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International
Journal
Of Modern Engineering Research (IJMER)

Synergy of the University and Cement Industry Sectors in Application to Cement Market Price Innovative Forecasting in Azerbaijan.

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ABSTARCT: *The Progress requires relationship between the University and Industry sectors in Azerbaijan. There are described some initiatives and state-of-the-art methodologies to confirm the synergy perspective's probability.Global economic situation and energy resources' prices influence local economic trends, investment of capital, status of financial institutions and cement industry in Azerbaijan in whole. These trends influence demand and activities of cement business communities which start to optimize expenses and find new priority decisions in business. Moreover some independent economic analysts refer to forecasts that since 2016 yearly demand will increase 4-5% in Azerbaijan. Objectives are to forecast cement price in the market using Fuzzy c-means (together with Fuzzy Inference System) and ANFIS which are entered MATLAB mathematical packet and to compare the results of these methods. Taking into consideration the results of research and applied forecast models the cement price can show the stable slow increasing in the market even there is probability of some periodic fluctuations and regulating actions by the state authorities. Therefore it is high probability that the cement price will increase next 1-2 years.*

Keywords: *Cement Industry, Forecasting, Fuzzy Neural Network, Fuzzy clustering, Fuzzy rule*

I. INTRODUCTION

Republic of Azerbaijan is one of the major emerging market economies with a population of 9.78 million in 2015(Table I)[7]. The country is considerably dependent upon the oil and gas industries. Azerbaijan is emerging market economy. The statistic data are shown for recent years[16,17].

1.1. The Synergy Perspective of Scientific Institutions, Universities and Industries in Azerbaijan.

The creation of knowledge is the process of inventive activity. It is usually the result of explicit research and development effort normally carried out by scientists and engineers. The key institutions involved in the creation of knowledge are scientific institutions, universities, state and public R&D laboratories.

There are some initiatives which can help to ensure the synergy of Azerbaijan State Oil Industrial University – ASOIU and Cement Industry in Azerbaijan and worldwide. This can help to be the first with right initiative in the competitive market, ensure student practical training events, employment of graduates in Cement Industry and worldwide, papers by Cement Industry and ASOIU, Local and International Seminar (including online versions) in ASOIU together with experts of Cement Industry, cooperation in exhibitions to meet perspective business partners and customers, Investment in the future that is students as well as in students' sport events in local and global level, cooperation via international collaboration networks of Cement Industry and ASOIU, Agreement in view of institution of doctoral candidacy and practical introduction, Investment in world level innovative scientific research and new products, Ecology - Waste Management, Future perspective for scientific promotion of new joint-development products/brands/scientific research/science/expert decisions via Cement Industry and ASOIU facilities and capabilities, Up-to-date scientific laboratory / classrom introduction by Cement Industry in ASOIU, New available market segments via together cooperation of Cement Industry and ASOIU, Global and local (scientific) products advertisement, Introduction of the stat-of-the-art methodologies of Business Administration, Innovation in Strategic and Operations Management, Marketing, Logistics, Alternative Fuel Resources – AFR.

Table 1 GDP growth rates and Cement capacity

Country	GDP (US$ bn)	GDP growth (%)			GDP/capita (US$)	Population (mln)	Plants	Cement capacity (Mt/yr)
		2014	2015	2016				
Azerbaijan	166	2.8	4.0	2.5	17,800	9.78	3	4.70
Kazakhstan	420	1.5	1.5	2.4	24,100	18.2	8	11.85
Kyrgyzstan	19.2	3.6	2.0	3.6	3300	5.66	5	3.16
Tajikistan	22.4	6.7	3.0	3.4	2700	8.19	2	2.10
Turkmenistan	47.9	10.3	8.5	8.9	14,200	5.23	4	4.65
Uzbekistan	172	8.1	6.8	7.0	5600	29.2	9	7.60

1.2.Cement Industry and Market Leaders Overview

Republic of Azerbaijan has three integrated cement plants with 4.7Mt/yr of cement production capacity. Holcim Azerbaijan was the only integrated cement plant in the country some years ago. Norm Sement and Akkord Cement started operations later. The country's dependence on the oil and gas industries has made the economy low development since prices crashed in 2014[17].

