Neural Network-Based Evaluation of the Effect of the Motivation of Hospital Employees on Patients’ Satisfaction

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ABSTRACT

This article evaluates the effect of the motivation of employees on organizational performance using a neural network. Studies show that employee motivation influences organizational performance, particularly in organizations providing services. Methods based on statistical computations like regression and correlation analysis were used to measure the mutual effects of these factors. As these statistical methods necessitate the fulfillment of certain requirements like normally distributed data and because they are not able to express non-linear relations and hidden complicated patterns, a back propagation neural network has been used. The neural network was trained by using data from 300 questionnaires answered by hospital employees and 1933 patients hospitalized in a private hospital in Tehran over three successive months.

Keywords: Employee Motivation, Hospital Employees, Neural Network, Organizational Performance, Patient Satisfaction

1. INTRODUCTION

The fact that satisfied clients are the key to long term success for businesses is well-documented in the literature (Kristensen et al., 1992; Zeithaml et al., 1996; McColl-Kennedy & Schneider, 2000). Client contentment and faithfulness are one of the sources of competitive advantage, a means of development for a business organization and sometimes, its rescue from crises. If clients have a high level of satisfaction, return on investment (ROI) will increase (Armstrong & Kotler, 2000; Frederick, 1996; Weitz & Jap, 1995). Numerous researchers have confirmed the existence of a positive relation between customer satisfaction and enterprise profitability.
According to Herzberg’s two-factor theory, factors affecting motivation have generally been categorized into two sets: intrinsic and extrinsic. Each of these two groups consists of many parameters; as a result, developing an exact mathematical model for the study of these groups is complicated due to the non-linear relations and interdependencies of some of the variables. Owing to the possible existence of such non-linear, complex relations and hidden patterns in the data, neural networks were used in this research for modeling and classifying the two groups of factors and their effect on patient satisfaction. As can be seen in Table 1, the most common methods used to evaluate causal relationships between two variables are multivariable regression and correlation tests. It is usually difficult to employ regression models in HR research as a result of the two main assumptions in such models- the normal distribution of the target variable and a lack of correlation between dependent (input) variables- and also the natural interdependence of human variables. Newer data analysis techniques such as neural networks provide better tools for investigating relations between human variables by removing the presuppositions inherent to statistical methods (Bigus, 1996). In this research, data collection is generally divided into two sections. The first section concerns determining the patients’ satisfaction as the output of the network and the second one deal with the network’s input data.

This article is organized as follows: in Section 2, a background of relevant theories and the applied models will be presented. The second part consists of two subsections: in the first, the opinions of management authorities on motivation are discussed, and in the second, an overview of theories pertaining to employee motivation is offered. In the third part of this article, the model used in this research is described. The research methodology, consisting of the definition of variables, data collection, neural network design and training and model application have been defined in separate subsections in the fourth part. A detailed treatment of the results is given in part 5, and in conclusion
Table 1. Classification of different studies carried out by independent researchers on factors affecting performance

<table>
<thead>
<tr>
<th>Software</th>
<th>Case study</th>
<th>Method</th>
<th>Effective factor</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>–</td>
<td>Three large state-owned corporations located in Greece, (Public Power Corporation (PPC), Athens Water Supply and Sewerage Company (Eydap) and Hellenic Aerospace Industry (HAI))</td>
<td>Neural Network</td>
<td>Employee Motivation</td>
<td>Manolopoulos, D. (2008)</td>
</tr>
<tr>
<td>–</td>
<td>Call centre agent</td>
<td>Correlations analysis</td>
<td>Several effective factors (intrinsic motivation (IM), reward/recognition (RR), customer stress (CS), and stress management (SM))</td>
<td>Mahesh, V. S., &amp; Kasturi, A. (2006)</td>
</tr>
<tr>
<td>SPSS10.0, AMOS4.0</td>
<td>194 high-tech firms in China</td>
<td>Correlation analysis, Cronbach’s coefficient alpha</td>
<td>HRM, Technology innovation</td>
<td>Li, Y., Zhao, Y., &amp; Liu, Y. (2006)</td>
</tr>
<tr>
<td>–</td>
<td>An isolated community of about 12,000 people in United States</td>
<td>ANOVA (The significant F ratios, biserial correlations)</td>
<td>Motivation to work</td>
<td>Friedlander, F. (1965)</td>
</tr>
</tbody>
</table>
the limitations of this study and suggestions for further research are given in the sixth part.

