# Developing a Model Based on the Time-Series Techniques for Controlling and Managing the Inventory

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**Abstract:** There is a considerable attention in the available academic literature to the concept of the times series' prediction mainly because the superior the superior prediction processes have been expressed as a source for competitive advantage. On the other hand, the biggest concern of the organizations is to manage and control their inventories. Therefore, the organizations that chose their strategies based on the prediction and scenario-planning can imagine the improvement of their future performance. This will be possible when the organizations can predict the conditions of their future inventories. This article tries to present an approach based on the time series techniques, and to provide an optimal method for monitoring and managing the inventory in order to express the predictive validity level of the sample, its desirable situation, and the way of improving it from the current situation to the desirable situation. This method is tested on three Iranian organizations and it is evaluated using structural validation approach.

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### 1. Introduction

Inventory includes goods and items that are being used or consumed in the process of the production and distribution. The items such as the raw materials, purchased components, needed goods for the production, and the end products are among the most important items of the inventories that are being used in the processes of the production and distribution. The term inventory has been defined from different points of view (Kitanidis, et al, 1996): (1) inventories include the goods, materials, parts and components that are being used in the processes of the production, sale, and administrating an industry (Bastin, et al, 1984); (2), the most comprehensive definition of the term inventory has been proposed by the Official Institute of the USA Accountants. According to this definition, inventory is the items of the tangible and intangible assets of an organization that (a) are kept in the institute during the procedure of the normal activity of the institute, (b) for manufacturing and selling the production in the process of the production, (c) for providing for the consumers in the process of the production or sale. Since the beginning of the industrial revolution in which the developed countries moved from the agricultural economy to the industrial economy, the need of organizations and companies for the inventories was increased and made the management of the organizations pay special attention to their inventories. Consequently, at the beginning of the current century, the organizations tried some analytical technics for scrutinizing the inventories. The problems of the production planning on one hand, and the simultaneous growth of the production industries and engineering branches (particularly the industrial engineering) on the other hand, resulted in the formation of some elementary movements in using mathematical methods for analyzing the inventories (Ghahraman, et al, 2001). In this regard, the automotive industries not only manufacture and supply the cars and their parts for the domestic markets, but they export a part of their products to the foreign markets as well. Considering the size of the production in this industry and the competitive nature of its

market, it is necessary to continuously improve the system and to be always ready for taking part in the national and international competition. Such a necessity brings the companies to create a desirable system for controlling their inventory that is a very important part of the supply chain. Accordingly, the inventory planning and control is a general challenge and problem in most companies of each industry. The planning and controlling the inventory by the organizations is crucially important for several reasons. In Iran, the automotive industry is the largest industry of the country and the manufacturers of car and auto-parts not only try to meet the domestic needs, but to export their products to other countries of the region. This is why it is crucial for the car-maker organizations to scrutinize the situation of their inventories. The main problem to be considered in this research is to determine the current situation of the inventories in the industries, and to predict its future situation so that the relevant organizations obtain and economic inventory and to prevent any shortage of their inventory in future with a high level of confidence. Currently, in Iranian automotive industry, the organizations have a department (i.e. Orders and Inventory Control Dept.) which controls and plans the inventories. In current system, the size and time of the orders for the raw materials is determined experimentally lacking the needed precise of the scientific prediction. Thus the future and foresight are very important issues because the future will belong to those who have a suitable plan for it. Any successful organization has to do the needed planning based on its prediction of the future (Szentimrey, 2001). There are several methods for such a foresight. These methods can use the previous experiences as the base of predicting coming events. Accordingly, a time series is a sequence of statistical data points, measured typically at successive points in time spaced at uniform time intervals. The relevant statistical methods for such statistical data are called time-series analysis. Time-series have four components: long-term trend (T), commercial terms (C), seasonal variances (S), and irregular changes (R). Each time series can include all these 4 components or just include

one or some of them. Each observed time series is divided to its components (Kyriakidis, et al, 1999). Several models have been proposed for the time series. In this research we attempt to identify and introduce these models and to evaluate them based on suitable parameters to obtain to the best model. Then based on the suggested obtained model, we will try to predict the inventory of the organization (the prediction time interval in this research is a 5-years one).

The main questions of the research are as follow: how is the situation of the predictive validity of the sample companies? What is the desirable situation for them? How the sample companies can promote their situation from the current to the desirable situation? What is the best time series-based prediction method in the car-maker companies? How efficient is the suggested best method in meeting the needs of the organizations?, Accordingly, the hypotheses of the research are as follow:

Hypothesis 1:      Do the automotive companies have a suitable scientific method for predicting and controlling their inventories?

