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A NEW METHOD BASED ON NEURAL NETWORK FOR ESTIMATING THE VALUE OF CUSTOMERS

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ABSTRACT

With advances in technology nowadays, organizations are attempting to find ways to assure their survival. Organizations know that their survival is no longer merely in reaching continuous profitability conditions, and they should be seeking competition. In addition, they are aware that the key to success in the information era are the decisions that are quickly and accurately made without inconsistency. Business intelligence is an approach that has been the focus of attention in the previous decades. It has been proposed as a new approach in organizational structure, and this structure, based on the speed of data analysis, assists managers in adapting accurate and intelligent decisions regarding business in minimum time. On the other hand, the aviation industry is among industries in which adapting accurate decisions is extremely crucial and has a significant role in the organizations survival. Determining the value of customers is among the decisions of the organization. As a result of this necessity, this study aims at evaluating the role of business intelligence in the aviation industry and providing solutions for calculating the value of customers in this organization and adapting accurate decisions based on this value. On this basis, a structure is proposed for his organization. In this system, artificial neural networks are used to estimate the value of customers and finally the proposed system is assessed using data from the customers.

Keywords: Aviation industry, business intelligence, neural network, value of customers

1. INTRODUCTION

During its lifetime, an organization creates data. This data is usually categorized based on assets, marketing, sales, human resources, management of customer relations, etc. and

each section carries out its own responsibility in the company and collects data pertaining to its own section. This issue requires organizations to search for means to facilitate the process of effectively gathering, processing, and analyzing data extensively in order to create a basis for discovering new knowledge. The appearance of inexpensive technologies for data storage and the expansion of internet connections have provided access to a great amount of data for individuals and organizations.

A great amount of data exists in organization's data systems. Part of this data is from the organization's internal transactions and others are from external sources. Nevertheless, even if they are gathered and stored by means of systematic methods, they cannot be directly used for decision making. This data should be extracted by appropriate tools and processing using analytical methods, and then be transferred to data and knowledge so they can be used in the decision making process.

For consecutive years, existing management information systems such as EIS, ES, DSS, and MIS have been used. However, these systems have not been able to create integration between unorganized and heterogeneous data and accurately identify dependency among new data. In order for organizations to be able

to quickly act upon marketing changes, they require information management systems that can carry out various cause and effect analyses of the organization and its environment.

Thus, in order to maintain their survival with advances in technology, organizations have to consider the dominance of new technologies such as business intelligence as a requirement and necessity for their business. Business intelligence systems create tools on which basis the organization's information requirements are met in an efficient manner.

Therefore, the most important advantage of using business intelligence systems is an increase in effectiveness of the decision making process. It seems that business intelligence and knowledge management have similarities in their goals. Both aim at creating an environment in which the staff can review the complex issues that come about in the decision making process and provide solutions for solving them. If we were to name a difference between them, we could point to the focus of knowledge management methods on the interpretation of information which is mostly in an unstructured and unorganized form, including documents, correspondences and previous experiences. While business intelligence systems are mainly carried outin the data warehouse based on structured

information in a measurable environment, this is an extremely crucial difference. For example, the ability to check emails and websites can be carried out by step-by-step methods available in business intelligence systems even though information sources are unstructured [1].

The remaining sections of this study are as follows: in section two an introduction to business intelligence is put forth. In section three, studies carried out in this realm are reviewed. In section four, the proposed structure is described and finally the paper is concluded by testing the proposed structure and providing conclusions.

2. Business Intelligence

In this section, the concept of business intelligence is briefly described.

2.1 Defining Business Intelligence

Numerous definitions exist for business intelligence and a few will be pointed out in this section.

Turban defines business intelligence as a group of tools, structures, databases, data warehouses, and methodologies that are gathered in one software [4].

Atre and Moss define business intelligence as a structure and group of practical and decision making programs and databases that assist

organizations in accessing business data more easily [5].

According to Chang, business intelligence is accurate, timely and crucial data, information and knowledge that is used for the operational and strategic decision making of an organization [6].

