partial \text{net}_j} = \frac{\partial}{\partial \text{net}_j} \left( \frac{1}{2} \sum_{k \in \text{Downstream}} \left( t_k - o_j \right)^2 \right) = \frac{1}{2} \sum_{k \in \text{Downstream}} \left( t_k - o_j \right) \frac{\partial}{\partial \text{net}_j} \left( t_k - o_j \right) = -\left( t_k - o_j \right)
\]

\[
\frac{\partial o_j}{\partial \text{net}_j} = \frac{\partial}{\partial \text{net}_j} \left( 1 + e^{-\text{net}_j} \right) = \frac{1}{1 + e^{-\text{net}_j}} = \sigma(\text{net}_j)(1 - \sigma(\text{net}_j)) = o_j (1 - o_j)
\]

\[
\Delta w_{ij} = \eta \left( t_k - o_j \right) o_j (1 - o_j) x_j
\]

And calculated for the hidden layer nodes as follows

\[
\frac{\partial E_d}{\partial w_{ij}} = \frac{\partial E_d}{\partial \text{net}_j} \frac{\partial \text{net}_j}{\partial w_{ij}} = \frac{\partial E_d}{\partial \text{net}_j} \frac{\partial}{\partial w_{ij}} \left( \sum_{i=0}^{n} w_{ij} x_i \right) = \frac{\partial E_d}{\partial \text{net}_j} x_j
\]

\[
\frac{\partial E_d}{\partial \text{net}_j} = \sum_{k \in \text{Downstream}} \frac{\partial E_d}{\partial \text{net}_j} \frac{\partial \text{net}_j}{\partial \text{net}_j} = \sum_{k \in \text{Downstream}} -\delta_k \frac{\partial \text{net}_j}{\partial \text{net}_j}
\]

\[
\frac{\partial \text{net}_j}{\partial \text{net}_j} = \sum_{k \in \text{Downstream}} -\delta_k \frac{\partial \text{net}_j}{\partial o_j} \frac{\partial o_j}{\partial \text{net}_j} = \sum_{k \in \text{Downstream}} -\delta_k \frac{\partial}{\partial \text{net}_j} \left( \sum_{j=0}^{n} w_{jk} x_j \right) \frac{\partial o_j}{\partial \text{net}_j} = \sum_{k \in \text{Downstream}} -\delta_k w_{jk} o_j (1 - o_j)
\]

\[
\Delta w_{ij} = \eta o_j (1 - o_j) \sum_{k \in \text{Downstream}} w_{jk} \delta_k x_j
\]

The algorithm presented above introduces neural network training data to identify the weights of different layers of the neural network. Appropriate neural network parameters must also be determined before using it. These parameters include the number of hidden layers, the conversion functions in each hidden layer, and the number of neurons in the hidden layer.

5. Study the literature

In the research (Mahutta & Galeta, 2003) users' commitment and motivation in the success of the management system was identified as the most important factor for the success of the knowledge management system, while in the present study, although this factor is of high importance, it is the third most important factor for success. Knowledge was identified.

In the present study, decentralized management was identified as the most important factor and this indicates that in the research community, namely Iranian companies, experts of the knowledge management system lack authority and decision making at different levels of the organization as an obstacle to successful implementation of the knowledge management system. They believe that in order to achieve these goals, sufficient attention should be paid to decentralization in Iranian organizations and delegating authority to knowledge managers and other staff at different levels to foster the growth
and fertility of the knowledge-based organization, the storage, and the utilization of knowledge. Lead in organizations.

In research (Ginsberg & Campbell, 1999) and (Alavi & Leidner, 1999), motivation was identified as the most important organizational factor in the success of the knowledge management system. Considering the results of this research and the present research, motivation should be given due attention to employees. Because knowledge workers are the most important assets of a knowledge management system.

In the research (Sage & Rose, 1999), process modeling was identified as the most important factor influencing the success of the knowledge management system in order to identify its knowledge needs and resources, and motivation and commitment were identified as the third important factor. In the present study, this factor can be considered as a subset of the factor of application of knowledge management system in organizational processes. The results of the present study indicate the high importance of this factor and its priority as the second influencing factor of knowledge. Thus the results of the research are in line with the research (Sage & Rose, 1999). However, decentralized management continues to be identified as the most important factor in Iranian societies, which suggests that Iranian organizations need to pursue decentralization at all levels of the organization with practice and effort.

The results of this research can still be compared with those of Desouza et al. (2011) who do not consider knowledge technology alone to be sufficient for the success of the knowledge system.

6. Research findings

A total of 40 questionnaires were distributed among experts of knowledge-based Iranian companies, of which only 30 responded fully.

The desired levels for effective neural network performance parameters, namely number of hidden layer neurons, learning algorithm and conversion functions in the output layer and neural network hidden layer are shown in Table (2).

| Level 1 | Level 2 | Level 3 | Level 1 | Level 2 | Level 3 | Level 1 | Level 2 | Level 3 |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 5       | 4       | 3       | P       |
| trainbfg| traincfg| trainlm | Learning algorithm |
| logsig  | tansig  | purelin | Convert function in hidden layer |
| logsig  | tansig  | purelin | The conversion function in the output layer |

In order to train the neural network, the tested data are categorized into three categories of training, validation and test data, with 70% of the data being used for training, 20% for validating and preventing over-training. Networks are used and 10% are used for network testing to evaluate network performance outside of training data. It is necessary to explain that data segmentation into training, validation and testing data is done for the following purposes. First, the neural network uses training data to configure the neural network, which recognizes the neural network edge edges using the conversion function and learning algorithm.
Table 3 Prioritizing Knowledge Management System Success Factors Using Neural Network

| Success Factors for Implementing and Implementing a Knowledge Management System | Priority  | Points |
|---------------------------------------------------------------------------------|----------|--------|
| Decentralized management                                                        | 0.3896   | 1      |
| Implementation of knowledge management system in key organization processes     | 0.2955   | 2      |
| Motivation and Commitment                                                       | 0.0673   | 3      |
| Knowledge management technology like intranet and ...                           | 0.0671   | 4      |
| Backup training and technology                                                   | 0.0635   | 5      |
| Knowledge Management System Users                                               | 0.0343   | 6      |
| Awareness of the role of knowledge management                                   | 0.034    | 7      |
| Senior management support                                                        | 0.033    | 8      |
| Corporate culture encourages learning                                            | 0.0165   | 9      |
| Knowledge Management Resources                                                   | 0.0114   | 10     |

The first ten priorities are listed in Table 4, respectively. As can be seen, decentralized management is first recognized as the most important priority.
7. Summary and Conclusion

In the 20th century, the widespread adoption of knowledge gathering, organizing, storing, sharing, and evaluating techniques has become increasingly widespread. It is possible and at the least possible cost. In the present age, knowledge is valued as a valuable resource, alongside resources such as land and capital, which have been the focus of attention in the past (and even more importantly, especially in knowledge-based organizations) in a way that offers quality products and services and It would be very difficult and perhaps impossible for an economically desirable customer to manage and utilize this valuable resource without the proper management and utilization of this valuable resource.

In this article, we review the literature reviewing the factors of implementation and successful implementation of the knowledge management system. Then, using neural networks as one of the new data mining methods, we prioritized and identified the importance of each of these factors in the research population.

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