Hypothesis 2:      What is the best prediction method based on the time series in the automotive companies?

Hypothesis 3:      Is the suggested method efficient enough to meet the needs of the organizations for predicting the level of their inventories in accordance with the market demands?

## 2.      Literature review
### 2.1. Times series

Time series is a regular set of the observations of a variable in different time intervals. The study of such time series is very important. The most important thing on the time series is how to understand the information and data of any series. The most important instruments for this purpose are the graphic charts. Mainly three types of the charts are used for obtain the data of any time series, i.e. time chart, chronogram, and spectrum (Perry, et al, 2004).

## 2.2. Components of the time series variation

Periodical variations: Suppose we have a time series that shows the temperature each 8 hours in some specific days of the year. The findings of such a time series show that the temperature increases in the summers and decreases in the winters. Moreover, it shows that the temperature of the days is higher than the nights. Such variations are observed in several series. For example, the unemployment rate is increased in the winter while decreased in the summer. The identification of such a component can help us identifying our system and consequently our modeling. In this research we focus on the discrete time series. In discrete type of the time series, the identification of the periodical variations depends on the time interval of the observations. For example, in the above-mentioned case, if we only recorded the temperature at days, we would never understand the variation between the temperature of the nights and days. Since most time series (particularly the time series in the field of the economy) have components of the periodical changes with seasonal variation, some researchers use the term "seasonal variation" instead of the "periodical variation" (Johnson, et al, 2000).

Trend: Trend is a component of the time series which express the procedure and tendency of the system. Trend is defined as the "component which shows the long term changes of the series". In this definition, the term long-term would cause the ambiguity. Here the term long-term is a completely relative concept depending on our observation of the system. Indeed, the periodical variations whose time periods are more than the time interval of our observation of the system form the trend. Suppose a meteorological process occurs twice in each 50 years. If our observation of the system  happens once in each 20 years, the mentioned process will play the role of the trend for us; while if the time interval of our observations is each 100 years, then the mentioned process will be considered as a periodical variation (Kyriakidis, et al, 2004).

Regular changes: after deleting the regular components of the variations (i.e. the trend and periodical variations) from the series, then we come to the time series of the remainders. It is to be noted that the mentioned series is not necessarily random. Most models are being built on this region. This issue will be illustrated later in more details.

Atelier series: when we look at a time chart of a time series we would find some values that are not similar to each other. Indeed, a part of the observed data is the result of some undesirable factors such as the observational errors, etc. These data have to be corrected before doing any other action because their presence can have undesirable effects on the obtained results of the time series analysis. The correcting process of such data is very complicated and we have to use some methods like the reliability methods. However, we can do the correction based on our own obtained intuition and control them desirably (Hirsch, et al, 1993).

2.3. Time series analysis

Time series analysis is to apply some processes on the observed data which help us achieving our objective. Among all types and steps of the time series analysis, prediction plays the most important role in the field of the technology future study. Thus our objective in this part of the article is to introduce the types and objectives of the time series analysis emphasizing on the prediction.

Description: when our data form a time series, the first job is to draw a graphic diagram in terms of the time. In this regard, we can use the general trend of the system, and the components of the variation such as the trend, periodical changes, irregular changes, etc. Such a procedure not only increases our knowledge of the system, but makes us more able to describe the system and reinforces our intuition. Before conducting the modeling, we have to obtain suitable information about the series of the study. Some parts of the information are obtained by this step itself. This step of the time series analysis can help us in conducting the next steps. In many cases, the assessment of the time series analysis will be very helpful for the later steps. Indeed, in many cases, the assessments that confirm our modeling or

prediction are the result of the description step (Holder, et al, 1993).

Illustration and explanation: when we have more than one series, it is desirable to illustrate (to model) and explain the changes of a series in terms of the other series. For example, it will be important for us to find the effect of the advertisement costs and the price of the commodity on the net income of the company; or to find the cause of the climatic features of a region on the monthly level of the raining in that region. Obviously, in the latter case we do not intend to an exact and numerical correlation but we look for the explanation of a qualitative parameter. The result of this step is the expression of a model which illustrates and explains the series value based on the other series or even other values of that single series. In fact, the suggested modeling for the relevant time series aims to illustrate and explains the relation between the parameters (Khalili, et al, 2004).