Based on Solomon Negash's definition, business intelligence systems combine operational data with analytical tools to provide complex information for planners and decision makers. The goal is timely improvement and input quality for the decision making process. Business intelligence is used for understanding the existing capabilities in the company, procedures and future orientations in the market, technologies, the competitive market, competitive actions, and the consequences of such actions [7].

Business intelligence includes a number of practical activities, methods, and programs. Some of the ones most often used are: Data Warehouse, Data Marts, On-line Analytical Processing (OLAP), extract-transform-load data (ETL), data analysis, etc.

Some organizations have also provided definitions of business intelligence.

The Oracle organization has also provided a definition for business intelligence as follows: business intelligence is a group of programs

and technologies which create an organization performance management system. This system includes financial performance management programs, operational business intelligence programs and a data warehouse.

The Microstrategy organization also defines business intelligence as an interactive process for discovering and analyzing structured data on a specific issue which eventually leads to discovering patterns, processes, and results of data.

Based on the definition of the SAS institute, business intelligence is delivering accurate information to the right individuals in the given time which is used for better decision making and obtaining profit.

2.2 Business Intelligence Abilities

The know-how of business intelligence is a group of coordinated facilities for facilitating the decision making process in the organization at all levels which is able to be implemented easily and with low costs [2].

- Data coordination: Data dispersion is usually observed to a great extent in organizations. The use of various tools results in the creation of various data banks with different structures in one organization. The data coordinating service in the business intelligence approachmakes it possible to create a centralized data bank of valuable data for decision making.

- Data Warehouse: Data dispersion is one of the biggest difficulties in organizations. The data warehouse makes it possible to centralize important data into a data bank after going through the coordination process.

- Report Dashboard: various ways exist to display data in the form of different reports; however this is only part of the business intelligence approach. An effective report has to communicate well with the audience and resolve their needs.

- OLAP: an ability for non-technical users to have access to information for reporting and analyzing data

- Monitoring: by monitoring, conditions of important goals and their development can be held under supervision

- Analysis: obtaining information and displaying it in various forms is only the first step towards business intelligence. This approach provides the powerful means of analysis for different groups and various issues.

2.3 Phases of Business Intelligence

In the process of business intelligence, the data sources are collected in the first phase. These sources can be data from various databases or data from available software. The collected data during the Extract-Transform-Load (ETL) process is uploaded in the analytical database or data warehouse. ETL is one of the most important success factors of an analytical database project and saves more than 70 percent in time. Data in the analytical database is placed in separate sections called the data mart. In the next phase, business intelligence comes to action and carries out analyses on the categorized data. Finally, data is transferred to high-level tools for propagation. These phases are shown in the figure below [3].
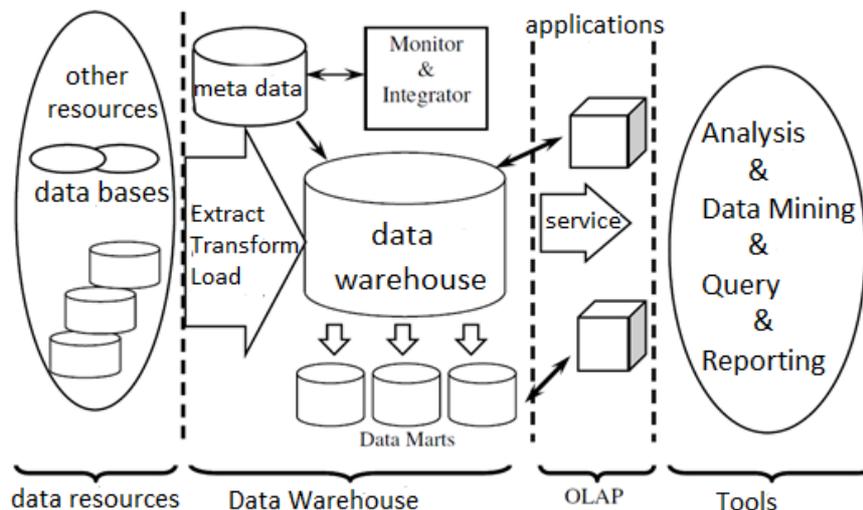

Figure 1: Business intelligence Phases

3. Business Intelligence in the Aviation Industry

In this section, research carried out in the aviation industry using business intelligence is studied.