Above –Table I: The 2014 GDP, 2014 GDP growth rates (and projections for 2015-2016), 2014 GDP/capita, 2015 population, active integrated cement plants and active cement production capacity of the Central Asian countries. Sources: The Global Cement Directory 2016, CIA World Factbook, IMF World Economic Outlook (October 2015 update).

The devaluation of the Azerbaijan Manat (AZN) has also raised some production costs across many sectors. Despite this, in 2014 construction materials production grew by 22.2% year-on-year to US$585m. Cement production grew by 40.5% to 2.98Mt and gypsum production increased by 23.3% to 192,800t, according to the Azerbaijan State Statistics Committee. In 2014, domestic cement demand was 4.3Mt. Currently, about 60% of the market is provided by local producers and 40% of cement is imported from neighboring countries. The domestic cement plants were able to meet market requirements. Azerbaijan plans to double its production of building materials, including cement, in 2016 - 2019, according to the government's draft concept of socio-economic development. Additionally it is planned to expand the production of building materials and bring their quality to international standards. The government expects building materials production to grow by 6.1% to US$608m in 2016, by 13.1% to US$708m in 2017, by 20.3% to US$871m in 2018 and by 16.2% to US$1.03bn in 2019. However, according to other government forecasts, the construction sector is expected to decline by 4.6% in 2016 to US$17.5bn. Holcim Azerbaijan a member of LafargeHolcim group, has a 1.7Mt/yr cement plant in Garadagh, Baku. Norm Sement has 2Mt/yr of cement production capacity in Garadagh, Baku. Akkord Cement plant has a 1Mt/yr. It is a member of Akkord Corporation and located in Gazakh [17].

Strategic thinking requires an awareness of alternative strategic purposes and objectives and the ability to recognize critically different environments. Strategy is not directly part of planning, but about thinking and implementation. It is a part of a technique, a way of managing of the business according to a strategic understanding and perspective. Strategic management is the process in which the organization will have a competitive advantage. Strategic management includes awareness of how successful and strong an organization and its strategies are, how the effectiveness of these strategies might be improved, and of how circumstances are changing. The main issues are the ability of an organization to add value, to achieve synergy and at the same time to satisfy the needs of the organization’s major stakeholders, particularly customers and owners. The effective management of resources to develop and produce these products for the market helps achieving the right quality for the right price at the right time [17].

Local media reported that Azerbaijan's construction industry was benefitting from the sporting and tourism sectors. The Eurovision Song Contest 2012 and the 2015 European Games, the 2016 Baku European Grand Prix, the 42nd Chess Olympiad in 2016, the 2017 Islamic Solidarity Games and four matches of the 2020 UEFA European Championships are main examples. Such types of public and commercial events can continue to provide good rises in the construction industry, prompting higher demand for cement and other building materials.

Real competitive advantage is ability of an organization to satisfy customer needs more effectively than its competitors. It is achieved if and when real value is added for customers. The important elements in adding value are understanding and being close to customers, a commitment to quality, a high level of all-round service, speedy reaction to competitive opportunities and threats. Taking into consideration existing market condition trends and in order to be effective, cement plants have to be strategically aware. Effective result requires a clear understanding of the needs of the market, and the satisfaction of customers more effectively and more profitably than by competitors. This can be achieved when real value is added for customers. Actually this approach works

in the market if there is the dynamic market condition as well as supply and demand are balanced or stable at least. Otherwise the cement production will not increase and market price will not decrease accordingly [17].

Competitive Market Analysis and Market Cement Price Forecast are one of the main issues. The unpredictability of the market in the long term is the critical issue. The share of local production in the market amounted to 41.4%. Thus, in one case, prices of construction materials fell because the construction market is more sluggish, and in another case, grow due to the activity of the market. Since 2016 yearly demand will increase 4-5%. [17]

II. FORECASTING PROCESS

Time-Series clustering is one of the important concepts of data mining that is used to gain insight into the mechanism that generate the time-series and predicting the future values of the given time-series. Numerous works are devoted to the prediction of time-series[1-2,4-6].