2. RELATED THEORIES

Organizations are social systems where human resources are the most significant factors influencing effectiveness and efficiency. They need effective managers and employees to achieve their objectives and cannot prosper without the efforts and commitment of their personnel (Dixon, Palmer, Stradling & Woodhead, 2008).

Over the past 40 years, there has been some academic debate as to whether greater job satisfaction leads to improved performance. Parker and Kleemeir (1951) posited that a company that was able to satisfy its employee would, as a result, improves its own productivity. Furthermore, the opportunity to participate in the decision-making process may increase job satisfaction, with the positive attitudes generated aiding productivity (ibid).

2.1 Motivation

Greenberg and Baron (2008) define motivation as “the set of processes that arouse, direct, and maintain human behavior towards attaining some goal” (Greenberg & Baron, 2008, p. 14). Basset-Jones (2005) argues that “motivation is concerned with how behavior gets started, is energized, is sustained, is directed, and is stopped and what kind of subjective reaction is present in the organization while all this is going on” (Basset-Jones, 2005, p. 938). Helepota (2005) states that “the concept of motivation is abstract because different strategies produce different results at different times and there is no single strategy that can produce guaranteed favorable results all the times” (Helepota, 2005, p. 20).

It can be understood from the above definitions that, motivation is more or less fundamentally concerned with factors or events that move, lead, and drive human action or inaction over a given period of time with regard to the prevailing conditions. Furthermore the definitions propose that an “invisible force” is required to drive people to do something in return. The fact that having a motivated work force or creating an environment in which high levels of motivation are maintained remains a challenge for today’s management is another subject that can be deduced from the definition. If the firm does not possess the capability to motivate its employees, the knowledge within the firm is not practically used to a maximum. Hence, it becomes the aim of every learning organization to determine the factors that create employee motivation and lead to continuous learning and the exploitation of this knowledge to ensure the continued life of the enterprise (Osteraker, 1999).

In today’s business environment, the future belongs to those managers who can best manage change. To manage change, organizations must have employees committed to the demand of rapid change and as such, committed employees are the source of competitive advantage (Dessler, 1993). The key to motivating employees is to find proper ways to satisfy their needs, which are different for each individual. Worker participation, recognition, and a sense of belonging to a team are the three basic categories of needs. Regarding participation, many employees are motivated when they are “empowered” and feel that their participation contributes to the success of the company. If employees sense this, they will work in a manner that not only fulfills their own needs but also the needs of the company as a whole. In the words of Holt and Nesan (2000): “the participative approach addresses development of good supervisor–subordinate relationships and cohesive work groups in order to satisfy both social needs and the needs of business demand” (Holt & Nesan, 2000, p. 49).

2.2 Theories of Employee Motivation

Early management theories, such as the one put forth by Frederick W. Taylor proposed using financial compensation to drive motivation and job performance (Taylor, 1911). Personality and learning theories in psychology during the early 1900s led to the development of motivational programmers to enhance performance by creating organizational conditions that matched...
need satisfaction with on-task efforts. There is a wide variety of theoretical frameworks that have been developed and used in attempts to explain the issues of motivation and satisfaction. Theories for predicting, explaining, and influencing a person’s motivation in work settings flourished in the 1960s. The major theories in motivation have been classified into needs theories, cognitive theories, and reinforcement theories by Bartol and Martin (1998). The most prevalent needs theory was devised by Abraham Maslow and is known as Maslow’s motivation theory of hierarchical needs. He proposed that human needs can be grouped into five categories which can be arranged in a hierarchy of importance (Maslow, 1943). These include physiological, security, belongings, esteem and self-actualization needs. According to Maslow, a person is motivated first and foremost to satisfy physiological needs. This is true for employees which are motivated only to fulfill these needs if they are unsatisfied. As long as the employees remain unsatisfied, they turn to be motivated only to fulfill them. Alderfer (1972) suggested the ERG theory in an attempt to modify Maslow’s hierarchy by reducing the number of need categories. He found only three levels of need: (1) Existence or survival (E); (2) Relatedness (R), dealing with social interaction and the external facets of esteem (recognition and status from others); and (3) Growth (G), focusing on the desire to achieve and develop a person’s potential and the internal facets of ego fulfillment (success and autonomy). Herzberg (1968) developed the 2-factor (motivators and hygiene factors) theory in employee motivation. Herzberg’s theory posited a two factor model of work motivation, namely “job satisfiers” and “job dissatisfiers”. Job dissatisfiers were defined as extrinsic work motivational factors which if not present at optimal levels caused job dissatisfaction. An acceptable salary, job security, work conditions, level and quality of supervision, quality of administration, and interpersonal relations are some of these conditions. McClelland (1987) found three types of needs: achievement, affiliation, and power. He claimed that most social behavior can be understood in terms of an interaction between underlying motives and features of the environment. He suggested that there are three fundamental motives: achievement motivation which predicts one’s approach to doing concrete tasks; affiliation motivation which predicts one’s desire to be with other people; and power motivation which predicts one’s desire to influence others. One of the best known cognitive theories, known as expectancy theory, was originally expressed by Victor H. Vroom (1964). Vroom suggests that people are motivated by how much they want something and how likely they think they are to get it. In his opinion, motivation leads to effort, and the interplay of effort combined with the employee’s ability and environmental factors results in performance. In turn, performance leads to various outcomes, each of which has an associated value called valence. Equity theory was developed by Adams (1965). It recognized that individuals are concerned not only with the absolute amount of rewards they receive for their efforts, but also with the relationship of this amount to what others receive. People tend to view their outcomes and inputs as a ratio and then compare these ratios with those of others and tend to become motivated if this ratio is high. Adams proposed that people are motivated to seek social equity in the rewards they receive for high performance and that the outcome from a job includes: payment, promotion, social relationships and intrinsic reward. To achieve these, various inputs need to be applied by the employees to the job in the form of time, experience, efforts, education and loyalty.