3.1 Continental Airlines: successful experience in the realm of business intelligence

One of the organizations that has had a successful experience in the realm of business intelligence is Continental Airlines. This organization was established in 1934 and developed during the following years. Continental Airlines is ranked the United States' fifth largest airline and the seventh airline in the world. 50 million passengers use this airline for travelling to five continents year

round. During the past few years, this organization faced a problem and with regard to the transportation criteria among the existing airlines, it received the last ranking. These criteria include on-time arrival, cargo management, passenger complaints, and flight cancellations. The consultants of the organization at that time developed a plan for the airlines improvement which resulted in effective steps towards the organization's recovery and the considered criteria were improved [10].

In industries such as aviation organizations, a main and significant necessity is identifying and meeting the needs and expectations of the customers and accurately carrying out commitments. Measures taken in this realm have not been successful at times due to the disregard to marketing. Marketing states that identifying and resolving customer needs as compared to competitors should be better and more efficiently carried out.

After this success, the organization managers decided to obtain customer satisfaction rather than improving flight criteria. For this aim, strategies were based on the organizations operational success and appropriate attitude towards customers, especially valuable customers. At that time, data was not easily accessible. Thus, the management decided to use a data warehouse by means of which all the staff could easily access business data and customer information. Using the data warehouse resulted in great financial success in the organizations business, and the organizational plans made use of an association of data including customer, financial, flight and safety information.

Continental Airlines has been using the business intelligence and data warehouse technique from the year 1998. During this time, the aforementioned data warehouse has developed in the organization's business sectors and various geographical locations. Programs have transformed from strategic and technical to operational and the number of users, programs, and data has increased each year.

The main project has been created for two specific sectors: marketing and profit management. The profit management sector is responsible for determining the number of tickets sold in each flight. In 1998, they required obtaining flight data at the lowest detail level for analysis. The results of this analysis were conditions that increased organizational profit. The marketing sector also required better recognition of the customers. They needed to know which customers were more valuable for the

organization and also to what extent flight delay and cancellation affected which customers to a greater extent. By getting better acquainted with the customers, we are better able to respond to their needs. Thus, customer satisfaction will increase.

The organization recognized the need for business intelligence straightoff and planned for it and the data gathering and loading process in the data warehouse was designed for the organization. The overall theory was that all users have access to all data, unless a reason was otherwise found [12].

The data warehouse has to give the staff access to information straight-off so decision making can be done accurately. For this reason, the business intelligence team goes towards business intelligence straight off. Thus, data must be saved in the data warehouse and easily extracted and questions should be answered on the spot. As a result, in the year 2001, data was at hand straight off in the data warehouse.

Benefits of business intelligence in Continental Airlines are as follows:

- Flight authorities, gate authorities and all staff that are in contact with passengers, should know which individuals are of the organizations valuable customers at all times and provide special services for them.

- Efficiency and performance during the day is observed and provides the authorities with the possibility of making important decisions about staff, gate traffic control and other issues.

- Pricing specialists have observed the effects of changes in prices straight off and thus decisions are made in order to reach maximum profit.

- Based on FBI's list, flight and reservation safety is checked.

- This organization has had over a 500 million dollar cut in costs and profits from the business intelligence technique during 6 years.

The organizations programs are categorized into a number of sections [10], [12]:

- Accounting and profit management: the goal of profit management plans is to increase organizational profit by using limited resources. Plans for calculating profit are also seeking methods for accurate and quick calculation of organizational profit.

- Customer relations management: customer relations management plans are used for increasing profit and providing excellent services

with regard to better recognition of customers.

- Paying staff wages: staff programs are issues related to airline staff. Among these issues include paying wages, flight scheduling and staff efficiency.

- Safety and fraud: the organization also uses the data warehouse for identifying inaccurate reservations and suspicious transactions and the organizations safety.Fraud also includes selling tickets at prices lower than the real price, counterfeit sales records, and false claims of baggage loss.

- Ticket reservations: ticket reservations by the customers and its processing by the organization is an important issue. Continental airlines uses the data warehouse as a reservation support system because it contains reservation information.

