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# Abstract

The current research sought to present a model for evaluating the financial performance of companies active in Tehran stock exchange. T this end, 50 financial ratios proposed by experts were utilized, among which, 49 ratios were finalized. These ratios were categorized into 6 groups including consolidation, economic, leverage, liquidity, profitability and activity. According to the experts' views, these ratios were weighted and analyzed using multivariate decision making criteria of BWM and Aras technique as well as Lingo software. Finally, the companies were ranked; among the existing 516 companies whose ratios were accessible, the investigations were conducted. The results indicated that Iran mineral salts company, Golgohar mining and industrial company and Khouzestan steel company obtained 1 to 3 rankings, respectively.

Keywords: Performance evaluation, Financial ratios, The best worst method, Tehran stock exchange

#### INTRODUCTION

In fact, if it is not possible to measure what is being spoken of, and if it is not possible to express the intended meaning in terms of numbers, it seems that nothing has been understood regarding the issue; since in this sense, the comprehended knowledge becomes only a narrow and superficial knowledge. This may be an introduction to the knowledge that have not reached to the level of science. Performance evaluation refers to the sum of actions and information that occur to increase the optimal use level of facilities and resources to achieve the intended purposes, especially economic ones, along with efficacy and Regarding organizational dimension, effectiveness. performance evaluation refers to the extent of activities` effectiveness. Effectiveness means the amount of having access to the purposes and programs having the characteristics of efficiency in activities and performances. Overall, the performance evaluation system can be viewed as a measurement process as well as the comparison between the amount and the way of achieving an appropriate status <sup>[1]</sup>. It seems that performance evaluation system was firstly and officially presented in individual and organizational level in a textile industry by Robert Aven in Scotland during 1800; regarding which, the produced goods were ranked using woods in various colors, which was a kind of evaluation regarding the quality or headquarters of the organization. This method was also utilized for identifying the reasons of having changes and their controlling in the production and finally improving the products or presenting services. Edward Deming has emphasized on the fact that all business processes should be a part of evaluation system along with the feedback cycle. Jac Fitz Enz believed that evaluating every business activity is an essential issue. Evaluation should take place on both common processes and individual performances. In case the design of a project is intended, or only daily management activities are considered, there would be no knowledge on what to do without taking numbers into account. Without having a measurement system, managers would only play the role of a supervisor. In traditional views, the most important aim of evaluation was judgment and evaluation of

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the intended performance. However, in the modern views, the philosophy of evaluation has focused on the growth, development and improvement of the capacity of assessors <sup>[2]</sup>.

Management quality is basically dependent on the quality of decision making, since the quality of designs and programs, the effectiveness and efficiency of strategies and the quality of results obtained through their use, all are dependent on the quality of decisions that management makes. In most of the cases, the decisions are appropriate and satisfactory to the decision maker in case the decisions are based on some investigated criteria. Regarding multivariate decision making methods, which have been considered by the researcher in recent decades, instead of using an optimal measuring criterion, multi-criteria measurements are utilized. One of these criteria that has been designed by an Iranian scientist of Netherlands Industrial University, is BWM method, which has some advantages over other multicriteria methods. In this study, firstly, the criteria were integrated using ISM and later, the outcomes of ISM were put as BWM model's input, so that a model was finally designed to evaluate the companies` performance. Having succeeded in this evaluation, it could be used for predicting future performances.

#### Background of the Study

One of the main duties of financial managers is controlling financial resources and being confident to obtain the predetermined results. The results of accountants` endeavor is presenting reports that indicate the financial status of the institute as well as their performance results during a period. In case these reports not be properly analyzed, they may not provide the readers with beneficial data and may be delusive, instead. Various measurement tools could be used for evaluating one trading unit's health; among which, the analysis of horizontal and vertical financial statements and the investigation of ratios can be pointed out. The analysis of financial statements is an endeavor to evaluate the strength and weakness points of institution's financial statuses through investigating the reported numbers. On the other hand, perfect business models is a response to the question that how is a superior organization? what goals and concepts does it follow? and what are the criteria governing its behaviors?. Nowadays, most of the counties in the world have used some models as the stimulants of the organization and business to elevate, develop and make wealth. In this section, firstly, a brief explanation of the previous researches has been presented and the measured financial performance of the companies have been introduced.

# **Theoretical Foundations**

Unfortunately, nowadays, the desire of people toward investment in stock exchange is not high. One of the reasons regarding this issue is the inability of investors in predicting and evaluating and overall, analyzing the data and most importantly, the performance of the companies, as well as people's desires for investing in the banks and commercial issues. On the other hand, organizations need those decisions that provide an appropriate pattern for predicting and measuring the performance so that continuous improvement could be achieved in all fields. With the emergence of modern methods, and using such methods along with traditional financial criteria, the companies` performance evaluation changed. However, it is still possible to increase the accuracy of output data using accounting economic criteria and their integration with various methods as well as the use of new financial criteria. Using SIM approach to cope with the ambiguities existing in input data, along with BWM method, can present a specific applied research in terms of evaluating and predicting companies` financial performance. On the other hand, all models have investigated companies` performance through one or multi dimensions and have sought to provide a model for comprehensively evaluating companies` financial statuses. As it was mentioned, due to the various use of performance evaluation discussion in financial and management fields, the evaluation and investigation of its various aspects is a necessity for managers and investors as well as capital market activists. In this regard, the results of this research can be used in organizations such as investment companies, banks, credit institutions, investment provision companies, investment counselling centers and all capital market activists can benefit from it.