According to Wiley (1997) “modern approaches to motivation may be organized into three related clusters: (1) personality-based views; (2) cognitive choice or decision approaches, and (3) goal or self-regulation perspectives” (Wiley, 1997, p. 264).

3. ARTIFICIAL NEURAL NETWORKS

Research has shown that the relationships among variables such as the client’s satisfaction, faithfulness, and systematic profitability are non-linear and asymmetric.
Several researchers (Mittal et al., 1998; Anderson & Mittal, 2000; Ngobo, 1999) recommend that asymmetric nonlinear satisfaction and loyalty models have superior predictive power. Furthermore, the rapid growth of the amount of data collected by firms not only leads to a complicated and disorganized data structure but also results in the inability to apply traditional statistical methods due to extreme complexity. Hidden knowledge in this data volume cannot therefore not be used directly. The nature of our problem and the ability of artificial neural networks (ANN) in analyzing the non-linear relations among the variables was our main objective in applying ANN in the problem.

The idea of neural networks was derived from how neurons operate in the brain. Real neurons are connected to each other, and accept electrical charges across synapses (small gaps between neurons). They in turn pass on an electrical charge to other neighboring neurons. The relationship between real neuron systems and artificial neural networks probably end at that point (Churchland, 1997). Neural networks can be applied to a variety of data types, and they can deal with continuous data input or categorical data input, making them flexible models (Nelson & Illingworth, 1994). ANNs are usually arranged in at least three layers, and have a defined and constant structure that is capable of reflecting complex non-linear relationships, although they do not have anything close to the capacity of the human brain.

Many neural network models are available. About 95 percent of business applications were reported to use multilayered feed-forward neural networks with the backpropagation learning rule (Wong, Bodnovich, & Selvi, 1997). This model supports prediction and classification when fed inputs and known outputs. Backpropagation is a supervised learning technique in that it uses a training set to fit relationships. This model uses one or more hidden layers of neurons between inputs and outputs. Neural networks have relative advantages in that they make no assumptions about data properties or statistical distributions. They also tend to be more accurate when dealing with complex data patterns, such as non-linear relationships.

4. RESEARCH METHODOLOGY

As mentioned in the previous section, employee motivation depends on various variables including work environment, salary, job security, etc., each of which has different effects on different people in a way that a factor that can satisfy and motivate one person and be insignificant to another, and vice versa. This makes the investigation of the effect of motivation on function complex and difficult to define. The diverse and unstable effects of motivational factors on different people, the inability of linear models to define their effect on motivation, and subsequently on function, led us to use a neural network model to investigate the relationship between motivation and function, and to take advantage of the model’s ability to deal with complexity. The research steps include defining variables, collecting data, designing the ANN and implementing it. These steps are described below.