- Flight operations: this includes all phases until the passengers arrive at their destination safely and on time. This operation has a great effect on customer satisfaction and the

organization endeavors to provide a good experience for the customer. Until the year 2002, the two sectors of profit management and marketing worked with the data warehouse. During these 9 years, the existing data warehouse has expanded to 50 domains and 1400 users. Continental airlines, by using business intelligence and the data warehouse, is currently among the most popular aviation industry organizations.

The flight management dashboard is a group of interactive graphical displays, the input of which comes from flight operation staff in the New Jersey center. These displays help the staff in quickly identifying problems in the organizations flight network and manage the flights such that flight efficiency and customer satisfaction increases. Some of the dashboards are for providing better services to valuable customers. On-time arrival is among other important criteria of the organization. Therefore, another group of dashboards is used to assist in flight take-off and on-time arrival. Figure 2 shows the dashboard structure of flight management. This structure is based on the data warehouse. For the flight management dashboard plans, data related to flights must be combined with passenger information. Whereas the sources of these two data groups are different, their extraction methods are also

different. Information related to flights is sent to the control center via satellite, while passenger information which is saved in the database system is updated by the reservation system.

3.2 Introducing Business Intelligence products for the Aviation Industry

In this section, business intelligence products which are used in the aviation industry are introduced.

❖ ARACS: One of the systems produced for the aviation industry is the ARACS management system. This system is specifically designed for the aviation industry by using business intelligence. Among the goals of this system is preventing discrepancy among data with different sources and also delivering data on time without any medium. In other words, it provides fixed definitions for data throughout the organization.

ARACS uses the best technologies in the world for business intelligence (microstrategy) and based on the microstrategy, provides a group of services related to dashboards and standard reports which are allotted effective, complete and timely control of key parameters such as airlines,

calculating profits, and profit and sales management. This product has over 300 dashboards and pre-defined reports based on successful experiences. These dashboards are dynamic and able to be diffused to other users.

This product also helps in reducing costs because it does not require a description of management information and is used in various sections including sales, reservation, profit, costs, etc. Among other features of this system is that it is adaptable to different airlines and strategic information is available 24 hours a day, seven days a week.

This system is designed for ultimate users. An important point is that using this product does not require much training and users can work with it by short-term training. The output of this system is also extractable through CSV, Excel, PDF and other formats. Currently, aviation industry organizations such as Air Europa, JET, Copa Airlines, and others are using this product for the analysis and control of their organization's key parameters.

❖ SabreSonic: This product is used for management of customer reservation

and flight data. This tool provides analysis capabilities for users by which a complete overview of business strategies is obtained. In this program, business intelligence is used as an important element for data analysis and reporting. This product is used in over 200 airlines.

One of the most important activities for maximizing profit is finding destinations, channels, markets, and passengers that result in more profit. Thus, distribution channels and their connections can be upgraded; less effective and more effective sources can be identified, and based on this information important decisions can be made. Essential analyses give users this viewpoint and the possibility for analyzing the sales process.

SaberSonic collects industrial knowledge regarding reservations which are used for flight data management and measuring channel efficiency. By using this product, sales resource analysis and displaying the best resources available based on the users chosen date becomes possible. Analysis results are displayed graphically. Using this product, the user is able to choose his/her ideal parameters.

❖ Airport IS: This product, being the most comprehensive database available in the market and the strongest analysis tool of airports and flight data, collects all traffic worldwide and market necessities in a specific framework. This database includes complete information of flight times and capacity, worldwide traffic flow, complete flight schedules, and detailed and exact airline information.

❖ Airsat: This is a study to compare customer satisfaction of different airlines. This research considers all aspects of airline services prior to, during and after flights. Thus, airlines can become aware of how they are doing compared to their competitors.

Better services are among the most important differentiating factors in any market. This issue becomes of great significance in the airlines. Among the satisfaction factors including the reservation process (time required for reservation), the organization website (user friendliness), inspection (time spent in line), resting lounge (comfort), freight (intact arrival of luggage), cabin

and seats (comfort of seats), flight crew (being responsible and affable), entertainment during the flight, meals and drinks (such as food choices), and on-time arrival are used in this comparison. This benchmark considers 50 instances for customer satisfaction of airlines and evaluates customer satisfaction based on these instances. This comparison is carried out for 23 of the main airlines worldwide and received its information from 27 airports around the world. This system also receives feedback from 40,000 airline passengers during the year in order to up-date the information for comparison.

