

The Determination of the Effect Level on Employee Performance of TQM Practices with Artificial Neural Networks: A Case Study on Manufacturing Industry Enterprises in Turkey

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Abstract

Total Quality Management which is one of the human-centered, participatory, and in the understanding of a customer-oriented philosophy, a system which processes the continuous development and improvement. Businesses to achieve the objectives of today's highly competitive environment are strategically important to take measures to improve employee performance. Internal customer satisfaction, customer satisfaction, in which the external companies will be successful in this study in line with its strategy, total quality management practices was conducted to investigate the effects on employee performance. In this context, operating in the province of Malatya is certified in accordance with ISO 9001 Quality Management System in a company, Total Quality Management practices effects on employee performance, measured by means of a questionnaire prepared. The result of the survey data, Total Quality Management is doing a positive impact on the performance of applications running in general has revealed. Result of the analysis identified four factors that affect employee performance, the performance impact of these factors in determining the rank, the method of artificial neural networks used in classification feature.

Keywords: Employee's Performance; ISO 9001; TQM; ANN

1. Introduction

With the phenomenon of globalization, use of advanced production techniques is inevitable for business to adapt changing competitive conditions and to gain competitive advantage through competitors. Total Quality Management, applied in the fields of production and management, is a system that envisages the continuous development and improvement of process in the understanding of participatory and customer-focused philosophy (Gules & Bulbul, 2004). "Kaizen" referred as the concept of continuous improvement of TQM, appears to be an issue internal and external customer orientation and the innovation with the principles continuity of all them (Colenso, 2000).

TQM is the management philosophy which is developed in mid-20th century and starting in late quality concepts of governance structures. TQM is a model in which rotating the axis of three main themes: customer, process and human (Mitra, 1998). In the development process of TQM exhibits integrity on the basis of principles, despite many differences in practice (Tekin, 2007). In fact, the principles of TQM is related to competitiveness of enterprises gained and main purpose is high efficiency, product and market differentiation, high quality, low cost and achieve the high competitiveness power (Yatkin, 2004).

Commonly used as a model for TQM in business studies, ISO (International Standard Organization) 9000 Quality Management System standards, which is used all over the world formed the basis of idea of creating a QMS (Tekin, 2007). ISO 9000 and TQM is not a same but a significant help to shorten the way (Vouzaz, 2007).

ISO 9000 applications is a factor that increase employee motivation and operational efficiency, then provide stability and consistency to business life (Magd and Curry, 2003). In today's globally competitive environment, started the creation of an integrated quality management systems for the product, system and the personal certification process, ahead of these standards, criteria such as environment, health and safety have been included in. Satisfy and motivate the employees seen as internal customers depends on providing continuous technical Training in companies which are implementing ISO 9000 QMS in the context of TQM (Ersen, 2003; Tansel, 2007). Meanwhile, adoption of the importance of their work is very important for employees (Bolat, 2000). With TQM practices, it will be possible to reduce absenteeism and leave from work, increase job satisfaction and improve commitment to the workplace and increase staff motivation and morale (Simsek, 1998).

Although many factors that affect the employee performance, job commitment, job satisfaction, working Environment and motivation can be classified as such factors. A number of Studies, commitment referred as psychological condition which describes the employees' relations with organization (Varol, 2010). Meyer and Allen note that organizational commitment consists of three forms: emotional commitment, continuance commitment and normative commitment (Balay, 2000). Job satisfaction is a kind of reaction comes from employees in response to work and its bringing (Luthans, 1994). Businesses are contact constantly with internal and external environment. Technology used by businesses, the importance given to human beings, task distribution, environmental, economic, ideological and cultural construction effect the success of employees thus the organization's success (Baydar, 1995). High motivation in enterprises requires loving job and know what you add to your job. Employee performance increase and reduce the rate of absenteeism when the organization values are supported by workers. (Ozturk & Dundar, 2003).