Prediction: in many cases, it is very important to predict the values of a time series. Indeed in the field of the technology future study, the prediction is the most important goal of the time series analysis. The methods of predicting the time series are very abundant and diverse; and no one can offer a single route and method for such a process. In this section we aim to know the different types of the problems and to introduce the most suitable and most current methods of prediction. Meanwhile we have to note that any prediction has to be done based on a series of hypotheses. Moreover, we have to use several hypotheses and methods to come to the best confrontation to the problems (Salas, et al, 1980).

## 3. Materials

This study is a descriptive-survey research. In survey researches the researchers use questionnaire and interview to discover the attitudes, thoughts, perceptions and preferences of their sample. Survey has completely defined problems and objectives; and the collected data are all about the relation between the current events and situations.

### 3.1. Data collection method

In this research we relied on two methods for collecting our needed data:

Library method for collecting our needed data for the literature review, referring to the study of the articles, books, dissertations, research plans, internet resources, etc.

Questionnaire which includes a set of questions being completed by some experts of the field. The questionnaire of our research was designed with multi-item answers among which the respondents had to choose and mark the correct answer.

The data collection instrument of this research was the Organizational Learning Questionnaire.

### 3.2. Statistical population, sample, and sampling method

By definition, statistical population includes all individuals or units which hat at least one characteristic in common. In the methodology terms, the statistical population is a group of people whom the researcher wants to study their variable characteristic(s). Accordingly, the statistical population of this research includes 3 main Iranian automotive companies.

The sampling process was conducted based on the simple random sampling method. In this sampling method, all individuals of the population have an equal chance to be selected. Besides, we used the following equation for determining the sample size:

$$n = \frac{Z2\,P\,(1-P)}{\varepsilon 2}$$

Where

P = Percent of the employees' learnability in controlling the inventory

1-P = Percent of the employees' un-learnability in controlling the inventory

Z = Expected level of the test variable

ε = Estimation accuracy

In the above equation, P has been considered as equal to 50% in order to obtain the maximum size of the sample. Accordingly, if Z is equal to 0.95 and if we consider the estimation accuracy as equal to 99%, then n will be approximately equal to 96%. Thus the size of our sample has to be equal to 38.4, while in order to ease of the research, we selected 40 subjects from each

organization. Thus, by and large, 120 subjects were selected from the three organizations. All subjects had passed several relevant training courses.

In order to design the prediction model and doing the prediction, we pick the data of the organizations' inventories directly from the company based on the prepared checklist for the five years, i.e. 2004-2008. Moreover, the data of the year 2009 was used for correcting the prediction model in order to compare the prediction data and the current data of the companies.

On the other hand, in order to study the validity level of the model and to validate the results of the model, we used a questionnaire completed by the sample based on the Cronbach's alpha.

### 3.3. Data collection instrument

The instrument of the data collection is an instrument which helps the researcher collect and record his needed data. The data collection instrument of this research is questionnaire. Our questionnaire included 18 questions. The questions were dispersed with a determined interval once in every 7 questions. The questionnaire contained 5 items including "completely disagree, disagree, no idea, agree, and completely agree". Every respondent can put a score (1 to 9) for each question (corresponding to 5-25 for each variable). 4 spectrums are considered for interpreting the scores of the questionnaire including "weak, less than average, higher than average, and desirable". To determine the reliability and validity of the questionnaire we used Cronbach's alpha.

### 3.4. Data analysis

In order to analyze the data of the research we used both descriptive and inferential statistics as follow:

Descriptive statistics including the mean, frequency, and diagram; and

Inferential statistics including the Pearson's correlation coefficient, determination coefficient equation, Cronbach's alpha, Chi-equare test, and multi-variable regression.

Data analysis was carried out in Zaitun Time Series software.

In order to predict, we used some time series with 5 basic steps including the preparation, identifying the model, estimating the parameters of the model, controlling the model, and prediction.

Preparation: first of all, we have to collect as much information about the time series and system of the study as possible. If we have more information we can explain the suggested data better and more precise. Moreover, through this step we can clarify our objective of the times series analysis. Then the data are drawn and we have to look for the variations' components. We have to try to find a mental model based on observing the diagram. We have to look for the principles that are formed in our minds by observing the series. Then the data have to be formulated. This formulation can be extremely effective on the final results of the modeling.