❖ CargoIS: This is an online reporting tool that has access to real, reliable and timely information at all times. This product evaluates the markets activities in various realms and gives the user a real image of the market. It compares the organization with other competitors in the market. Thus, it gives users the ability to analyze new markets. In addition, it gives users the ability to compare current conditions of the organization with previous conditions. Also, it gives the organization the

ability to determine pricing strategies. In CargoIS, data is spread at different levels. This software considers the 10 best airlines.

The business intelligence package is used as the most comprehensive solution in this system. Data are collected in ASCII format, and can thus be used in any information management system. Over 30 million records from 100,000 airlines among airports are saved in this system.

The reports of this system include standard reports for comparison with the market, annual and monthly reports, and online reports.

❖ Monthly Statistics: is the quickest reporting tool for evaluation and supervision of airline traffic. This product includes accurate data from real traffic and covers all airlines and previous data from the year 2000. Monthly Statistics provides the user with monthly reports and these reports can be transformed to Excel format.

❖ Data AirHouse: is a simple and safe tool for gathering data from various sources. This product retrieves important information based on the user's needs and has access to all

airline ticket sales data on a daily basis. This software provides the user with quick and easy reporting.

❖ Direct Data Solution: This tool provides quick, accurate and low cost access to worldwide sales data. A key feature of this system is that it does not require IT investment. It provides 24 hours a day, seven days a week online access for the user. Among the

capabilities of Direct Data Solution is search and reporting for analysts and graphical display of the results.

4. Suggested Structure

This section evaluates the overall framework and structure of the suggested system. A structure has been designed for the current project. The following figure shows details of this structure.
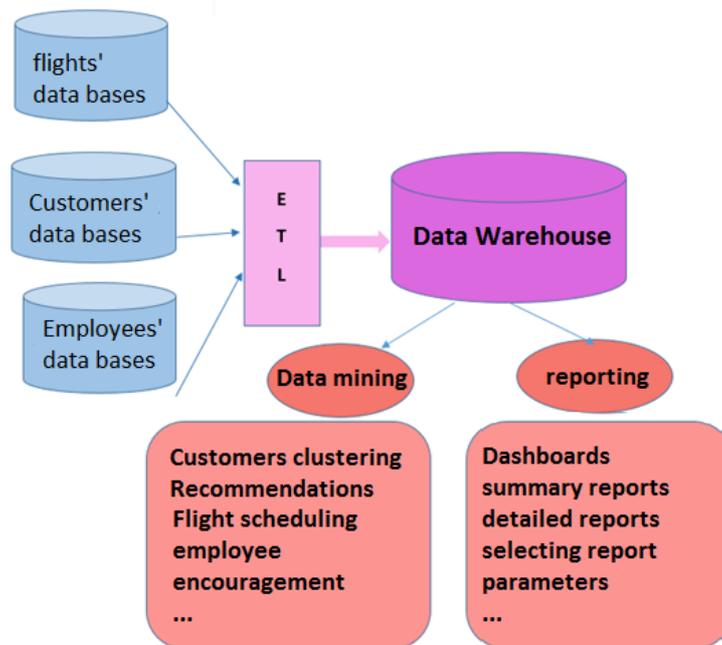

Figure 3: Suggested Structure of the System

In this structure, the required data from databases of staff, passengers, number and flight times and airport information, metadata and other necessary data is initially gathered and then purging data and eliminating inaccurate, contradictory and redundant data is carried out. Then extraction operation, transformation and uploading is done and the

data is placed inside the data warehouse and analytical database. The data can also be placed in the Data Mart according to subject. Finally, the analytical database is used for data analysis and reporting. For example, data can be used to prepare brief and comprehensive reports or ideal reports based on user parameter choices and evaluate organization

conditions using these reports. Also, data analysis can be performed to analyze data patterns. As an example, customers can be categorized and special facilities can be provided for valuable customers or appropriate services can be proposed for them. Among other functions are evaluating staff demeanor with customers and customer satisfaction rate.