[14] proposes a fuzzy clustering approach based on the autocorrelation functions of time series, in which each time series is not assigned exclusively to only one cluster, but it is allowed to belong to different clusters with various membership degrees. A two-factor fuzzy time series is presented in [16] to predict the temperature. Authors combined high-order fuzzy logical relationships and genetic-simulated annealing techniques in their work. A method is developed to deal with the temperature prediction based on two- factor high-order fuzzy time series. In [12] have adopted a two-level clustering method, where both the whole time series, and the subsequence of time series are taken into account.

Another method to cluster time series is hierarchical clustering where nested hierarchy of similar groups is generated based on a pair-wise distance matrix of time series. Although, hierarchy clustering does not require the number of clusters as an initial parameter that is a well-known and outstanding feature of hierarchical clustering, the length of time series have to be identical due to the use of Euclidean distance as a similarity measurement[11]. Moreover, these algorithms are not able to deal effectively with long time series due to poor scalability. In work [13], hierarchical and partition clustering is used together with a symbolic representation of a numeric time series. In this method, they use the multi-resolution property of wavelets in their algorithm in such a way that the final centers obtained at the end of each level are reused as the initial centers for the next level of resolution. In research [10] also, the same representation (symbolic representation of a numeric time series) is used together with a compression-based distance function.

The problem with these approaches is their weakness in reorganization of the structural features of a sequence; for instance, the place of local maxima or inflection points. Subsequently, it is difficult to find the similarity among sequences and produce value-based differences to use in clustering.

Considering the advantage of k-means which is a faster method than hierarchical clustering[3] , the number of clusters has to be pre-assigned by user, which is not practical in obtaining natural clustering results. Additionally, K-mean is unable to deal effectively with long time series due to poor scalability. Advantages of Fuzzy c-means clustering method[8] is given below:

1) Gives best result for overlapped data set and comparatively better then k-means algorithm.

2) Unlike k-means where data point must exclusively belong to one cluster center here data point is assigned membership to each cluster center as a result of which data point may belong to more then one cluster center [17].

The experimental results of computer simulations are described in the below.

Computer simulations.

A time series example has been given in equation:

$$X = \{x_t\}, t = \overline{1,n}$$

In such a time series, t is time index and n is the total number of observations. Important events are formed over the time. This event characterization function *f(t)* as shown in the following form:

$$f(t) = f(x_t, x_{t-1}, \ldots, x_1)$$

This function changes according to the prediction aim. For example, if x_t represents current year Market Price of cement and our aim is to predict the next year price of cement.

Our goal is to forecast cement price in the market using Fuzzy *c-means* (together with Fuzzy Inference System) and ANFIS which are entered MATLAB mathematical packet and to compare the results of these methods.

The structure of the fuzzy neural network with 2 input and one output is presented in Fig. 1. [17].

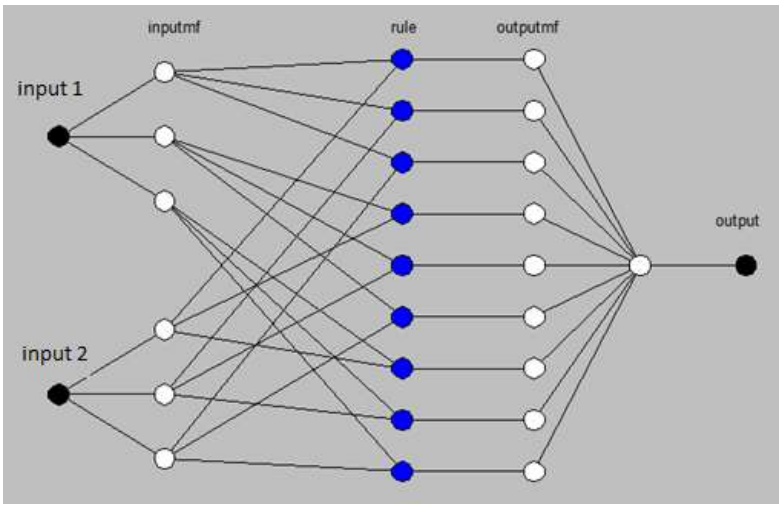

Fig 1. Structure of the fuzzy neural network[17]