Identifying the model: obtaining the suitable format, now we have to fit the type of our desirable model to the mentioned format. In this regard we have to pay attention to the following points:

We have to identify the type of the trend. The trend can be linear or it would have a linear behavior in an area. Even the trend can be nonlinear. Each of these modes can affect our model.

Have a look at the series and find if it looks like the special types of the time series.

We have to try different methods for the prediction. The application of different methods can bring more value to our work. Besides, we can have a conclusion of the obtained results to make our prediction more precise. Then we determine the prediction horizon depending on the number of our data and the type of the time series.

Estimating the parameters of the model: in this step we have to calculate the parameters of the model that we have estimated. Here by the parameters of the model we mean the coefficients. There are several methods for doing this step all of which are based on the minimization of an error parameter or the optimization of a similarity parameter.

Most of these error parameters are defined in terms of the sum of the squares or the mean of

the squares of the errors of model. Here we don't need to explain the details of the estimation of the parameter for the time series. However the implementation of these methods requires long calculations. Thus the researchers have offered some standard methods to be used in some special modes of the calculations.

Controlling the model: after selecting the model. We have to check if our selected model works well. The procedure to be done in this step is as follow:

First we consider a part of our data as a part of the future and begin to predict them based on other data. If our prediction matches the available data, then we can claim that our model is suitable. The task of matching the prediction with the reality of remaining part of the analysis can lead us to select a better model in case of the mismatch between the data.

Prediction: now we have the suitable model for the prediction. The other tasks just include simple calculations.

## 4. Case study; findings of the research

The questionnaire of the research contains two parts. The first part deals with the general characteristics of the questionnaire itself and the organizations of the study. The second part included the relevant analysis of the information and data about the 5-years inventory of the organizations. It totally contains 18 questions. The organizations of the study included Saze Gostar Saipa, Part Gostar, and Shokoofe San'at. The sampling method in the organization was done by simple random sampling method. In this section we first analyze each organization separately and then we will analyze all of the studied organization altogether.

**Saze Gostar Saipa Co.:**

Saze Gostar Saipa is a private company. 40 questionnaires were distributed in this company. 23 respondents (out of 40) were male and the remaining 17 respondents were female. Educationally, 10% of the respondents have a master degree or higher, 67.5% of them had a bachelor degree, and 22.5% of the respondents had a high school diploma. 77.5% of the respondents were lower than 30 years old, and 87.5% of them had a work experience less than

10 years. Considering the conducted analyses on the filled questionnaires by the experts, the total score of Saze Gostar Saipa Company in controlling the inventory is equal to 4 (average score). Studying the obtained score by this organization we find out that the mentioned organization lacks a suitable databank and suitable method for documenting its inventory. Among the current problems of the organization one can refer to the lack of clear organizational goals relating to the management and controlling the inventories, the lack of a suitable mechanism for estimating the expenses, and the lack of suitable teamwork and plan for controlling the inventories.

We first extracted the diagram of the inventory of the organization. According to the suggested inventory of the figure 1, the inventory diagram for the five years (2004-2008) is specified.
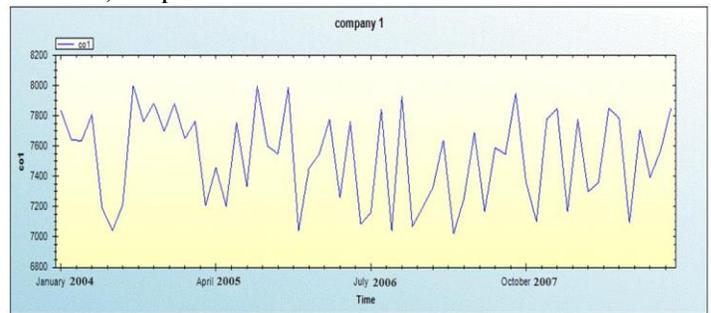


Fig. 1. Inventory data of Saze Gostar Saipa Co.

Then we conducted a statistical analysis based on the available data of the 5-year inventory. The analysis showed that the standard deviation and the mean are equal to 303 and 7522 respectively and the skewness test is normal at the level of 0.56. Then the trend analysis was conducted on the input data of the company inventory. The results are shown in table 1.

Table 1. Trend Analysis of Saze Gostar Co.

| Variable | Value |
|---|---|
| Included Observation | 60 |
| Exponential Trend Equation | $Yt = 7569 * (0.99**t)$ |
| R | 0.099 |
| R-Squared | 0.009 |
| R-Square Adjusted | -6.34 |

| Sum Square Error (SSE) | 0.018 |
|---|---|
| Mean Squared Error (MSE) | 0.0003 |

In this analysis, the trend equation was extracted exponentially. The low standard deviation and values of the correlation imply the strength of this model.