Gathered data can be divided into a number of categories:

- ✓ Passenger's personal information including name, ID number, gender, age, nationality, etc.
- ✓ Flight information including flight source, flight destination, time of departure, flight duration, date of flight, number of passengers, type of airplane, flight crew, etc.
- ✓ Each of the passengers flights including the number of trips for each individual, from the source to destination, and the date.
- ✓ Other information regarding customer satisfaction is one of the flight conditions. For this means, a questionnaire

was prepared for the passengers and they were asked to fill it out. This questionnaire asked of their satisfaction rate of the flight.

In this research, an attempt is made to identify the organizations valuable passengers by a categorization method and then by providing special services, increase the organizational profit. In order to do this, available data regarding passengers in the data warehouse is used.

One of the methods that are used in data analysis for predicting and estimating output is artificial neural networks. Artificial neural networks are modern calculation methods and systems that are used for mechanical learning, displaying knowledge and implementing obtained knowledge towards predicting output results from complex systems. The main idea behind these types of networks is to a certain extent from the biological neural system functioning for data and information processing in order to learn and create knowledge. The key element of this idea is creating new structures for the information processing system. This system is comprised of a great number of continuous processing elements called neurons which cooperatively operate to solve a problem and transfer

information through synopses (electromagnetic connections). Learning in these systems is carried out comparatively, that is, by using examples, the synopses value changes such that by giving new input, the system can produce a correct response [13].

In order to provide a solution for the above problem, a neural network was designed and the existing data in the data warehouse was given to the designed neural network as input. The network is designed such that it may identify highly valuable passengers from new data. It is clear that passenger characteristics are effective for the organization. Among these characteristics, the number of times tickets are bought from the organization, purchasing rate from the organization, passenger income, type of flight requests, and customer satisfaction and loyalty can be referred to, which are of significance for value of customers. In the desired network, input are passenger characteristics. The expected output of the network is the value of customers for the organization. The more profit a customer has for the organization, the higher its value.

On this basis, a neural network is designed to estimate the value of customers. In this network, five characteristics of those named are the network input and one output exists for the network which is value of customers for

the organization. In Figure 4, the designed network is observed. This network includes one input layer, one middle layer, and one output layer. The number of inputs is equal to the considered characteristics for the customers and in this research five characteristics are considered. These characteristics include:

- ✓ Purchasing rate from the organization
- ✓ Number of flights
- ✓ Type of flights
- ✓ Customer satisfaction (including duration of connections with the organization and the questionnaire responses for satisfaction rate)
- ✓ Customer income rate

The number of neurons of the output layer is equal to the number of network output which is 1 indicating the customer value. The number of neurons of the middle layer has to gradually follow the equation below:

$$2(n_i + n_o) \leq n_1$$

In this equation, n_1 is the number of neurons in the middle layer, n_0 is the number of neurons in the output layer, and n_i are the number of input. In this research, the number of input is 5 and the number of output is 1, therefore the number of neurons in the middle layer obtained from the equation above should be more than 12. In the considered network, a

number of 20 neurons is obtained for the middle layer.

Also in this network, the stimulus function of the middle layer is sigmoid and the stimulus

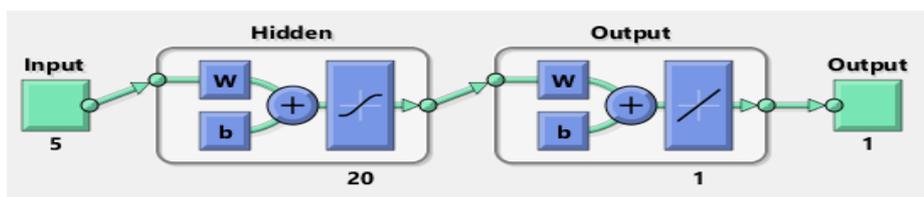function of the output layer is considered as linear.