# Research Purposes

A. Local Studies

| Author                      | Years | Title  |
|-----------------------------|-------|--|
| Noroush and<br>Mashayekhi   | 2005  | In all studied companies, regardless of the<br>industry they belong, there was a<br>significant relationship between changes<br>in accounting income as well as changes<br>in economic value-added.                            |
| Abzari et al.               | 2009  | In companies of basic metals` group, there<br>was no significant relationships between<br>economic value-added and the two<br>common indexes of accounting, namely,<br>actual return of stock and the share of<br>each profit. |
| Soukh Yekan<br>et al.       | 2011  | To select optimal portfolio, ELECTRE<br>method can be utilized through<br>companies` financial ratios and superior<br>ones of each industry can be prioritized<br>regarding their investment in the stock<br>exchange.         |
| Moradzadeh<br>Fard et al.   | 2012  | Investigating the efficiency of fuzzy<br>hybrid approach, AHP and Tapsis models<br>for evaluating the performance.   |
| Mousazadeh<br>Abbasi et al. | 2012  | Presenting a modern model in financial ranking and evaluating of companies   |

| Fallah Shams<br>and Atai | 2012 | The performance of 50 companies listed<br>in the Tehran stock exchange is different<br>using M3, SORTINO and ERVO criteria<br>and none of the mentioned criteria showed<br>the better performance of investigated<br>companies in the market. |
|--------------------------|------|---|
| Mir Ghafouri<br>et al.   | 2013 | Using Gray Theory and considering<br>identified indexes, Telecommunication<br>company of Yazd province, East<br>Azarbaijan and Qom had the most<br>efficiency.  |
| Farshid<br>Karimi        | 2015 | Predicting stock exchange indexes<br>through ANN hybrid model as well as<br>genetic algorithm, finally led to the<br>designing of a model.  |
| Abdolreza<br>Karimi      | 2017 | Identifying and ranking productivity index<br>of working teams in the hospital using<br>ANP-BWM approach, case of study:<br>Sajjad Hospital of Tehran   |
| Shohreh<br>Zehkesh       | 2018 | Designing a model using financial ratios for evaluating companies` performance  |

#### **B.** Foreign Studies

| Yumura et al.                | 1996 | The superiority of economic value-added to traditional accounting indexes  |
|------------------------------|------|--|
| Qahraman et<br>al.           | 2004 | Ranking banks through using equal evaluation cards, Tapsis and FAHP.   |
| Yong Huang                   | 2007 | Performance evaluation, as a multi<br>attribute decision making issue, selects a<br>way from among possible several ways.  |
| Ertugrul and<br>Gargash Oglu | 2009 | Using FAHP and Tapsis, a hybrid method<br>for evaluating companies` performance<br>could be presented.   |
| Yalkin et al.                | 2012 | Ranking companies listed in the stock<br>exchange of Turkey using fuzzy approach,<br>Tapsis and Vikor  |
| Balzentis et<br>al.          | 2012 | Using multi attribute fuzzy decision<br>making techniques. They evaluated<br>Lithuania economic parts based on<br>financial ratios.                                  |
| Lee et al.                   | 2012 | In a study, they compared the financial<br>status of four carriage companies in<br>Taiwan and Korea using some of the multi<br>attribute decision making techniques. |
| Egnatius et al.              | 2012 | Evaluating the financial performance of<br>Iranian car factories listed in Tehran stock<br>exchange using multi attribute decision<br>making techniques              |

| Bayraktaroglu<br>and Yalkin | 2013 | They evaluated the financial strategic<br>performance of 17 companies listed in<br>Istanbul stock exchange and using FAHP<br>method as well as VIKOR technique, they<br>ranked the studied companies. |
|-----------------------------|------|---|
| Park et al.                 | 2014 | Cost reducing strategies  |
| Dighe A and<br>Yucheng      | 2015 | Using ANP method for evaluating the performance   |
| Mangala et al.              | 2015 | Using fuzzy approach and AHP for ranking the companies  |
| Rezaie                      | 2016 | Using BWM for evaluating the companies  |
| Gu and Zhao                 | 2017 | Developing BWM for evaluating the companies and adding fuzzy logic to that.   |

#### **Overall Purpose**

Presenting a model for evaluating and predicting the performance using financial criteria of ISM and BWM methods

# Secondary Purposes

- **1.** Identifying the ability of ISM in recognizing performance evaluation criteria
- **2.** Identifying the amount of effect of various criteria on performance evaluation
- **3.** Identifying the best financial criteria affecting the performance
- **4.** Identifying the amount of ability of BWM model in evaluating and predicting the performance
- **5.** Comparison of various criteria for evaluating the performance

# **Research Questions**

# Main Question of the Study

Which model can be presented to evaluate and predict companies' performance using the integration of various financial criteria of ISM method?