4.1 Defining Variables

In this survey, ten possible motivators are investigated. The motivators were mainly identified in the classical study conducted by Herzberg (1968), which was revalidated in 2003 and the work of Jurgensen (1978). Herzberg identified: firstly, intrinsic factors in employee motivation, such as achievement, recognition for achievement, the work itself, responsibility, growth and advancement; and secondly, extrinsic factors, such as company policy and appreciation, supervision, interpersonal relationships, working conditions, status, payment and security.

Thus, the motivators we used in our research were: (x_1) provision of fair wage, (x_2) existence of trust and friendly relationships in the work environment, (x_3) work promotion based on employee competence, (x_4) feeling job security, (x_5) feeling respected and acknowledged, (x_6) employee cooperation in procedure design, (x_7) opportunity for growth and learning, (x_8) being rewarded for high performance, (x_9) having respect and friendly relationships with...
superiors, \((x_{10})\) employee position assignment based on skill and ability. Six factors including 
\(x_1, x_2, x_3, x_4, x_8\) and \(x_9\) are considered to be extrinsic factors and other are considered as intrinsic factors. The motivators in this survey are defined in Table 2.

### 4.2 Data Collection

One of the most important stages in the design of a supervised ANN is the collection and preparation of data, therefore the examples for training must be representative of all possibilities concerning the application. Researches that have used ANNs with supervised learning support the previous statement (Yin et al., 2003). In this article, to achieve the desired input and output data, two questionnaires were designed. The first questionnaire, used for the acquisition of the input data, is based on Herzberg’s theory of motivational factors it contains 10 questions dealing with the state of one of the internal or external motivational factors in the hospital environment (see Table 2). The answers have been defined on a 1 to 5 Lickert scale, and the resulting answer to every question is used as

<table>
<thead>
<tr>
<th>Variables</th>
<th>Motivation instruments</th>
<th>Survey question</th>
<th>5</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>(x_1)</td>
<td>Provision of fair wages</td>
<td>I receive fair salary in accordance with my performance, education &amp; experience</td>
<td>Strongly agree</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td>(x_2)</td>
<td>Existence of trust and friendly relationships in the work environment</td>
<td>The work environment is based on friendly relationships and there is mutual confidence between employees</td>
<td>Strongly agree</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td>(x_3)</td>
<td>Work promotion is on based employee competence</td>
<td>The organization has explicit criteria for employee’s career development, based on their merit</td>
<td>Strongly agree</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td>(x_4)</td>
<td>Feeling job security</td>
<td>I have job security</td>
<td>Strongly agree</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td>(x_5)</td>
<td>Feeling Respect and acknowledgment</td>
<td>My job gives me respect and prestige</td>
<td>Strongly agree</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td>(x_6)</td>
<td>Employee cooperation in procedure design</td>
<td>Processes are determined through employee’s communication</td>
<td>Strongly agree</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td>(x_7)</td>
<td>Opportunity for growth and learning</td>
<td>There are opportunities for self-development &amp; improvement in this job</td>
<td>Strongly agree</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td>(x_8)</td>
<td>Being rewarded for high performance</td>
<td>Employees are appreciated and rewarded if their performance is above the standard performance</td>
<td>Strongly agree</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td>(x_9)</td>
<td>Having respect and friendly relationships with superiors</td>
<td>There are friendly relationships between employees and superiors</td>
<td>Strongly agree</td>
<td>Strongly disagree</td>
</tr>
<tr>
<td>(x_{10})</td>
<td>Employee position assignment based on skill and ability</td>
<td>Employees’ positions are assigned based on their real skills and abilities</td>
<td>Strongly agree</td>
<td>Strongly disagree</td>
</tr>
</tbody>
</table>
the question’s homogenized neuron input. The mentioned questionnaire was distributed among 300 hospital employees over three successive months. Every month, 100 questionnaires were completed by 100 employees from different sections of the hospital including security, reception, nurses, supervisors, services, etc. Among the 100 completed questionnaires in every month, 70 questionnaires were utilized to train the network and 30 of them used for testing it. The second questionnaire was designed to assist the calculation of the model’s desired outputs (see Appendix). As described in the review of literature, since the patients’ (i.e. the clients’) satisfaction is the most prominent criterion in the function of the hospital, its average has been considered as the output of the model, and the distributed questionnaire also contains questions which evaluate the patients’ satisfaction under the Lickert’s value scale 1-5. Copies of this questionnaire were distributed among the patients during three one-month periods. In the first month, 558 were answered; in the second month, 570 and in the third month, 805; in other words, the total number of answered questionnaires was 1933. To achieve the output related to the desired criteria, the average of the patients’ satisfaction in each period has been calculated and the average of each period has been used as the desired output of the collected data set in that month. Tables 3 and 4 indicate the relevant calculations and the resulting desired output.