2. Total Quality Management Practices

TQM is a customer-oriented management philosophy including improvement of business processes, using Statistical Process Control (SPC), identification of required procedures and creating quality policies to adopt the businesses. The use of quality tools, determination of potential quality problems in the firm, employee training, benchmarking studies lead to businesses focus on customers better, increase productivity and speed of response (Erdil & Kitapçı, 2007). Critical factors of total quality management are such as: leadership, making and inquiry, Strategic plan, employee training, teamwork and employee participation to decisions, continuous improvement, giving attention to the quality process, evaluation of quality and operational results and finally provide customer satisfaction (Kocyigit et al., 2011).

A quality concept is essentially a business philosophy, a company ideal, or a policy statement. The business philosophy can be contrasted with its implementation reflected in the activities and behaviors of an organization. Focusing on behaviors rather than philosophical notions makes it easier to operationalize the different quality constructs (Nilsson et al., 2001). TQM provides people with opportunities to learn and to develop themselves through joint problem-solving efforts (Hackman and Wageman, 1995).

TQM and productivity have become major concerns of business managers seeking to maintain or increase competitive advantage. At present dynamic manufacturing environment, where quality is vital to success, manufacturers use TQM as a tool to substantially improve productivity and customer satisfaction. Besides, most of the previous studies point out that productivity is one of the measure performances directly affected by application of the TQM principles. This means that the adoption of TQM concepts leads to inspiring employees to succeed and grow, then improving their performance and productivity (Belay et al., 2011).

There is a growing body of empirical research supporting a direct relationship between the adoption of TQM and improved performance. TQM leads to sustainability of advantage. TQM provides a unifying framework that brings a range of "good management practices" to bear simultaneously. As already pointed out, there is agreement among Crosby, Deming, Feigenbaum, Ishikawa, and Juran that the purpose of quality management is to reduce costs and improve satisfaction (Reed et al., 2000). In TQM approach, it is essential that company owners, dealers and suppliers, employees and customers are to be satisfied at the same time and loyal to the firm. Nilsson et al., (2001) have been conducted in Sweden with a sample of Swedish firms. In a cross-cultural quality management study of 12 countries, the US, Japan, and Sweden are on the same high level with respect to their cultural approach toward quality management. These countries were considered more advanced than other countries such as Korea and China. This makes Sweden a good context for investigation.

However, it is still important to conduct a cross-cultural study that investigates differences in the relationship between quality practice and performance going forward. Gules et al., (2011) in general, they assess the competitive priorities in their study and note that businesses have more attention to quality in the size of priorities of the competitiveness. In addition they have suggested that binding substances on the quality in business contracts, keeping quality standard certificate are the compulsive factors for businesses to offer continuous and reliable quality.

3. Performance Management

Performance defined as the point of an individual, group or organization's pre-set objectives reached both qualitative and quantitative. Employees beginning from arrival to business, they use their knowledge and skills within the framework of job description and in return for gathering social and economic advantages within the business opportunities. In this context we can say that organizations' high or low performance depends on employees' individual performance level (Aydin et al., 2010). The concept of performance in business is an issue due to several factors. Realistic organizational goals, explaining the objectives to employees, overlapping individual purposes with organizational objectives, improving the quality of employee skills are the elements which must be business performance (Calik, 2003).

Performance is affected by a large number of factors. It was not surprising that the effect of quality management practices in purchasing on business performance is small. TQM practices have a positive effect on performance (Rodriquez and Hemsforth, 2005). Performance strategy, task-performing teams sometimes head off in the wrong direction or go about their work in inefficient or inappropriate ways, merely because members are not entirely clear about what they are supposed to do or whom they are supposed to satisfy. Under TQM, these risks are minimized (Hackman & Wageman, 1995).