#### Secondary Questions of the Study

- **1.** Do financial criteria of ISM method have the ability of predicting companies` performance?
- **2.** What are the most important financial criteria affecting companies` performance?
- **3.** What is the appropriate model for evaluating companies` performance?
- **4.** How much is the ability of each criteria in evaluating the performance?
- **5.** How much is the ability of BWM model in evaluating and predicting the performance?

### **Performance Evaluation Indices**

Since long ago, the existing approaches toward performance criteria have led to various studies in order to achieve an appropriate criteria for evaluating the performance of companies and managers to be assured about their company's align movement with actual investors' earnings; this has been a basis for taking economic decisions by potential investors and creditors. The results of these studies have led to the presentation of five approaches related to the performance criteria as stated in the following:

# Accounting Approach

In this approach, for evaluating the performance, use is made of included figures in the financial statements such as earnings, earnings per share, operating cash flow, return on assets and the return of shareholder's equity.

# **Economic Approach**

Based on this approach, in which economic concepts are used, the trading center's performance is evaluated with an emphasis on the profitability of the company's assets and regarding the rate of return and used rate of capital cost. Economic value-added, refined economic value-added and the market's value-added are placed in this group.

# **Consolidation Approach**

In this approach, an integration of accounting data and market is used for evaluating the performance; for example, Tobin s q ratio and P/E ratio <sup>[3]</sup>.

# Financial Management Approach (Risk Focused Approach)

According to this approach, mostly financial management theories such as CAPM as well as risk and return concepts are utilized. The main focus of this approach is on determining the excess return of each share.

### Modern Approaches

Modern liquidity methods include comprehensive liquidity index and cash conversion cycle criteria.

In this research, considering previous researches, 50 ratios related to the experts` views have been extracted as stated in the following:

1. Cash Value-Added (CVA): Cash value-added is referred as the surplus cash, which is obtained after discounting the capital in cash costs from the operating income cash. This surplus cash is sometimes referred as the surplus cash earning <sup>[4]</sup>.

Cash value-added= Operating income cash after discounting the taxes- capital in cash costs

Operating income cash after discounting the taxes= cash resulting from operational activities- the taxes of operating income cash after discounting the taxes

Capital in cash costs= the paid earning+ dividend payout ratio

#### 2. Comprehensive Liquidity Index

This index solves the problem related to not considering the current assets` liquidity degree and the time of refunding current debts through calculating the weighted mean of the current ratio.

The details of this model are as the following:

Each current asset receives a certain weight regarding its liquidity degree and their adjusted amount is then calculated. The weight of each asset equals to:

The reversion of assets` turnover ratio

The cash receives the coefficient of one, due to the fact that it is cash in its essence, so it doesn't need any adjustments.

Since company's claims has a one phase distance to be cash, it is adjusted.

The stock in hand is adjusted since it should change to receivable accounts and then to cash.

The adjusted coefficient is calculated for each current debt whose adjusted amount is calculated, as well.

Comprehensive liquidity index is calculated as follows:

ACR= ACA / LCA

In which: ACR= Comprehensive Liquidity Index ACA= Adjusted Current Asses LCA= Adjusted Current Debts

**3.** Cash Conversion Cycle Index: Gitman (1974) defined the cash conversion cycle as the vital part of managing working capital. Cash conversion cycle is a net time between paying debts and receiving cash from the place of collecting debts. In case this period takes shorter, the company would have a better liquidity. The formula of calculating cash conversion index is as the following:

CCC = OC - PP OC = INVP + RP PP = PA / DCOGS In which: CCC = cash conversion cycle OC= operating cost RP= collecting debt period INVP= Keeping stock in hand period PA= remaining payable account DCGS= cost of goods sold (daily COGS/360)

 Net Cash Balance Index: This is a new index identified for determining company's liquidity position. In this index, cash balance as well as securities' exchange are considered to show the liquidity position of the company. It indicates the real liquidity reserve of the company in relation to unpredicted needs. Calculating net cash balance is done as the following:

#### NLB= (CASH+MKT-AP)/TA

In which: NLB: Net cash balance Cash: ready money MKT: marketable securities exchange AP= Payable notes TA= total of assets

**5. Tubin's q:** Tubin's q is among consolidation criteria which is based on accounting studies and market data. According to many researchers' beliefs, it is the best criteria for measuring the performance and company's capitalization. Tubin's q is calculated as THE following:

Tubin's q ratio= market capitalization / replacement value or the book value of the company's assets

6. Return on Assets` Rate (ROA): Return on assets` rate is defined as the ratio of net earnings for ordinary investors to the sum of measured assets. This ratio is one of the profitability ratios whose overall purpose is measuring the amount of institution`s ability or inability in using company`s financial resources. The specific purpose behind measuring asset return is actually measuring the overall profitability of the assets<sup>[5]</sup>.