Anova or variance analysis: The extracted variance analysis shows the confirmation of the analytical model of the company and confirms the accuracy of the extracted data as well. The prediction values for 12 later periods are predicted as shown in table 2.

Table 2. Prediction of Saze Gostar Co.

| March, 2009 | 7701 |
|---|---|
| April, 2009 | 7608 |
| May, 2009 | 7732 |
| June, 2009 | 7638 |
| July, 2009 | 7763 |
| August, 2009 | 7668 |
| September, 2009 | 7793 |
| October, 2009 | 7699 |
| November, 2009 | 7824 |
| December, 2009 | 7729 |
| January, 2010 | 7855 |
| February, 2010 | 7759 |

Hypothesis 1: Do the automotive companies have a suitable scientific method for predicting and controlling their inventories?

To study this hypothesis, once again we use the chi-square test. Based on the results of this test (table 3), since the obtained result for df is equal to 17 and the obtained significance level is equal to 0.000 and lower than the significance levels of $\alpha= 0.05$ and $\alpha= 0.01$, thus the H0 is not rejected. Therefore we can conclude that suitable scientific method can be used for controlling the inventories.

Table 3. Scientific method for inventory control

| Variable | Chi square | df | Sig |
|---|---|---|---|
| Scientific method for inventory control | 65.532 | 17 | 0.000 |

Hypothesis 2: What is the best prediction method based on the time series in the automotive companies?

The best method in this company is the exponential smoothing that has the least error.

Hypothesis 3: Is the suggested method efficient enough to meet the needs of the organizations for predicting the level of their inventories in accordance with the market demands?

Based on the results of the table 4, the obtained correlation coefficient (r) is equal to 0.127 and the significance level (Sig.) is equal to 0.209. This level of significance is significant both at $\alpha= 0.05$ and $\alpha= 0.01$ levels, thus the hypothesis is confirmed.

Table 4. Efficiency of the model

| Variable | r | r square | Sig. |
|---|---|---|---|
| Efficiency of the model | 0.127 | 0.016 | 0.209 |

**Part Plastic Co.:**

Part Plastic is a semi-private joint stock company. 40 questionnaires were distributed in this company. 37 respondents (out of 40) were male and the remaining 3 respondents were female. Educationally, 30% of the respondents have a master degree or higher, 64% of them had a bachelor degree, and 4% of the respondents had a high school diploma. Approximately 90% of the respondents were higher than 30 years old, and 66% of them had a work experience higher than 10 years.

Considering the conducted analyses on the filled questionnaires by the experts, the total score of Part Plastic Company in controlling the inventory is equal to 5 (average score). Studying the obtained score by this organization we find out that the mentioned organization has a suitable databank and suitable method for documenting its inventory. Among the current problems of the organization one can refer to the lack of clear organizational goals relating to the management and controlling the inventories, the lack of a suitable mechanism for estimating the expenses, and the lack of suitable teamwork and plan for controlling the inventories.

We first extracted the diagram of the inventory of the organization. According to the

suggested inventory of the figure 2, the inventory diagram for the five years (2004-2008) is specified.
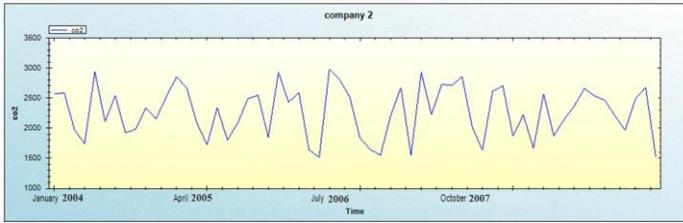


Fig. 2. Inventory data of the Part Plastic Co.

Then we conducted a statistical analysis based on the available data of the 5-year inventory. The analysis showed that the standard deviation and the mean are equal to 428 and 2271 respectively and the skewness test is normal. Then the trend analysis was conducted on the input data of the company inventory. In this analysis, the trend equation was extracted exponentially. The low standard deviation and values of the correlation imply the strength of this model thus we can rely on the model to do the prediction for the later periods.

Anova table: The extracted variance analysis shows the confirmation of the analytical model of the company and confirms the accuracy of the extracted data as well. The prediction values for 12 later periods are predicted as shown in table 5.