4.2.1 Questionnaires Validity

Validity determines the extent to which the measuring instruments actually gauge the variable in question. Without assessing the validity of the instruments, the accuracy of the data collected by them becomes uncertain. A measuring instrument might be valid for evaluating a specific characteristic in a statistical population, but completely invalid for assessing that same characteristic in another population (Sarmad et al., 2004). The method of determining content validity encompasses the mental judgment of the expert regarding the appropriateness of the measurement. In this study, the factors considered in the questionnaires which filled out by the

<table>
<thead>
<tr>
<th>Satisfaction range</th>
<th>June</th>
<th>July</th>
<th>August</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percentage %</td>
<td>Total mean</td>
</tr>
<tr>
<td>High satisfaction</td>
<td>225</td>
<td>45.69</td>
<td>3.34</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>251</td>
<td>45</td>
<td>3.34</td>
</tr>
<tr>
<td>Partly satisfaction</td>
<td>45</td>
<td>8.06</td>
<td>3.34</td>
</tr>
<tr>
<td>Dissatisfaction</td>
<td>7</td>
<td>1.25</td>
<td>3.34</td>
</tr>
</tbody>
</table>

Table 3. Classification of questionnaire 2 results measuring patient satisfaction of hospital operation to arrive at desirable neural network output

<table>
<thead>
<tr>
<th>Satisfaction range</th>
<th>June</th>
<th>July</th>
<th>August</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total mean</td>
<td>Percentage%</td>
<td>Total mean</td>
</tr>
<tr>
<td>High satisfaction</td>
<td>3.34</td>
<td>83.5</td>
<td>3.4</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>3.34</td>
<td>84.5</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Results of patient satisfaction responses on a per-month basis

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employee were adapted from Carol Sansone’s and Judith Harackiewicz’s book (2008) where they are defined as “intrinsic and extrinsic motivation: the search for optimal motivation and performance”. Furthermore, in the second questionnaire all sections of the hospital were queried regarding personnel performance in order to assess patient satisfaction.

4.2.2 Questionnaires Reliability

Reliability assessment has been used to verify the data resulting from questionnaire analysis. The reliability of a measuring instrument is defined as the similarity, accuracy and overall dependability of the results of a test repeated using the same instrument under similar conditions. In other words, it can be said that reliability is determined by the similarity of measurements by a certain instrument under unchanged circumstances. Reliability can be measured from 0 to 1, with 0 indicating no relation among results from repeated measurements and 1 denoting their full congruence. The following methods are used to determine the reliability of a measurement instrument.

- Reliability Test-Retest
- Reliability parallel-forms
- Split-Half Reliability
- Kuder-Richardson Reliability
- Cronbach’s Alpha Reliability

In the present study, Cronbach’s Alpha Reliability test has been applied in order to determine the reliability of the two questionnaires using the SPSS 16 software application. The results of these calculations can be seen in Tables 5 and 6 respectively.

### 4.3 Designing the Artificial Neural Network

The introduced neural network is a supervised one in its training and therefore it is necessary to determine four variables:

1. Network inputs
2. Network outputs
3. Terminating network learning
4. Activation function

With the questionnaire prepared to evaluate the hospital employees’ motivation, input variables of the neural network should be 10 neurons, each of which indicates a question. Considering the applied methodology and Herzberg’s theory of motivational factors which are the basis of this article, the aim is to classify the input variables into two groups of internal and external motivation; therefore, the present neural network, which has been designed using a hidden layer, is comprised of two neurons representing the internal and external motivational factors. In the output layer,

<table>
<thead>
<tr>
<th>June</th>
<th>F-value</th>
<th>α-Cronbach</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.75</td>
<td>0.91</td>
<td>0.00</td>
</tr>
<tr>
<td>July</td>
<td>2.251</td>
<td>0.872</td>
<td>0.1</td>
</tr>
<tr>
<td>August</td>
<td>5.645</td>
<td>0.912</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statistical results</th>
<th>F-value</th>
<th>α-Cronbach</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.899</td>
<td>0.851</td>
<td>0.00</td>
</tr>
</tbody>
</table>
only one neuron can be seen as the total function of the organization; thus we see a neural network with 10 input neurons, 2 neurons in the hidden layer, and 1 output neuron. All of the neurons in the layers of model (input, hidden, output) connect to each other according to weights which indicate the extent to which every input neuron affects its corresponding output neuron. The weight of the connection of the $i^{th}$ input neuron to $j^{th}$ output neuron in the hidden layer is shown with $w_{ij}$ and the weight of the connection of the $j^{th}$ neuron in the hidden layer to the $k^{th}$ output neuron in the final layer shown with $v_{jk}$. According to this, we can simulate the structure of the ANN in Figure 1.