ROA= net earnings of ordinary investors/ all assets

7. The Return Rate of Shareholders' Equity (ROE): The return rate of stakeholders' equity is calculated through dividing the net earnings belonging to the ordinary investors to the shareholders' equity.

ROE= net earnings of ordinary investors/ shareholders` equity

This ratio shows that how much earning is obtained during a year for each unit of shareholders` equity. In fact, ROE states the profitability ratio of a company.

8. P/E Ratio: This means the ratio of the price to the income of each earning indicating the ratio of time needed for the return of the principle of investment from coming income earnings.

P/E= market price of each share/ earnings per share

**9. Earnings Per Share (EPS):** One of the main factors of the superiority of a share is the amount of its profitability. Considering the fact that the number of distributed shares by the companies is different, the profitability amount of each share is calculated through the profit ratio of each share. Having calculated this

number, the earnings obtained by a company for an ordinary share in a specific period is identified.

EPS= (earnings after discounting the debts- the share of blue-chip stocks)/ distributed ordinary shares` number

**10. Economic Value- Added (EVA):** EVA was firstly used by Stern Stewart in 1980, and is one of the remaining profit indexes after discounting all costs such as debts costs and capital's costs. Stewart declared that in case operating profitability could be increased without adding any extra capitals, or if it be possible to invest on projects that have more overall earnings than capital costs, then EVA would be increased <sup>[3]</sup>.

EVA is as the following: CAPITAL/R=NOPAT ×CAPITAL→R×CAPITAL−C×CAPITAL EVA=(R-C) R is the rate of capital`s return and C is the weighted average cost of capital (WACC). NOPAT= Net operating profit after tax at the end of t period

**11. Refined Economic Value Added (REVA):** In the above section as well as part 10, net book value of the assets was utilized for determining the used capital cost. In case daily value of the assets is utilized instead of net book value of the assets, the obtained amount would indicate refined economic value added <sup>[5]</sup>.

REVA-  $(\gamma - C) \times M$  capital t-1

M Capital shows the market value of company's assets

And C shows the capital cost, which is obtained through calculating the weighted arithmetic mean based on market values.

**12. Market Value Added (MVA):** Stwart has defined market's value added as the ratio of surplus value of the capital market to its book value.

MVA= company`s market value – working capital

Market's value added is a reflection of the accumulated wealth for the investors. According to MVA index, operationally, market evaluation is the effective use of a company's manager, who has used rare resources, thus has stabilized his own status in the company.

MVA has been derived from EVA concept. Net EVA is the current value of a company and MVA equals to the current overall value that is expected from the company in near future; therefore, MVA is an estimation of the current value that is expected from EVA <sup>[4]</sup>.

**13. Capital Cost:** Conceptually, capital cost of a company is the investment opportunity cost for investing in that company through estimating the weighted arithmetic mean of that company's capital cost. It seeks to quantify the average return expected from all investors which

includes the debts related to short term and long term creditors to whom, profit belongs as well as blue-chip investors and ordinary ones. In this model, company's capital cost is calculated through weighted arithmetic mean whose weights are determined based on utilized capital's various resource values. In the following equation, a common formula has been shown for estimating the weighted arithmetic mean of a company's capital cost.

#### WACC=wi\*kj

In the mentioned model: WACC= the weighted arithmetic mean of company`s capital cost W= the weight of each part of resources

K= expected return of each resource

#### **Risk Focused Criteria**

14. Beta: Beta index, as one of the risk measuring indexes, has been used since 1980. Beta coefficient is a criterion for calculating systematic risk and can be considered as an index for rating various assets` risks. If beta coefficient of an asset be more than one, its fluctuations in the return would have a more share of market fluctuations, which is called high risk asset. In contrary, assets having a beta coefficient less than one would be considered as fluctuations less than market`s, which is called low risk asset.

$$eta_i = rac{ ext{cov}(r_i,r_m)}{\sigma^2(r_m)}$$

In which, ri is the representative of the share return process and rm is representative of market return, the numerator is the covariance of these two and the denominator is the standard deviation.

**15. Excess Return:** The difference between company's average return and basis return is called excess return. This difference is called ex post alpha or differential return and is indicated as the following:

#### Excess return= company`s return- basic return

Basic return can include industry's overall return and company's overall return.

**16. Trainer:** This criterion is close to the ex post alpha and its other name is the ratio of return to volatility.

# The ratio of excess return to volatility= excess return÷ beta

**17. Sharp:** This criterion is similar to trainer criterion, though in the denominator part, standard deviation of the company's return is utilized instead of beta.