Performance management is a process in which managers and employees reach a consensus on responsibilities, goals and how to achieve success, and also a process of strengthening practical management and driving employees to gain excellent performance. Performance management is the core, which connects closely with every ring of human resource management. The most important goal of performance management is to know the advantages and disadvantages of employees' performance in work, and improve the performance (Chen, 2011). Employee management supports both a firm's process and customer orientation, while process orientation also directly supports customer orientation. This provides basic support for the argument that organizations that have good internal quality management systems are typically in a better position to adopt a customer orientation (Nilsson et al., 2001).

Performance management systems are a cornerstone of human resource management practices. In theory, a performance management system links organizational and employee goals through a goal-setting process, and subsequently links employee goal achievements to a variety of human resource management decisions through a performance measurement process. The goal is to develop quality improvement plans that are targeted to the specific causes of quality problems (Deadrick & Gardner, 1999).

According to the studies done on TQM, using of the TQM implementations reduces the contradictions in the production process (reprocessing and wastes are reduced while quality performance is increased) (Reed et al., 2000). It has been determined that TQM has an effect which increases the socio psychological motivation on employees and organizational-managerial motivation (Okay and Akcay, 2010). As the result of the studies done to determine the factors effecting on job satisfaction, it has been understood that the factors such as salary, security, promotion, leadership, management style, working conditions, colleagues, appreciation and job itself have significant impacts on job satisfaction (Luthans, 1994). TQM significantly and positively impacts its firm's performance (Vanichchinchai and Igel, 2011).

The employees that cannot be met these requirements in their jobs, will search the conditions they desire in other places and environments. And, this situation will effect on employee's job satisfaction. Ensuring employee participation in decisions making in companies also helps to improve last decisions into the companies, in addition to increasing job satisfaction. Personnel participated in the decisions, will be in positive emotions to their jobs, colleagues and management and there will be an increase in their job satisfaction. That the management support personnel relations and contribute to them improves employee satisfaction. The satisfied employees will show better performance and threat customers better, as a result, it will be provided better satisfaction for all customers of enterprise (Luthans, 1994; Okay & Akcay, 2010).

In today's highly competitive condition, this practical study has been conducted in order to contribute to the objectives of businesses such as high efficiency, high quality, low cost and high competition by taking advantages of ISO 9000 and TQM philosophies.

4. The Purpose and Scope of the Research

The aim of the research is to examine the effect of use of TQM tools and employee performance in three industrial undertakings which has ISO 9000 QMS, different province of Turkey (Malatya, Kahramanmaraş and Konya). One each business in three different provinces and certified by TSI and running manufacturing sector were randomly selected. The data were collected from those who are working selected businesses. 600 questionnaires were implemented and only 352 of them returned. According to this feedback rate is 59%. The data obtained from these questionnaires primarily has been tested from validity and reliability then subjected to statistical evaluation.

5. Research method

Firstly related questionnaires that are used in previous studies are examined during the process of preparing the questionnaire (Erdil and Kitapçı, 2007; Tansel, 2007; Ozgur, 2008; Ekici, 2009; Isci, 2010; Aydın et al., 2010; Kılıç, 2010; Okay & Akcay, 2010; Varol, 2010; Karahan et al., 2011) and "The Effects of ISO 900 QMS Practices in Businesses on Employee Performance Questionnaire Form" has been developed. There are 33 questions in this prepared questionnaire to measure the demographic characteristics of workers and degree of satisfaction about their businesses. All answers of questions prepared in accordance with five Point Likert Scale (1: Strongly Disagree,....., 5: Absolutely Agree). Cronbach Alfa reliability was found 0.96 by testing 33 questions on scale. These results show that executed scale has high level of reliability. At the end of the survey, data obtained from 352 of employees were transferred to the computer and evaluated statistically by using the SPSS 17.0 package program.

5.1. Findings and evaluation of the research

By order of this section, such studies will made: setting demographic characteristics of employees in enterprises, analyzing the validity and reliability of scale about employees' satisfaction with their businesses, determining the factors that affect the employees performance, influences of these factors are classified by the method of Artificial Neural Network in order to determine the strength, compare the factors affecting the employees' performance with correlation analysis.