Table 5. Prediction of Part Plastic Co.

| March, 2009 | 2204 |
|---|---|
| April, 2009 | 2204 |
| May, 2009 | 2203 |
| June, 2009 | 2202 |
| July, 2009 | 2201 |
| August, 2009 | 2200 |
| September, 2009 | 2199 |
| October, 2009 | 2199 |
| November, 2009 | 2198 |

| December, 2009 | 2197 |
|---|---|
| January, 2010 | 2196 |
| February, 2010 | 2195 |

Hypothesis 1: Do the automotive companies have a suitable scientific method for predicting and controlling their inventories?

To study this hypothesis, once again we use the chi-square test. Based on the results of this test (table 6), since the obtained result for df is equal to 17 and the obtained significance level is equal to 0.000 and lower than the significance levels of $\alpha= 0.05$ and $\alpha= 0.01$, thus the H0 is not rejected. Therefore we can conclude that suitable scientific method can be used for controlling the inventories.

Table 6. Scientific method for inventory control

| Variable | Chi square | df | Sig |
|---|---|---|---|
| Scientific method for inventory control | 46 | 17 | 0.000 |

Hypothesis 2: What is the best prediction method based on the time series in the automotive companies?

The best method in this company is the exponential smoothing that has the least error.

Hypothesis 3: Is the suggested method efficient enough to meet the needs of the organizations for predicting the level of their inventories in accordance with the market demands?

Based on the results of the table 7, the obtained correlation coefficient (r) is equal to 0.03 and the significance level (Sig.) is equal to 0.01. This level of significance is significant both at $\alpha= 0.05$ and $\alpha= 0.01$ levels, thus the hypothesis is confirmed.

Table 7. Efficiency of the model

| Variable | R | r square | Sig |
|---|---|---|---|
| Efficiency of the model | 0.03 | 0.09 | 0.1 |

**Saze Gostar Saipa Co.:**

Shokoofe Motor is a private joint stock company. 40 questionnaires were distributed in this company. 21 respondents (out of 40) were male and the remaining 19 respondents were female. Educationally, 28% of the respondents have a master degree or higher, 48% of them had a bachelor degree, and 23% of the respondents had a high school diploma. 66% of the respondents were higher than 30 years old with more than 10 years of work experience. Considering the conducted analyses on the filled questionnaires by the experts, the total score of Shokoofe Motor Company in controlling the inventory is equal to 5 (average score). Studying the obtained score by this organization we find out that the mentioned organization has a suitable databank and suitable method for documenting its inventory. Among the current problems of the organization one can refer to the lack of clear organizational goals relating to the management and controlling the inventories, the lack of a suitable mechanism for estimating the expenses, and the lack of suitable teamwork and plan for controlling the inventories.

We first extracted the diagram of the inventory of the organization. According to the suggested inventory of the figure 3, the inventory diagram for the five years (2004-2008) is specified.
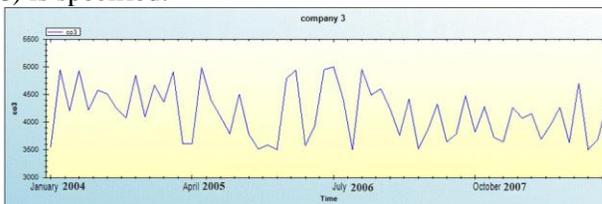


Fig. 3. Inventory data Shokoofe Motor Gilan Co.

Then we conducted a statistical analysis based on the available data of the 5-year inventory. The analysis showed that the standard deviation and the mean are equal to 482 and 4175 respectively and the skewness test is normal. Then the trend analysis was conducted on the input data of the company inventory. In this analysis, the trend equation was extracted exponentially. The low standard deviation and values of the correlation imply the strength of this model thus we can rely on the model to do the prediction for the later periods.

Anova table: The extracted variance analysis shows the confirmation of the analytical model of the company and confirms the accuracy of the extracted data as well. The prediction values for 12 later periods are predicted as shown in table 8.

Table 8. Prediction of Shokoofe Motor Gilan Co.

| March, 2009 | 3928 |
|---|---|
| April, 2009 | 3922 |
| May, 2009 | 3915 |
| June, 2009 | 3908 |
| July, 2009 | 3901 |
| August, 2009 | 3894 |
| September, 2009 | 3887 |
| October, 2009 | 3880 |
| November,2009 | 3873 |
| December,2009 | 3866 |
| January, 2010 | 3859 |
| February, 2010 | 3852 |

Hypothesis 1: Do the automotive companies have a suitable scientific method for predicting and controlling their inventories?