The ratio of excess return to vitality= excess return÷ standard deviation

18. Evaluation ratio: This ratio is also referred as the information ratio, since as the benefit ratio, it evaluates the considered cost which reduces the quality of investor's information through nonsystematic risk <sup>[6]</sup>. Evaluation ratio= Excess return for accepting

# nonsystematic risk ÷ nonsystematic risk

#### Liquidity ratios

- 19. Current ratios:Current assets ÷ current debts
- 20. Acid ratio: (Current assets-stock in hand) ÷ current debts
- 21. Cash ratio:
  - (Cash+ short-term investments) ÷ current debts
- 22. The ratio of operating cash flows to the sale: The ratio of operating cash flows  $\div$  sale
- 23. The ratio of operating cash flows to all assets: The ratio of operating cash flows ÷ all assets
- 24. The ratio of operating cash flows to all debts The ratio of operating cash flows ÷ all debts
- 25. The ratio of operating cash flows to the current debts: The ratio of operating cash flows ÷ the current debts

# **Debt ratios**

- 26. The ratio of the sum of debts to all assets: The sum of debts ÷ the sum of assets
- 27. The ratio of the current debts to the sum of debts: Current debts÷ the sum of debts
- 28. Shareholders` equity to the sum of all debts: The sum of shareholders` equity÷ the sum of debts
- 29. The ratio of interest coverage: Earnings before interest and taxes ÷ the cost of interest

#### Efficiency ratios

- 30. The ratio of asset turnover: Sale ÷ the sum of assets
- 31. The turnover ratio of the current assets: Sale ÷ the sum of the current assets
- 32. The turnover ratio of the fixed assets: Sale  $\div$  the net value of fixed assets
- Turnover ratio of long term assets: Sale÷ long terms assets (total asset-current asset)
- 34. Turnover ratio of payable accounts: Sale ÷ payable accounts
- 35. Average period of collecting debts: Average of collecting debts \*360 ÷ net sales on account
- 36. Turnover ratio of the stock in hand: Sold goods` prime cost ÷ stock in hand
- 37. Turnover ratio of the working capital: Sale÷ (current assets – current debts)
- 38. Turnover ratio of shareholders` equity:

Sale ÷ the sum of shareholders` equity

#### **Profitability ratios**

- 39. The ratio of gross profit to the sale: Gross profit (sale- sold goods` prime cost) ÷ sale
  40. The ratio of profit before tax: Financial costs (operating profit) + the profit before the tax ÷ sale
- 41. The ratio of net profit: Net profit (specific profit and loss after tax)÷ sale
- 42. The ratio of the profit before tax to the shareholders` equity:
  - Pretax profit ÷ the sum of shareholders` equity
- 43. The ratio of public and administrative costs to the sale:

Public and administrative costs÷ sale

#### The ratios of assets` structure

- 44. The ratio of the current assets to the sum of assets: Current asset÷ the sum of assets
- 45. The ratio of long term assets to the sum of assets: Long term assets ÷ the sum of assets
- 46. The ratio of liquidity to the current assets: Cash+ long term investment ÷ current assets

# Growth ratios

- 47. The growth rate of assets:(the sum of assets at the end of period- the sum of assets at the beginning of the period) ÷ the sum of assets at the beginning of the period
- 48. The rate of net profit's growth: (net income at the end of the period- net income at the beginning of the period) ÷ net income at the beginning of the period
- 49. Sale growth rate:

(sale at the end of period- sale at the beginning of the period)  $\div$  sale at the beginning of the period

[7]

#### Introducing Research Factors

This study included 50 indexes in 6 groups of the main criteria, which have been introduced in Table 1-4.

| Table 1-4: The results of primary evaluation |                               |                                |  |  |
|--|-------------------------------|--------------------------------|--|--|
| Row  | Criteria                      | Sub-criteria                   |  |  |
| 1  | Cash value added              | Consolidation<br>(C1)          |  |  |
| 2  | Comprehensive liquidity index |                                |  |  |
| 3  | Cash conversion cycle         |                                |  |  |
| 4  | Net cash balance              |                                |  |  |
| 5  | Tubin`s q                     |                                |  |  |
| 6  | P/E                           |                                |  |  |
| 7  | Capital cost                  |                                |  |  |
| 8  | EVAE                          | Economic and risk focused (C2) |  |  |
| 9  | REVA                          |                                |  |  |
| 10   | MVA                           |                                |  |  |
| 11   | Beta                          |                                |  |  |