The sigmoid activation function is adopted for the links between the input layer and the hidden layer, and also for the links between the hidden layer and the output layer. Other types of activation functions have been tried, but no better performance on calculated MSE (Mean Squared Error) has been found.

### 4.4 Neural Network Computation

Training a network by backpropagation involves three stages: the feed-forward of the input training pattern, the backpropagation of the associated error, and the adjustment of the weights.

During feed-forward, each input unit $x_i$ receives an input signal and broadcasts this signal to the each of the hidden units $H_1$, $H_n$ (n: the number of neurons in hidden layer). Each hidden unit then computes its activation and sends its signals $h_j$ to each output unit. Each output unit $Y_k$ computes its activation $y_k$ to form the response of the net for; this can be done through the following equation:

$$w_{ij} \text{(new)} = w_{ij} \text{(old)} + \Delta w_{ij}$$

- Terminate network learning.

Hush and Horne (1993) demonstrated there are three conditions for terminating network learning: (1) when the Root Mean Square Error (RMSE) between the expected value and network output value has reduced to a preset value; (2) when the preset number of learning iterations has been reached; or, (3) when the RMSE of a validation sample has begun to increase. The first two conditions are based on the preset values. In this research case, the second case has been selected for terminating network learning and iteration epochs has been set at 5000.
4.5 Implementation

In this study, the authors used the Matlab R2007b software application to build the backpropagation neural network model. For building a model that estimates performance based on the values of the motivation items, the neural network was trained using a supervised training algorithm. Each time, an input pattern was given to the network and the network estimated the corresponding performance. The training procedure was continued for all the observations pertaining to the data samples repeatedly. Training ended when iteration epochs reached 5000.

At the end of the process, considering the society and samples, the following weights from the input units to the hidden units were obtained and are shown in Table 7. After the training network, the network performance is evaluated based upon 30% of the input data including 30 questionnaires every month. For investigating the accuracy of the model, three criteria: Mean Squared Error (MSE), Correlation Coefficient (r) and Mean Absolute Error (MAE) were computed. The results are illustrated in Table 9 and the diagram of the network learning error is depicted in Figure 2.

The correlation coefficients are calculated between the actual outputs, and the network outputs, for the test data sets. If the network performance is high, the correlation coefficients between the actual outputs and the network outputs should take values that are very close to 1. The correlation coefficient (r) between the actual output and the network output is relatively high with the average value of 0.95.

The most important variable affecting the first hidden unit with its presence is work promotion being based on employee competence \((x_3)\). The 1st hidden node is also strongly affected by provision of fair wages \((x_1)\) and partially affected by feeling job security \((x_4)\) and limited by employee cooperation in procedure design \((x_6)\). The 1st hidden unit \((h_1)\) represents the extrinsic type of motivation. The 2nd hidden unit is also affected by motivator item \((x_8)\), namely being rewarded for high performance. Feeling respected and acknowledged \((x_5)\) is the second most important variable. The other relevant contributory weights ranked in order are the existence of trust and friendly relationships in the work environment \((x_2)\) and the opportunity for growth and learning \((x_7)\). Accordingly, it seems plausible to posit that the 2nd hidden unit \((h_2)\) represents the intrinsic type of motivation. The weights from the hidden units \((h_1)\) and \((h_2)\) to the output unit \((y)\) are presented in Table 8.

Our findings indicate that higher management in this private hospital attempted to motivate their employees and improve productivity (patient satisfaction) by emphasizing extrinsic factors and more specifically by the provision of fair wages and cultivating friendly relationships with superiors. One of the most important issues that private organizations have encountered is lower job security. One of the major employee anxieties is the lack of significant job security. Intrinsic incentives seem also to generate high performance. Noteworthy intrinsic factors including assignment of employee position based on skill and ability, employee cooperation in procedure design are fundamental issues to which a manager should pay particular notice in order to enhance hospital performance. This is another argument to support the synergy between extrinsic and intrinsic motivation, indicating the complexity of the motivational construct and underlining the difficulty to effectively capture all its facets in a real world setting. Opportunity for growth and learning and being rewarded for high performance are two extrinsic factors to which the hospital has paid less attention. Managers should not only consider the provision of extrinsic rewards based on performance, but also emphasize on the provision of meaningful jobs that offer opportunities for creativity and personal advancement. Our findings may have important implications for hospital managers. Perhaps the most important implication of the study is that managers need a new conceptualization of how extrinsic and intrinsic motiva-
Table 7. Weights between input variables ($x_i$) and variables in the hidden layer