Figure 4: The designed neural network for estimating value of customers

Information related to passenger characteristics and their value is given to the network and the network is trained such that by using passenger characteristics information, it can estimate their value. Therefore, with the passage of time and obtaining new data related to passenger characteristics decisions can be made regarding their value and provide organization managers and planners with value of customers for decision making and planning.

For example, passengers who are of high value for the organization can be given special services. Among these services can be suggestions for special offer tours, discounts, facilities during the flight and baggage transfer.

5. RESULTS AND EVALUATION

As was previously stated, in this research the aim is to find the value of customers using their characteristics. Thus, customer characteristics are given to the network and it is trained such that it can estimate their value.

In order to evaluate the proposed system, data including customer characteristics and their value is given to the network and the network is trained by using 70% of the data. Then it used another 15% of data for validation and was tested by the remaining 15%. For this means, data from study [10] was used. In this group of data, customer characteristics and their value were specified for the organization. Considering that this was done on 100 available records, 70 records were used for training, 15 records for validation and 15 of the remaining records were used for testing the system.

In this research, regression was used as the evaluation criterion. Figure 5 shows the regression diagram of the network. The best condition for a network is that all output and target numbers are equal. In other words, the "output-target" diagram is linear with a gradient of 1. This is shown as a dotted line in the diagram. However, due to the existing error

in the system and environment, this optimum result is usually not obtained.