| 12 | Excess return                        |                    |
|----|--------------------------------------|--------------------|
| 13 | Trainer                              |                    |
| 14 | Sharp                                |                    |
| 15 | Evaluation ratio                     |                    |
| 16 | Current ratio                        | Liquidity (C3)     |
| 17 | Acid ratio                           |                    |
| 18 | Cash ratio                           |                    |
| 10 | The ratio of operating cash flow to  |                    |
| 19 | the sale                             |                    |
| •  | The ratio of operating cash flow to  |                    |
| 20 | the asset                            |                    |
|    | The ratio of operating cash flow to  |                    |
| 21 | the debt                             |                    |
|    | The ratio of operating cash flow to  |                    |
| 22 | the current debt                     |                    |
| 23 | Liquidity to the current asset       |                    |
| 23 | Debt to the asset                    |                    |
| 25 | Current debt to the all debt         |                    |
| 26 | Capital to the debt                  |                    |
| 20 | Current asset to the all assets      | Leverage (C4)      |
| 28 | Long term assets to the all assets   | Levelage (C+)      |
| 20 | Assets` growth rate                  |                    |
| 2) | Assets growin rate                   |                    |
| 30 | Turnover of the asset                | Activity (C5)      |
| 31 | Turnover of the current asset        | neuvily (es)       |
| 32 | Turnover of the fixed asset          |                    |
| 33 | Turnover of the long term asset      |                    |
| 34 | furnover                             |                    |
| 5. | The average period of collecting     |                    |
| 35 | debts                                |                    |
| 36 | Turnover of the stock in hand        |                    |
| 37 | Turnover of the working capital      |                    |
| 0, | Turnover of the shareholders`        |                    |
| 38 | equity                               |                    |
| 39 | Sale growth rate                     |                    |
| 40 | Interest coverage ratio              | Profitability (C6) |
| 41 | Gross profit to the sale             | 1101111011119 (00) |
| 42 | The ratio of profit before the tax   |                    |
| 43 | The ratio of pet profit              |                    |
| 44 | The profit before tax to the capital |                    |
|    | Administrative and public costs to   |                    |
| 45 | the sale                             |                    |
| 46 | ROA                                  |                    |
| 47 | The return of shareholders` equity   |                    |
| 48 | The profit of each share             |                    |
| 49 | Net profit's growth rate             |                    |
| ., | rice prome o growin nuce             |                    |

# METHODOLOGY

This research was descriptive-analytical in terms of data collection and it was applied regarding the categorization of the research based on its purpose. An applied research is a study in which the theories, use special laws, principles and techniques for solving administrative and real problems. The current research was descriptive in terms of categorizing based on the method. Among various descriptive researches, this study was correlational since it investigated the relationship between criteria as well as the company's performance.

Library studies have been utilized for investigating the literature of the research and for exploring the background of the study. Field studies were used as the method for collecting the real data of the variables. Information related to the organizational investors, their performance and other mentioned variables were extracted through referring to the stock exchange organization as well as using experts` views, Pars Portfolio software and descriptive notes of companies` financial statements. To analyze the collected data and BWM output, Lingo software was used.

# RESEARCH FINDINGS The Results of ISM Method The Formation of Structural Similarity Index Matrix

In the first step, SSIM was formed using respondents` ideas. To form SSIM of the experts, the criteria were considered as pairs with each other and the respondents responded to the pair comparisons according to the below spectrum.

- V: Row factor of i leads to the emergence of j column.
- A: Column factor of j leads to the emergence of i row.
- X: Both row and column factors leads to the emergence of each other (i and j factors have a mutual relationship).
- O: There is no relationships between i and j factors.

SSIM has been presented in Table 2-4.

| Table 1. Structural similarity index matrix |                   |   |   |   |   |   |  |  |  |
|---|-------------------|---|---|---|---|---|--|--|--|
|   | C1 C2 C3 C4 C5 C6 |   |   |   |   |   |  |  |  |
| C1  |                   | 0 | Х | 0 | А | А |  |  |  |
| C2  |                   |   | А | 0 | 0 | А |  |  |  |
| С3  |                   |   |   | 0 | Х | 0 |  |  |  |
| C4  |                   |   |   |   | Х | V |  |  |  |
| C5  |                   |   |   |   |   | X |  |  |  |
| C6  |                   |   |   |   |   |   |  |  |  |

#### The Formation of Elementary Matrix

In the second step, the elementary matrix was formed through converting SSIM to zero and one numbers. To do so, the following rules were used:

- In case the sign of ij home be V, number 1 should be placed and for the opposite home, zero number should be placed.
- If the sign of ij home be A, zero number would be placed for that home and number 1 would be placed for the opposite home.
- If the sign of ij home be X, number 1 would be placed for that home and number 1 would also be placed for the opposite home.
- If the sign of ij home be O, zero number would be placed for that home and zero number would be placed for the opposite home, as well.

Elementary matrix has been presented in Table 2.