5.1.1. Demographic features of employees who are working in surveyed enterprises

115 people from Malatya, 119 people from Kahramanmaraş and 118 people from Konya for a total of 352 employee participated to the research. 81% of survey respondents (285 people) are male, 19% (67 people) female. Accordingly, vast majority of employees surveyed are seen as male. 70% of surveyed employees (247 people) are married and 30% (105 people) are single. Accordingly, it can said that majority of employees surveyed are married. Range of employees' age is such this: 41% of them (145 people) 21-30, 44% of them are (153 people) 31-40, 11% of them (39 people) 41-50 years. The majority of employees are very young cause they are range of 31-40 years. And also it has seen that 38% of surveyed employees (135 people) high school or equivalent, 24% (84 people) faculty, 521 (74 people) college, 513 (16 people) primary schools and %4 (13 people) graduate. In this case majority of employees in Enterprises had University or college education. 35% of surveyed employees (122 people) are worker, 22% of them are (78 people) office staff, 21% (74 people) technical staff, 12% (44 people) engineer, 10% (34 people) director. According to this, majority of employees are working as worker and office staff.

Results from experience of work is as follows: 34% of employees (118 people) 6-10 years, 29% (103 people) 1-5 years, 25% (88 people) 11-15 years, 9% (32 people) 16-20 years. So it can be said that majority of employees have experience between 6-10 years. 55% of employees (194 people) have been working existing business between 1-5 years, 27% of them (94 people) between 6-10 years and 14% of employees (48 people) have been working existing business between 11-15 years. In this case majority of employees have been working existing business between 1-5 years. When we look at the results about the fees, we can say that; 36% of employees (125 people) get 750-1000 TL, 23% of them (82 people) get 1001-1500 TL, 12% (42 people) get 1501-2000 TL and 18% (52 people) get 2001 TL and more. 11% of employees are working with minimum wage. So it can be said that majority of employees earn 750-1000 TL.

73% of employees who participate into research are aware of ISO 9001 QMS and 29% (97 people) do not have any idea about it. So it can be said that majority of employees have knowledge about ISO 9001 QMS. However, 87% of employees (307 people) know that enterprise has ISO 9001 QMS and 1 (5 people) didn't know, 12% (40 people) who are not knowledgeable about the subject. This situation can be interpreted that enterprises which are implementing ISO 9001 QMS, has a good position about creating awareness over employees. 57% of employees reported that they received training about ISO 9001 QMS but 43% of them didn't. In this case, in terms of businesses TQM can be considered as a positive situation in the context of "Continuing Education". Also it can be read that "Full Participation" principle literally applied in QMS certified businesses.

5.1.2. Study of reliability and validity of scale developed about effects on ISO 9001 QMS practices on employees' performance

The study of scale applied to employees in 352 enterprises, Cronbach Alfa reliability test was conducted on 33 items and as a result, the reliability of scale was calculated 0.96. In this application, based on results of the survey are quite reliable.

5.1.2.1. Factor analysis

The Origin of the mutual dependence between the data was investigated by using factor Analysis which is one of the multivariate analyses. In short, this technique defined as data reduction provides more meaningful and brief. Variables in scale were defined by Explanatory Factor Analysis (EFA) then was applied Confirmatory Factor Analysis (CFA) in order to determine the validity of scale.

Before proceeding to factor analysis, it requires to be tested with measure of sampling adequacy named as Kaiser Mayer Olkin (KMO) for congruity of data set. KMO is an index that compares the size of observed correlation coefficient and partial correlation coefficient. And the ratio should be higher than 0.5. Similarly, degree of importance of Barlett test has to be in low than 0.5. As shown in Table 1. Value of KMO obtained from the study is 0.890 so it shows that sample size (352 people) is sufficient. Barlett test result also shows that ($p < 0.01$) data have normal distribution. According to these results, selected samples are adequacy for measurement and study is appropriate for the factor analysis.