In Figure 5, the regression diagram of output-target has been given for various groups of data. This system's output is the estimated value by the network for customers and the target is the real recorded value in the database for the customers. In part (a) the training group, part (b) the validation group, part (c) the test group and part (d) all the data is shown. Regression for the training group is obtained at 99%, 93% for the validation group, 90% for the test group and 95% for all data. This result is acceptable with regard to the existing error of the system.
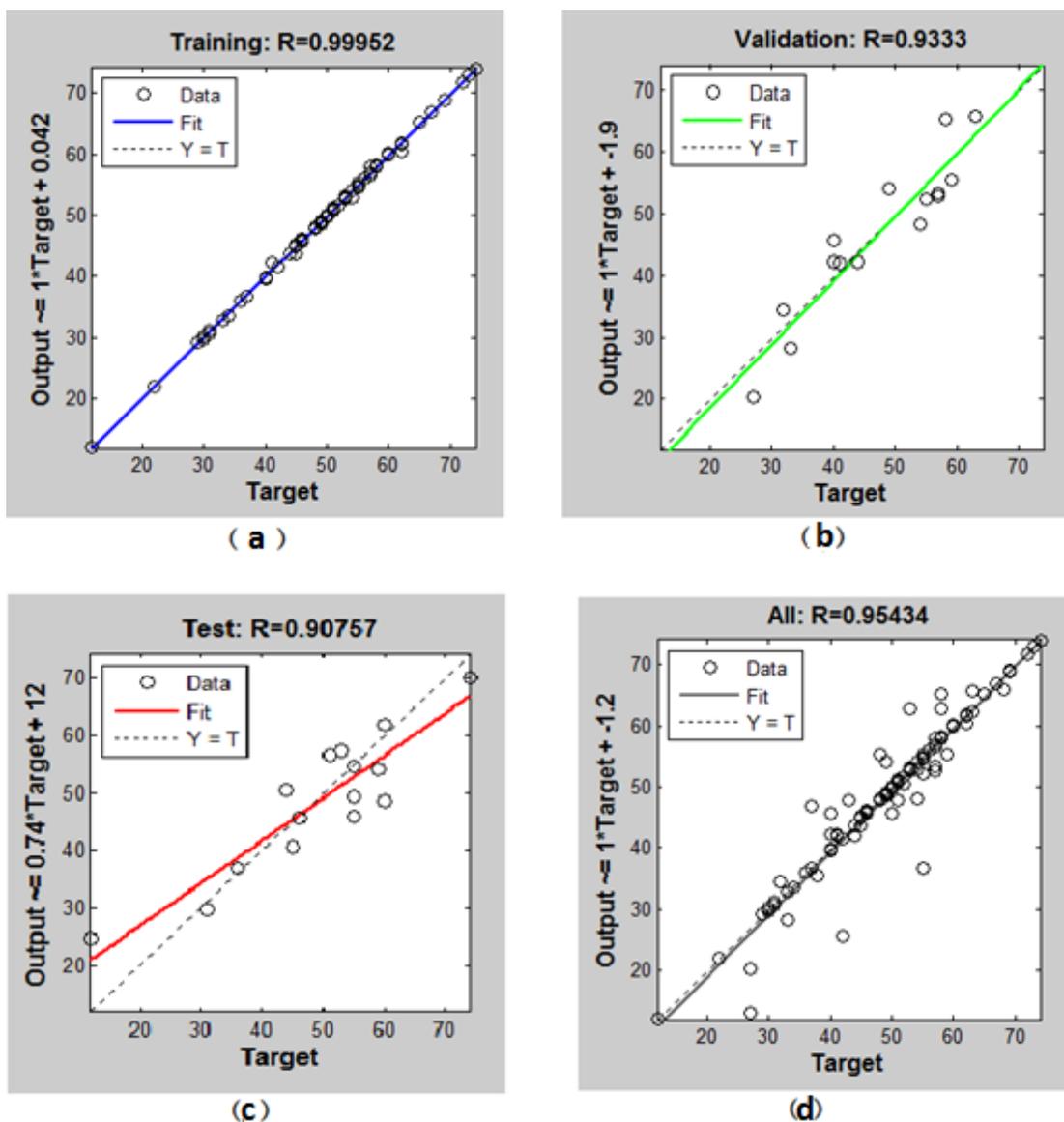
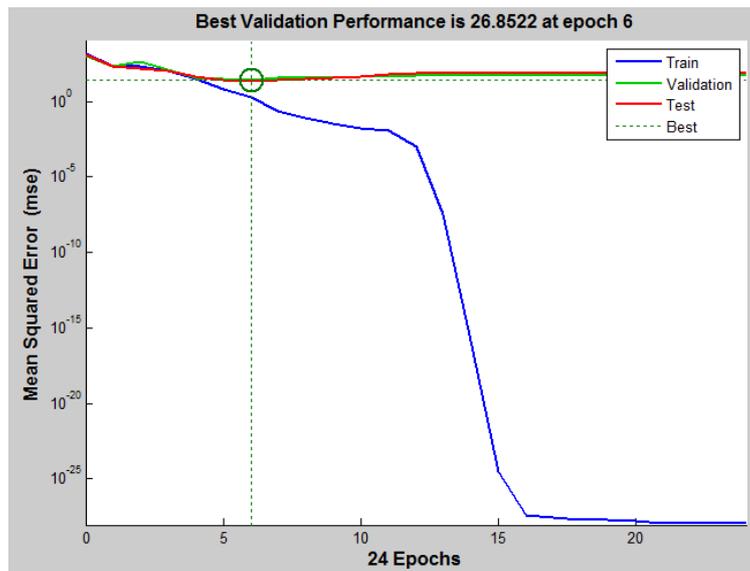

Figure 5: Regression diagram of the system test

Figure 6: Regression diagramof the System Test

6. CONCLUSION

As previously stated, in today's world, organizations have become competitive and are seeking ways to make advancements. One of the most important factors in the competitive world is adapting quick, accurate, and timely decisions.

Business intelligence is an approach that has become the focus of attention during the past decade for obtaining quick and accurate decisions. By analyzing the existing data in organizations that are of great potential value, business intelligence helps organization managers in the decision making process.

Among organizations in which decision making is of utmost significance is the aviation industry. In the past, some of these organizations used business intelligence to analyze data and make decisions to improve organizational performance. Some of these cases have been studied and it was observed to what extentthis approach was effective in an organization's situation.

Studying customer behavior in the aviation industry and analyzing data in order to determine the value of customers for that organization has been extremely effective for manager's decision making. For this reason, this research attempts to present a method based on data analysis and the neural network for analyzing passenger data and estimating their value for the organization. Finally, this method was tested and evaluated by using passenger data and it was observed that the designed system has the ability to accurately estimate the value of customers to a great extent.

Future directions for this research can be to carry out this method to determine the value of customers in organizations and then by proposing offers and services for special customers, evaluate the effect on organizational profit.

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