 Table 2. Elementary matrix

|    | C1 | C2 | C3 | C4 | C5 | C6 |
|----|----|----|----|----|----|----|
| C1 | 0  | 0  | 1  | 0  | 0  | 0  |
| C2 | 0  | 0  | 0  | 0  | 0  | 0  |
| C3 | 1  | 1  | 0  | 0  | 1  | 0  |
| C4 | 0  | 0  | 0  | 0  | 1  | 1  |
| C5 | 1  | 0  | 1  | 1  | 0  | 1  |
| C6 | 1  | 1  | 0  | 0  | 1  | 0  |

The Formation of the Adjusted Elementary Matrix

Having obtained SSIM, its internal adjustability should be confirmed. For example, if variable 1 led to variable 2, and variable 2 led to variable 3, then variable 1 should lead to variable 3. In case the accessibility was difficult in the matrix, then the matrix should be improved and such relationships should be made. Thus adjustability was added to the elementary matrix using secondary relationships that may not exist. Regarding Table 3, cells that have been shown with 1\*, indicated those relationships that have been formed in the adjusted matrix.

| Table 3. Adjusted elementary matrix |    |    |    |    |    |    |                      |
|-------------------------------------|----|----|----|----|----|----|----------------------|
|                                     | C1 | C2 | C3 | C4 | C5 | C6 | Penetration<br>Power |
| C1                                  | 1  | 1* | 1  | 0  | 1* | 0  | 4                    |
| C2                                  | 0  | 1  | 0  | 0  | 0  | 0  | 1                    |
| C3                                  | 1  | 1  | 1  | 1* | 1  | 1* | 6                    |
| C4                                  | 1* | 1* | 1* | 1  | 1  | 1  | 6                    |
| C5                                  | 1  | 1* | 1  | 1  | 1  | 1  | 6                    |
| C6                                  | 1  | 1  | 1* | 1* | 1  | 1  | 6                    |
| Dependence<br>Amount                | 5  | 6  | 5  | 4  | 5  | 4  |                      |

# Determining the Factors` Levels

In this step, the sum of input criteria (prerequisites) and output criteria (access) were calculated for each criteria and then the common factors were identified. In this step, the criteria had the highest level whose output (access) set equaled to the common set. Having identified this variable or variables, their row and column were deleted from the table and the operations were replicated on the other criteria. The inputs and outputs were extracted from adjusted elementary matrix (Table 4-4). To do so, the 1 numbers of each row showed the outputs and the 1 numbers of each column equaled to the inputs; to determine the first row, the results have been presented in Table 4-5.

Table 4. Level 1 criteria

| Name of the criteria | Output                | Input                 | Commonalities      | Level |
|----------------------|-----------------------|-----------------------|--------------------|-------|
| C1                   | C1-C2-C3-C5           | C1-C3-C4-C5-C6        | C1-C3-C5           |       |
| C2                   | C2                    | C1-C2-C3-C4-C5-<br>C6 | C2                 | 1     |
| C3                   | C1-C2-C3-C4-C5-<br>C6 | C1-C3-C4-C5-C6        | C1-C3-C4-C5-<br>C6 |       |
| C4                   | C1-C2-C3-C4-C5-<br>C6 | C3-C4-C5-C6           | C3-C4-C5-C6        |       |
| C5                   | C1-C2-C3-C4-C5-<br>C6 | C1-C3-C4-C5-C6        | C1-C3-C4-C5-<br>C6 |       |
| C6                   | C1-C2-C3-C4-C5-<br>C6 | C3-C4-C5-C6           | C3-C4-C5-C6        |       |

In Table 4, level 1 criteria have been extracted that included C2 criterion. Now, to determine second level criteria, it sufficed to delete the row and column of this criterion from that of adjusted elementary matrix (Table 4-4) and do the output and input determination calculations again. The results have been presented in Table 4-6.

| Table 5. Level 2 criteria  |                    |                    |                |       |  |  |
|----------------------------|--------------------|--------------------|----------------|-------|--|--|
| Name of<br>the<br>criteria | Output             | Input              | Commonalities  | level |  |  |
| C1                         | C1-C3-C5           | C1-C3-<br>C4-C5-C6 | C1-C3-C5       | 2     |  |  |
| C3                         | C1-C3-C4-<br>C5-C6 | C1-C3-<br>C4-C5-C6 | C1-C3-C4-C5-C6 | 2     |  |  |

| C4 | C1-C3-C4-<br>C5-C6 | C3-C4-<br>C5-C6    | C3-C4-C5-C6    |   |
|----|--------------------|--------------------|----------------|---|
| C5 | C1-C3-C4-<br>C5-C6 | C1-C3-<br>C4-C5-C6 | C1-C3-C4-C5-C6 | 2 |
| C6 | C1-C3-C4-<br>C5-C6 | C3-C4-<br>C5-C6    | C3-C4-C5-C6    |   |

In Table 5, level 2 criteria have been extracted that included C1, C3 and C5 criteria. Now, to determine the third level criteria, the row and column of these 3 criteria should be deleted from adjusted elementary matrix (Table 4-4) and the input and output determination calculations had to be done again. The results have been presented in Table 4-7.

| Table 6. Level 3 criteria |        |       |               |       |  |  |  |
|---------------------------|--------|-------|---------------|-------|--|--|--|
| Name of the<br>criteria   | Output | Input | Commonalities | Level |  |  |  |
| C4                        | C4-C6  | C4-C6 | C4-C6         | 3     |  |  |  |
| C6                        | C4-C6  | C4-C6 | C4-C6         | 3     |  |  |  |

#### Interpretive Structural Modeling (ISM)

In the fifth step, ISM was drawn using the obtained levels of the criteria. In case there was a relationship between i and j variables, this relationship would be indicated using a directional arrow.