Let us elaborate on the functionality of the layers in more detail. Layer 1 consists of fuzzifiers that map inputs to fuzzy terms used in the rules. Layer 2 comprises nodes representing these rules. Each rule node performs the Min operation on the outputs of the incoming links from the previous layer. Layer 3 consists of output terms membership functions. Layer 4 computes the fuzzy output signal for the output variables. Layer 5 realizes the defuzzification using the Center-of-Gravity (COG) defuzzification.

Typic rule majority for Sugeno fuzzy model having two fuzzy *If-Then* rule is expressed as following[9]:
If $(x_1\ A_1)$ and $(x_2\ B_1)$ then $f_1=p_1x_1+q_1x_2+r_1$
If $(x_1\ A_2)$ and $(x_2\ B_2)$ then $f_2=p_2x_1+q_2x_2+r_2$

The objects of above mentioned layers can be shown as followings:
Layer-1: Each bind taking part in this layer is the adaptive bind determined as following:

$$o_{1,i} = \mu_{A_i}(x_1), i = 1,2\ and$$
$$o_{1,i} = \mu_{B_{i-2}}(x_2), i = 3,4$$

Layer-2: Each bind in the layer extracting the sum of all received signals and denoted by Π . the extraction of the 2 –th layer can be described as following :

$$O_{2,i} = w_i = \mu_{A_i}(x_1) \times \mu_{B_i}(x_2), i = 1,2$$

Layer-3: Each *i* bind taking part in the layer is a constant bind denoted as N. Each bind in this layer calculates the correlation of reality degree of *i* rule to the sum of reality degree of all rules:

$$O_{3,i} = \overline{w}_{i=}\frac{w_i}{w_1+w_2}, i = 1,2$$

Layer-4: Each i bind of this layer, bind function is adaptive bind as following:

$$O_{4,i} = \overline{w}_i f_i = (p_i x_1 + q_i x_2 + r_i)$$

Layer-5: Last layer, in the 5 –th layer, one bind having **Σ** denoted and having sum output and receiving all signals takes part. Output of this bind is written as following: [17]

$$O_{5,1}\text{=Total output}=\sum_i \overline{w}_i f_i = \frac{\sum_i w_i f_i}{\sum_i w_i}$$

The objective is to determine market price of cement predicting value by using numerical data. Dataset contains 18 records with the data on 18 year.

We shall use 2/3 part of data majority for learning the model, and 1/3 part for testing the model. Solving the problem by two methods (ANFIS and Fuzzy clustering) we shall check up which of them is more efficient.

Fragment of input data is given in Table 2, fragment of rules and their membership functions in Fig.2.

Table 2 Fragment of input data[17].

f(t-2)	f(t-1)	f(t)
2,5	2,5	2,5
4,0	4,1	4,5
4,5	4,5	4,5
4,5	3,1	4,5
5,0	5,5	6,0
6,0	6,0	6,8
6,0	6,5	6,0
6,0	6,5	6,0
6,0	6,5	6,0
6,0	6,5	6,9
6,3	5,7	6,0
6,0	5,5	5,0
4,5	5,5	5,3

Graphical representation of the extracted fuzzy rules fragment is given below.
Result of testing process for 2016 year is given in Fig.3.