<table>
<thead>
<tr>
<th>s/n</th>
<th>Motivators</th>
<th>$w_{ji}$</th>
<th>Weight to 1st hidden unit</th>
<th>Motivators</th>
<th>$w_{ji}$</th>
<th>Weight to 2nd hidden unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Provision of fair wages</td>
<td>1.7</td>
<td></td>
<td>Provision of fair wages</td>
<td>-0.9827</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Existence of trust and friendly relationships in the work environment</td>
<td>-1</td>
<td></td>
<td>Existence of trust and friendly relationships in the work environment</td>
<td>1.5173</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Work promotion being based on employee competence</td>
<td>2</td>
<td></td>
<td>Work promotion being based on employee competence</td>
<td>-0.9827</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Feeling job security</td>
<td>1.1</td>
<td></td>
<td>Feeling job security</td>
<td>-0.9827</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Feeling respected and acknowledged</td>
<td>-1</td>
<td></td>
<td>Feeling respected and acknowledged</td>
<td>1.8173</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Employee cooperation in procedure design</td>
<td>1.2</td>
<td></td>
<td>Employee cooperation in procedure design</td>
<td>-0.9827</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Opportunity for growth and learning</td>
<td>-1</td>
<td></td>
<td>Opportunity for growth and learning</td>
<td>1.1173</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Being rewarded for high performance</td>
<td>-1</td>
<td></td>
<td>Being rewarded for high performance</td>
<td>1.9173</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Having respect and friendly relationships with superiors</td>
<td>1</td>
<td></td>
<td>Having respect and friendly relationships with superiors</td>
<td>-0.9827</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Employee position assignment based on skill and ability</td>
<td>1</td>
<td></td>
<td>Nomination employee position based their skill and ability</td>
<td>-0.9827</td>
<td></td>
</tr>
</tbody>
</table>

Table 8. Impact of hidden units (extrinsic and intrinsic motivation) on output node (performance)

<table>
<thead>
<tr>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>$h_1$</td>
</tr>
<tr>
<td>$h_2$</td>
</tr>
</tbody>
</table>

Table 9. Accuracy assessment of the neural network based on MAE, MSE and R criteria data

<table>
<thead>
<tr>
<th>Performance</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSE</td>
<td>1.13301E-05</td>
</tr>
<tr>
<td>MAE</td>
<td>0.002640636</td>
</tr>
<tr>
<td>$r$</td>
<td>0.951917828</td>
</tr>
</tbody>
</table>
tions operate. We should bear in mind that these results are particular to this case in this society and may differ in other cases.

5. CONCLUSION

Patient satisfaction has always been a fundamental requirement for the clinical and financial success of any organization providing healthcare, regardless of their specialty. Most research on service quality has been focused on measuring customer or patient satisfaction as an important outcome of the healthcare industry. In today’s shortened length of stay and increasing outpatient procedures, healthcare providers are competing to maintain a strong patient base. Patient satisfaction is therefore instrumental when monitoring the quality of hospital care in relation to costs and services.

Organizational performance is influenced by different factors such as manufacturing strategies, human resource management, technological innovation, the role of evolving skills and transitional workloads, intrinsic motivation, reward/recognition, customer stress, stress management, and employee motivation. In this paper, the importance and influence of all employee motivation factors on patient satisfaction was measured by using a neural network instead of regression and correlation analysis, which are two common statistical methods for investigating correlation and finding relationships between variables. Applying regression and correlation analysis to different situations is limited by certain assumptions. In this research, through the use of a neural network, we were able to measure the amount of influence of motivation factors on patient satisfaction level in a more reliable manner than other statistical methods. Using neural networks, it is possible to determine which set of intrinsic and extrinsic motivation factors have a positive effect on performance and the extent of this effect. The weight of each factor indicates the amount of the effect and also determines whether it is positive or negative. Also, by considering the learning characteristics of neural networks, it is possible to utilize the trained network for investigating patient satisfaction levels in other hospitals in relation to the same motivation factors.