To study this hypothesis, once again we use the chi-square test. Based on the results of this test (table 9), since the obtained result for df is equal to 17 and the obtained significance level is equal to 0.000 and lower than the significance levels of $\alpha = 0.05$ and $\alpha = 0.01$, thus the H0 is not rejected. Therefore we can conclude that suitable scientific method can be used for controlling the inventories.

Table 9. Scientific method for inventory control

| Variable | Chi square | df | Sig |
|---|---|---|---|
| Scientific method for inventory control | 54 | 17 | 0 |

Hypothesis 2: What is the best prediction method based on the time series in the automotive companies?

The best method in this company is the exponential smoothing that has the least error.

Hypothesis 3: Is the suggested method efficient enough to meet the needs of the organizations for predicting the level of their inventories in accordance with the market demands?

Based on the results of the table 10, the obtained correlation coefficient (r) is equal to 0.109 and the significance level (Sig.) is equal to 0.18. This level of significance is significant both at α= 0.05 and α= 0.01 levels, thus the hypothesis is confirmed.

Table 10. Efficiency of the model

| Variable | R | r square | Sig |
|---|---|---|---|
| Efficiency of the model | 0.109 | 0.016 | 0.18 |

## 5.     Discussion

The diagram of the total inventory of the companies is shown in figure 4. The diagrams show smooth variations at the inventory level. Highest amount of variations is observed in Part Plastic Company and this company has to work more on its inventory control through studying the market.
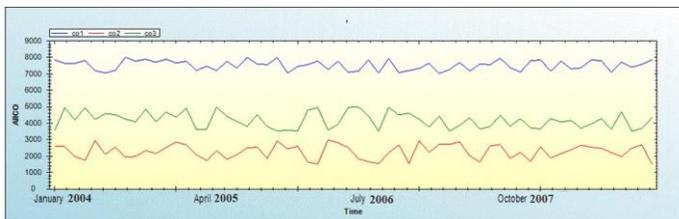


Fig. 4. General analytical diagram of the companies

In order to study the situation of the inventory control and management, we distributed a questionnaire in three companies. Based on the conducted analyses on the completed questionnaires by the experts, we found that the total score of the companies in controlling their inventory is equal to 5 that stand at the average level. The obtained results showed that the companies lack a suitable model for controlling and managing their inventory and they have failed to conduct suitable market studies. Among the current problems of these organizations one can refer to the lack of clear organizational goals relating to the management and controlling the inventories, the lack of a suitable mechanism for estimating the expenses, and the lack of suitable teamwork and plan for controlling the inventories. In order to improve their situations, the companies have to be informed about their future situation so that they can come to a suitable planning. Moreover, we

conducted some statistical analyses on the collected data and information of the companies. The results are summarized in table 11. The low standard deviation shows the suitable accuracy in data collection. On the other hand, the accuracy of the data are confirmed by the very low skewness and normal Kurtosis.

Hypothesis 1:     Do the automotive companies have a suitable scientific method for predicting and controlling their inventories?

To study this hypothesis, we use the chi-square test. Based on the results of this test (table 11), since the obtained result for df is equal to 53 and the obtained significance level is equal to 0.000 and lower than the significance levels of α= 0.05 and α= 0.01, thus the H0 is not rejected. Therefore we can conclude that suitable scientific method can be used for controlling the inventories.

Table 11. Scientific method for inventory control

| Variable | Chi square | df | Sig |
|---|---|---|---|
| Scientific method for inventory control | 56.66 | 53 | 0 |

Hypothesis 2: What is the best prediction method based on the time series in the automotive companies?

The best method in this company is the exponential smoothing that has the least error.

Hypothesis 3: Is the suggested method efficient enough to meet the needs of the organizations for predicting the level of their inventories in accordance with the market demands?

Based on the results of the table 12, the obtained correlation coefficient (r) is equal to 0.29 and the significance level (Sig.) is equal to 0.22. This level of significance is significant both at α= 0.05 and α= 0.01 levels, thus the hypothesis is confirmed.