After determining the suitability of data set, factor analysis can be forwarded. At this stage factor reduction is made by using basic component analysis and Varimax vertical rotation technique. Factors whose weight is over 0.40 were selected. Analysis performed on the data set of 33 variables in order to decide on the validity of the scale and four main factors were obtained. These four basic factors with sub-items and Cronbach Alpha reliability coefficients shown in Table 2.

The cumulative variance of four factors was found approximately 58%. According to this result, it can be expressed that total variance represents the majority. Factor loadings of items on the scale are ranging between 0.413 and 0.781 (Table 2) and all factor loading are statistically significant at the level of 0.95 ($p < 0.05$). According to these results, the scale used in the application deemed to be reliable and valid.

It can be decided number of the size of scale by examining "Scree Plot" chart shown in Figure 1. There is a sharp decline from the first point to second point then the slope of the line passes through a horizontal navigation. Therefore, the number of points on the second point gives us information about the number of factors. The information in this graph also shows us the scale can be considered as a one-dimensional.

5.1.2.2. Determination of strength of the factors effecting employee performance through the ANN classification feature.

Four basic factors were determined that effect the employee performance then started determines the degree of influence of the factors effecting performance. At this stage take the averages of data obtained from employees view for four factors separately then turned into points in the MS Excel. This composed of scores of four separate input data set (the independent variable-input data set) and an output data set consisting of total scores (the dependent variable-output data set) again created in MS Excel.

Input and output data sets shown in Figure 2 were made entries by using Artificial Neural Network of SPSS statistically package program. The rates of effect of input data to performance were calculated by taking advantage of classification feature of Artificial Neural Networks. These calculations are shown separately for each independent variable in Table 3.

As shown in Table 3 and related Figure 3 employee performance mostly affected by satisfaction and participation in management (%35) and process analysis and sustained improvement factors (%33). According to these results it can be interpreted that employee performance effected by the factors of sustained improvement and participation in management.

5.1.2.3. Correlation analysis of factors affecting the employee performance

A correlation analysis is used for determination of relationship between two variables. The notable thing here is that both variables are digital (numeric). Correlation is the answer of question that when there is a change in one variable, the other variable may change at same proportion. Correlation coefficient (r) takes a value between 0 and 1. When the value is 0, there is no relationship between variables but when it is 1, it implies that there is full relationship. Correlation coefficient may be (+) or (-). If coefficient (+), there is a positive relationship between two variables. In positive relationship when the value one variable increases, the other one also increase. In negative relationship one of the variables increases when the other decrease.

5.1.2.4. Factor comparison of management satisfaction and sustained improvement factors

Results of Pearson Correlation analysis for the relationship between satisfaction, participation, process analysis and sustained improvement shown in Table 4. According to the results of correlation analysis there is a statistically significant and strong positive relationship between administration satisfaction and participation in management and process analysis and sustained improvement. As shown in the Table 4, factor of F1 is associated with factor of F2 in the rate of 79% ($r=0.793$, $p<0.01$).

5.1.2.5. Management satisfaction factor and comparison of quality and customer centered factors

Management satisfaction factor and quality-customer centered factors, which measures the relationship between the Pearson's Correlation analyses results are shown in Table 5. According to the results of correlation analysis, there are statistically significant relationships between satisfaction of management and quality and customer centered factors. As shown in Table 5, there is a significant relationship between the F1 and F4 factors ($r = 0,690$, $p < 0.01$).

5.1.2.6. Comparison of factors with workplace satisfaction and customer centered factor

The results for the Pearson Correlation Analysis are in the Table 6 below. It shows us the relationship between businesses oriented satisfaction and quality and customer centred. According to the correlation analysis shown in the Table 6, Pearson Correlation Coefficient value implies that there is a statistically significant relationship between job and workplace satisfaction and quality and customer-oriented factor. It can be said that factor of F3 is related with factor of F4 in the rate of 59%. ($r = 0.589$, $p<0.01$).