In this particular case, it was observed that attaining a higher position as a result of merit was more effective on the network output than any other item. It is noteworthy that although employees are not commended and extrinsically acknowledged by their managers, and this factor has no positive effect on the network output,
the employees are satisfied and compensated by being appointed to a higher position.

Our findings indicate that one of the most important issues that this private organization has encountered is lower job security in that area. One of the major anxieties of employees is the lack of adequate job security. While extrinsic factors continue to have considerable appeal among employees, intrinsic incentives also seem to contribute to high performance. Considering intrinsic factors including Assignment of employee position based on skill and ability, employee cooperation in procedure design is a primary issue that managers should focus on in order to enhance the hospital performance. Managers must be aware that one way to acknowledge the efforts of employees is to compensate through external commendation. This issue has been extensively studied; an example is the 2004 research by Rynes et al. where subjects were questioned about the importance and effect of receiving monetary bonuses as a motivational factor. The majority of the subjects claimed the importance of this item to be around 50%, but in practice it was observed that granting such bonuses by managers is the most important motivational factor in compensating meritorious performance in employees (Rynes et al., 2004). This factor is of great consequence to administrators in places where employees are in direct interaction with customers, especially healthcare centers and hospital.

Our findings may have important general implications for hospital managers. Perhaps the most important implication of the study is that managers need a new conceptualization of how extrinsic and intrinsic motivation operates.

6. LIMITATIONS OF THE PRESENT STUDY AND SUGGESTIONS FOR FURTHER RESEARCH

Cultural, economic and management methodology dissimilarities among countries are all influential factors in HR and management studies which prevent the generalization of HR research results in a certain country to others (Chase, 1998). The model used in the present article can be employed in studying other hospitals in Iran; however, what must be considered is that disparate administrative systems in the private and public sectors and also differences of facilities available in small towns and large cities make it unfeasible to generalize the results to all domestic hospitals, limiting the scope of this study to private hospitals in Tehran. More extensive research and including hospitals from the private and public sectors all around the country could potentially increase the possibility of generalizing the results. A higher number of private hospitals in Tehran could also be studied in the future.

In the present research, questionnaires were distributed among 300 employees over a 3-month period. More accurate results can be obtained by extending the period to a year and selecting a larger number of employees as subjects.

REFERENCES


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APPENDIX

Questionnaire for Measuring Customers Satisfaction
The questionnaire is designed to gain a better understanding of your opinions about hospital performance. Please read the questions carefully, and mark your opinion about each one in the provided spaces.

1. The appropriateness of the security guards’ behavior in the hospital is:
   a) Very low
   b) Low
   c) Medium
   d) High
   e) Very high

2. The appropriateness of the information desk employees’ behavior is:
   a) Very low
   b) Low
   c) Medium
   d) High
   e) Very high

3. The speed and accuracy of reception employees in the hospital is:
   a) Very low
   b) Low
   c) Medium
   d) High
   e) Very high

4. The doctors’ performance especially in pursuing medical issues and visiting patients is:
   a) Very low
   b) Low
   c) Medium
   d) High
   e) Very high

5. Nurses’ performances in terms of accuracy, respect and scientific & practical abilities are:
   a) Very low
   b) Low
   c) Medium
   d) High
   e) Very high

6. The paraclinical service quality in sections such as radiology, laboratory, etc is:
   a) Very low
   b) Low
   c) Medium
   d) High
   e) Very high
7. The medical services quality during the night shift is:
   a) Very low
   b) Low
   c) Medium
   d) High
   e) Very high

8. Catering and hospital attendant performance in respect with politeness, cleanliness and responsibility is:
   a) Very low
   b) Low
   c) Medium
   d) High
   e) Very high

9. The cleanliness of clothes, bed sheets, pillows and bedding in the hospital is:
   a) Very low
   b) Low
   c) Medium
   d) High
   e) Very high

10. The quality of hospital’s water closet services is:
    a) Very low
    b) Low
    c) Medium
    d) High
    e) Very high

11. The quality of hospital’s communicational services (internal telephones, etc) is:
    a) Very low
    b) Low
    c) Medium
    d) High
    e) Very high

12. The quality of cashiers’ performance (their speed and accuracy) is:
    a) Very low
    b) Low
    c) Medium
    d) High
    e) Very high

13. What is your opinion about the medical services in general?
    a) Very low
    b) Low
    c) Medium
    d) High
    e) Very high