Table 12. Efficiency of the model

| Variable | R | r square | Sig |
|---|---|---|---|
| Efficiency of the model | 0.29 | 0.046 | 0.22 |

Based on the above analyses we can conclude that Shokoofe Motor Co has had the least standard deviation. In all three companies, the best method was the exponential smoothing implying that the exponential smoothing is the best way of prediction in the automotive companies. The number of respondents in the three companies has been equal while Shokoofe Motor has had a relatively higher mean than the other two companies implying that the situation of the inventory control in this company has been better than the others. By and large, we can state that the automotive companies can improve their inventory management and control, although they have done their best based on the Iranian current standards.

**6.      Conclusion**

With regard to the mentioned theoretical discussions and the case study on three Iranian companies, the following points can be helpful for the relevant companies. Iranian organizations rarely decide to change the methods of their performance and to improve the process of their inventory control and production. They usually keep their ways for years without paying attention to the scientific and technological progresses. The role of the R & D in these organizations is very weak and the employees have not enough room to state their suggestions and comments. These organizations does not usually learn from their previous mistakes, and the learning (whether individual or organizational learning) is not taken serious in these organizations nor any reward is considered for motivating the employees' learning.

There is no effective relationship between the lower and middle hand employees with the leaders and managers of the organization in Iranian companies, while the non-competitive space of Iranian economy reinforces such a situation. Thus it is necessary for the leaders of these organizations to change their view toward their organizations, strengthen their relationships with the universities and academic institutions for receiving the updated industrial knowledge and to get more familiar with the modern changes in the world of the global organizations because nowadays, competition is the most important factor for the development, and the

organizations can no longer live in a non-competitive environment.

Finally, based on the findings and results of this research we have to emphasize on the following guidelines for the Iranian organizations:

Learning from the previous mistakes: in Iranian organizations the observer can rarely see an employing talking about the learning from their previous experiences, and there is no accumulation of the experiences.

- Using the scientific models for managing and controlling the inventories: in the studied organizations we found that the leaders and managers are not willing to be questioned by their employees at all. Consequently they do not consider any right of asking and criticizing from the employees' side. In such a space, the employees cannot express their attitudes to change the space, and thus their sense of belonging to the organization will is very weak.

- Spending the time for creating the sense of trust: the creation of the sense of trust and honesty among the employees can help the organizational learning. In unhealthy atmosphere of inter-organizational competition, the trust of the employees to each other will be ruined.

One of the characteristics being asked in the questionnaire was the level the official and unofficial groups in the organization adjust their goals to the goals of their organizations. If they do so, the available energy of the organization will be saved. But we usually can see that the goals of the mentioned groups contradict the goals of the organization.

Another point to be paid attention is the free flow of information so that the individuals can access their needed information. But in Iranian organizations the information is mainly available only to the top managers.

A measuring system for determining the gap between the implemented plans and desirable situation: it will be very helpful for the Iranian organizations to have a feedback system that shows the gap between the current and desirable

situations in order to reduce the waste of resources and helps the managers make better decisions.

Creativity and innovation: many companies keep their working in a repeating and inflexible form, thus they have no room for the innovative and creative methods. But a desirable learner organization is one who cares the creativity and innovation among its employees.

Creating a balancing between the work and the family: from the learner organization's point of view, a successful organization is one who cares the families of its employees and their problems. Such an organization helps its employees make a balance between their work and their family. This point is particularly important in eastern societies like Iran where the family is extremely effective on the people's successfulness. Thus the organizations have to help their employees improve their families in order they can help the organization improves its situation.

Global attitude: if the Iranian organizations have a global attitude toward their national economy and understand that the economy of their country has to find a global position, then they would witness the effects of such attitudes on their own approaches and strategies. But considering the weak communication between the Iranian economies with the global ones, this important point has been neglected by many Iranian organizations. Thus it would be very helpful for the Iranian organizations to obtain a global attitude.

By and large, it seems that the subject of inventory control is an unfamiliar subject for the Iranian companies, and if one finds some activities for fulfilling the indexes of the inventory control in such companies, it he will find such activities being conducted intrinsically and unsystematic. Hence it seems very effective to promote the modern relevant concepts by the universities and to administer relevant training seminars in order to promote the indexes of the learner organization.

Since in this research we proposed a model based on the opinions and priorities of the researcher in selecting the statistical analysis method, we suggest the other researchers to try other statistical methods in future studies of the field so that the results can be compared and the errors can be resolved in order to come to a more practical model. Moreover, the future researches can test other variables that are effective in the explanation of the goals and situations of the organizations.

Since in this research we used the organizational analysis method, we would further suggest the application of other case analysis methods and stochastic and mathematical methods rather than the used method of this study.

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