5.1.2.7. Comparison of process analysis, continuous improvement and workplace satisfaction factors

Results for the Pearson Correlation analysis are shown in Table 7. According to the results shown in the Table 7, Pearson Correlation Coefficient value (r) note that there is a statistically significant relationship between process analysis and continuous improvement with job and workplace satisfaction level ($r = 0.740$, $p<0.01$). As shown in the Table 7, factor of F2 is related with factor of F3 in the rate of 73%.

6. Conclusion

This study has been done in order to contribute the aims of businesses such as low cost, high productivity, high quality by taking advantage ISO 9000 and QMS philosophy. And four main factors which affect the employees' performance were determined. The employees' performance were affected by these factors in the context of management satisfaction 35%, process analysis and continuous improvement 33%, job satisfaction and customer orientation 13%. These findings were found by using ANN.

There is a strong positive relationship (79%) between management satisfaction and continuous development. Accordingly increasing the satisfaction of employees' about their managers and their businesses affect the employees' performance in a positive way. By the outcome of correlation analysis (69%) again there is positive significant relationship in levels of administration satisfaction and quality-customer orientation. According to this result, employees' performance was affected by the studies which focus on administration satisfaction and quality and customer orientation. There is a significant strong relationship in the size of quality-customer orientation and level of satisfaction with their workplace. Produce the quality and satisfactory products will lead to foster positive feeling toward workplace.

According to the results process analysis and continuous improvement is one of the factors that enhance the employees' satisfaction. This result also pointed out that employees are affected by continuous innovation and improvements done in working environment. According to all of these results obtained from study, satisfaction from administration and working environment and continuous improvement effect employee performance in a positive way. Deficiencies in enterprises were revealed by evaluating employee performance with applications in QMS certified businesses.

Limitations of the research are ISO 9000 standards and internal customer orientation in the context of TQM. There is no doubt that the study will be substantial when the limitations of research have been removed.

7. Recommendation

In the light of the results above, developed recommendations to improve employee performance are as follows:

- More focus on quality, renewing the staff information with continuing education, more emphasize on internal and external customer orientation, improving of all processes that may cause customer dissatisfaction especially in the working environment.
- Provide more opportunities to employees and expand tangible and intangible reward mechanism such as premium and promotion are extremely important in terms of job satisfaction.
- Creating harmonious and positive environment between management and staff, taking the employees' opinions when making decision regarding employees will lead to feel esteemed themselves.
- Workplace physical Environment is an important factor in employee satisfaction and thus affecting the performance. Ergonomically designed work environments for employees increase their Performance and reduce the losses in the labor force.
- Businesses do not fully adopt the requirements of ISO 9000. In this context improvement is an important way to increase employee performance and will directly impact the overall business performance.

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Table 1. Kaiser Mayer Olkin Sampling Adequacy and Bartlett Tests

Kaiser-Meyer-Olkin Measure of Sampling Adequacy :		0,890
Bartlett's Test of Sphericity	Approx. Chi-Square :	2314,51
	df :	435
	Sig. :	0,00

Table 2: The average variance values of the measurement model and Cronbach Alpha reliability values.

Factors	Variables	Factor loadings Max - Min	AOV*	Cronbach Alpha Rel.
F1: Management satisfaction and participate in government	8-6-28-5-33-31 15-32-21-24-23	0.728 – 0.495	0.45	0.91
F2: Process analysis and continuous improvement	20-19-16-18-12 9-10-13-14-17-11	0.634 – 0.507	0.50	0.91
F3: Level of job and workplace satisfaction	35-26-34-30-27 1-22	0.709 – 0.464	0.54	0.84
F4: Quality and customer focus	3-2-4-7	0.781** – 0.413***	0.58	0.81