The values of obtained error measure are given below. The root mean square errors (RMSE) is calculated by using the following expression:

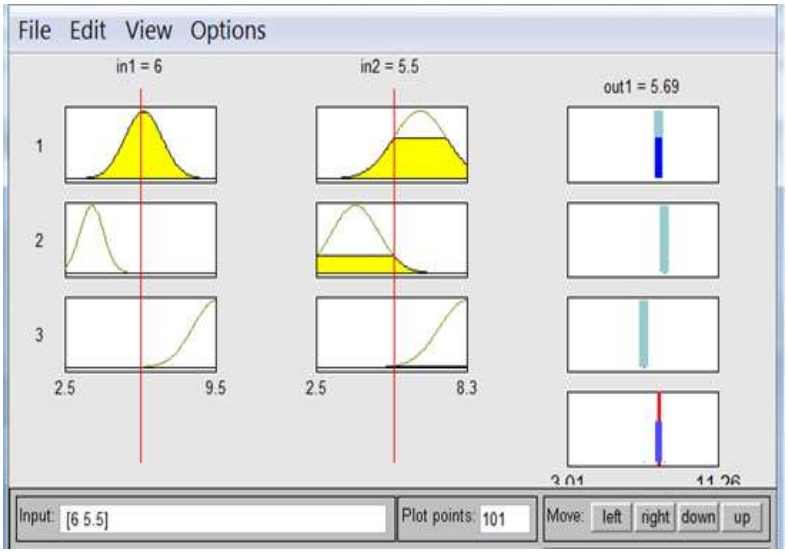

Fig 2. Fragment graphical representation of the extracted fuzzy rules[17]

Fig. 3. Forecat value of Market Price Cement for 2016 year((forecast data obtained fuzzy clustering)

$$RMSE = \sqrt{\frac{\sum(x - \bar{x})^2}{N - 1}}$$

Obtained RMSE and forecast data is represented in Table 3:

Table 3 Fragment of Real and forecast data obta- ined using fuzzy clustering method [17]

#	Year	AZN			Forecast,AZN
		X1	X2	X3	Yn
1	2000	2,5	2,5	2,5	2,56
2	2001	4,0	4,1	4,5	4,29
3	2002	4,5	4,5	4,5	4,82
4	2003	4,5	3,1	4,5	4,42
	…	…			
15	2014	6,3	5,7	6,0	5,73
16	2015	6,0	5,5	5,0	5,35
17	2016	4,5	5,5	5,3	5,62
18	2017	5,5	5,3	5,62	5,81
19	2018	5,3	5,62	5,81	5,94
RMSE=0,198221					

Obtained RMSE and forecast data based on fuzzy Neural Network is represented in Table 4 and Fig.4. The received results give the basis to approve, that for today forecasts made by using of Fuzzy Neural Network based forecasting are more reliable and exact.

Table 4 Real and forecast data obtained using fuzzy Neural Network [17]

#	Year	AZN			Forecast
14	2013	6,0	6,5	6,9	6,44
15	2014	6,3	5,7	6,0	5,63
16	2015	6,0	5,5	5,0	5,58
17	2016	4,5	5,5	5,3	5,58
18	2017	5,5	5,3	5,62	5,28
19	2018	5,3	5,62	5,81	6,05
	RMSE=0,123882				

Graphical representation of real and forecst data obtained by using Fuzzy neural network and fuzzy clustering is given Fig.5 and. Fig.6
All calculation were made in Matlab environment and MS Excel.

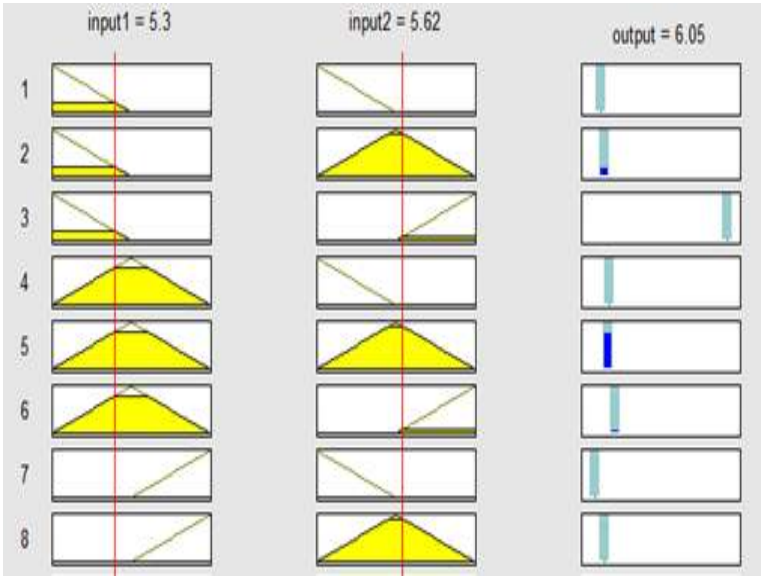

Fig. 5. Forecat value of Market Price Cement for 2018 year(data obtained using fuzzy Neural Network) [17]