* AOV: Average Variance Extracted

** Max factor loading, *** Min factor loading

Table 3. The level to effect of independent variables to outcome

Independent Variables	Importance	Normalized Importance
F1: Management satisfaction and participate in government	0,347	100,0%
F2: Process analysis and continuous improvement	0,332	95,9%
F3: Level of job and workplace satisfaction	0,195	56,2%
F4: Quality and customer focus	0,126	36,2%

Table 4. Correlation analysis of the relationship between the factors

Variables	x	s	n	1.r	2.r	p
F1: Management satisfaction and participate in government	38,27	8,254	352	1	0.793*	0.000
F2: Process analysis and continuous improvement	39,97	7,226	352	0.793*	1	0.000

* Correlation is significant at the 0.01 level (2-tailed)

Table 5. Correlation analysis of the relationship between the factors

Variables	x	s	n	1.r	2.r	p
F1: Management satisfaction and participate in government	38,27	8,254	352	1	0.690**	0.000
F4: Quality and customer focus	14,92	3,105	352	0.690**	1	0,000

** Correlation is significant at the 0.01 level (2-tailed).

Table 6. The summary table of correlation analysis between the factors

Variables	x	s	n	1.r	2.r	p
F3: Level of job and workplace satisfaction	23,58	3,992	352	1	0.589**	0.000
F4: Quality and customer focus	14,92	3,105	352	0.589**	1	0.000

** Correlation is significant at the 0.01 level (2-tailed).

Table 7. The summary table of correlation analysis between the factors

Variables	x	s	n	1.r	2.r	p
F2: Process analysis and continuous improvement	39,97	7,226	352	1	0.740**	0.000
F3: Level of job and workplace satisfaction	23,58	3,992	352	0.740**	1	0.000

** Correlation is significant at the 0.01 level (2-tailed).

Figure 1. The factor sizes sorted according to the eigenvalues

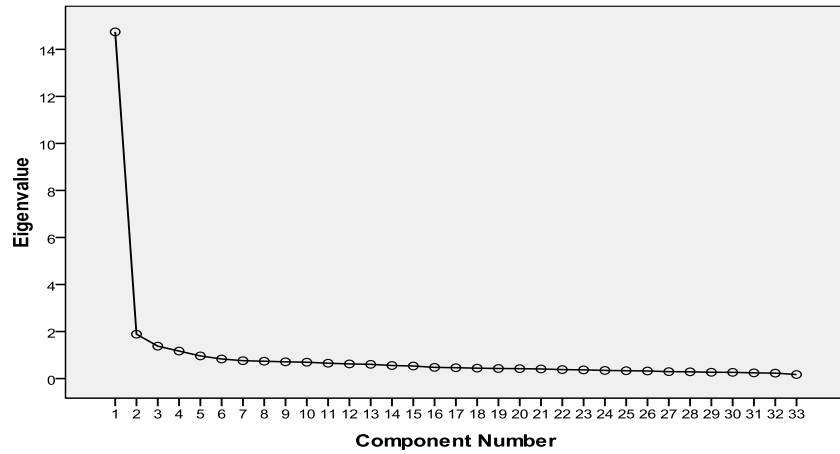


Figure 2. Artificial Neural Network Model

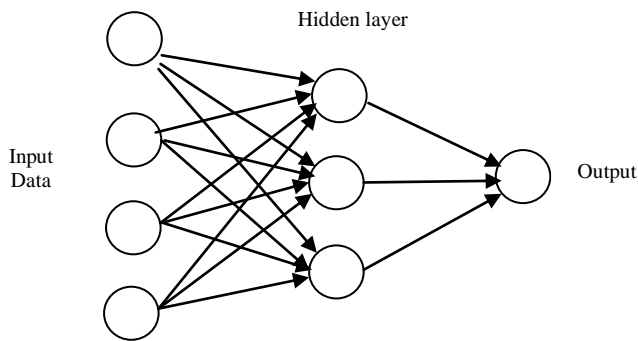


Figure 3. The effect to result of independent variables