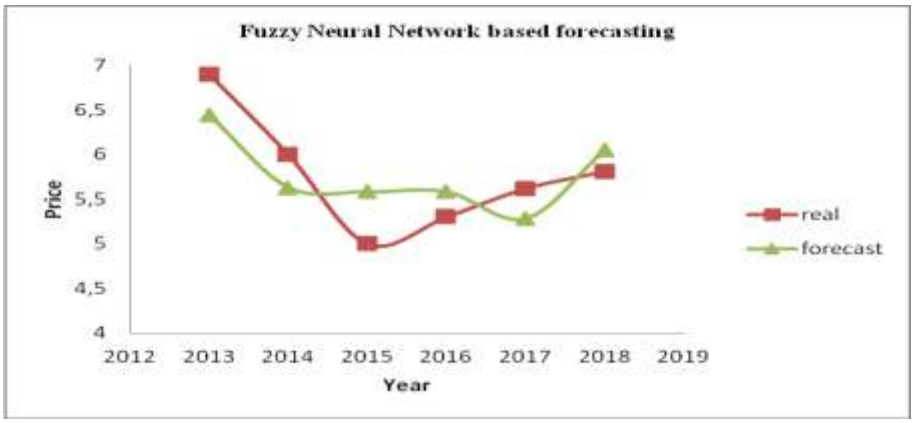

Fig.5. Graphical representation of real and forecst data obtained by using Fuzzy neural network [17]

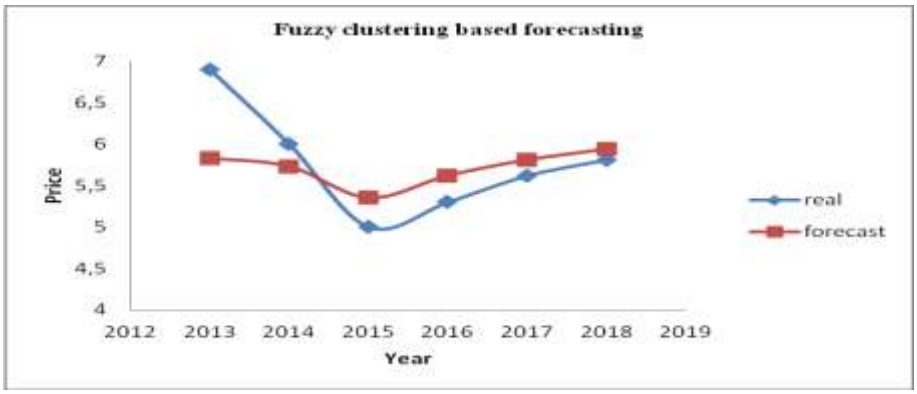

Fig.6. Graphical representation of real and forecst data obtained by using Fuzzy clustering

III. CONCLUSION

Financial resources, new big infrastructure projects and stable demand are essential conditions of development of this market.

Recommendation is also to provide the synergy between a cement plant, a research education institution and a financial institution in order to introduce innovative products and new demand. The state is advised to develop a strong supportive technological infrastructure such as technical information services and specialized public research institutes. It is also advised to develop special programs to support and create technological linkages between foreign firms and small domestic manufacturers. Therefore there are required steps to upgrade the quality of state university research, help to break down barriers between institutions and all industries. This also can help for the creation of large industrial conglomerates and regional innovation clusters. Furthermore, the state is advised to help to set up special industrial parks. Additionally it is advised to announce the State Progress Initiatives 2030 etc.

Therefore the above mentioned state-of-the-art analysis and calculations consider that the synergy of educational institutions and cement industry is probable and as regards the forecast the cement price will increase in 1-2 years.

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