The final diagram has been shown in Figure 4-1, in which, encroachment forms have been deleted and levels have been departmentalized.



Figure 1. Research's ISM model

Considering Figure 1, the research model included 5 levels, regarding which, two criteria of S and T were in the fifth level and were amongst the most effective criteria. Level 1

of this model belonged to three criteria including F, G and I, which were impressionable criteria.

#### Mic Mac Analysis

Moreover, in terms of penetration power and dependency, research model could be shown as Figure 2. Accordingly, only C2 criterion was of dependent kind; such variables have a strong dependency and weak conduction and they

have a high impression and less effect on the system. Other criteria were of intermediary kind and had high dependency and high conductivity, which means that the impression and effect of such criteria were really high; every small change in these variables, would lead to essential changes in the system



Figure 2. Penetration power-dependency matrix

# Determining the Weight and the Importance of Factors

In this part, the weight and importance of criteria and subcriteria of the research were determined using BWM model. The primary steps of this method included the determination of the most important and the least important criteria and sub-criteria. In this research, the most important and the least important criteria and sub-criteria were excluded using experts` views; the results have been presented in Table 7.

| Table7.Timportant crite      | he most importa<br>eria                      | nt and the least                                |
|------------------------------|--|---|
| Group                        | The most<br>important (the<br>best criteria) | The least<br>important (the<br>worst criteria)  |
| Main criteria                | Profitability                                | Leverage  |
| Consolidation                | Tobin`s q                                    | Net cash balance                                |
| Economic and<br>risk focused | EVA  | Sharp   |
| Liquidity                    | Current ratio                                | The ratio of operating cash flow to the assets  |
| Leverage                     | The ratio of assets`<br>growth               | The ratio of the current debts to the all debts |
| Activity                     | Inventory turnover                           | Fixed assets` turnover                          |
| Profitability                | The dividend of each share                   | Pre-tax income to the assets                    |

In the next step, the pair comparisons of the best criterion with other criteria (BO) and the pair comparison of the other criteria with the worst criterion (OW) were formed and accommodated to 6 experts so that they could respond to the pair comparisons. After responding, the pair comparisons were integrated using arithmetic mean method so that their weight could be determined through entering into BWM method algorithm, which have been presented in the following parts.

#### Calculating the Weight of Main Criteria

To calculate the weight of main criteria, firstly the pair comparison of the best criterion "profitability" was formed with other criteria. Similarly, the pair comparison of other criteria was formed with the worst criterion, which was "leverage". Pair comparison results of the main criteria have been presented in Table 8. This table shows the arithmetic mean of 6 experts` views.

| Table 8. Pair comparison of the main criteria |   |                           |                                     |  |  |  |
|---|---|---------------------------|-------------------------------------|--|--|--|
| во  | The most<br>important:<br>Profitability | OW                        | The least<br>important:<br>Leverage |  |  |  |
| Consolidation                                 | 2.621                                   | Consolidation             | 4.442                               |  |  |  |
| Economic and risk focused                     | 4.642                                   | Economic and risk focused | 2.289                               |  |  |  |
| Liquidity                                     | 3.302                                   | liquidity                 | 2.884                               |  |  |  |
| Leverage                                      | 9.000                                   | leverage                  | 1.000                               |  |  |  |
| Activity                                      | 4.610                                   | Activity                  | 2.828                               |  |  |  |
| Profitability                                 | 1.000                                   | Profitability             | 9.000                               |  |  |  |

Considering Table 8, the linear model of BWM regarding the main criteria was formed as follows:

 $\begin{array}{l} \min z \\ |W6-2.621 \times w1| \leq z \\ |W6-4.642 \times w2| \leq z \\ |W6-3.302 \times w3| \leq z \\ |W6-9 \times w4| \leq z \\ |W6-4.61 \times w5| \leq z \\ |w1-4.442 \times W4| \leq z \\ |w2-2.289 \times W4| \leq z \\ |w3-2.884 \times W4| \leq z \\ |w5-2.828 \times W4| \leq z \\ w1+w2+w3+w4+w5+w6=1 \\ \end{array}$ 

The above model has been solved in Lingo software, whose output has been presented in Figure 4-1.

| Variable | Value         | Reduced Cost |
|----------|---------------|--------------|
| Z        | 0.2772955E-01 | 0.000000     |
| W6       | 0.4363494     | 0.000000     |
| W1       | 0.1770618     | 0.00000      |
| W2       | 0.9997392E-01 | 0.00000      |
| W3       | 0.1405448     | 0.00000      |
| W4       | 0.4540220E-01 | 0.00000      |
| W5       | 0.1006679     | 0.00000      |

Figure 3. The output of BWM model's criteria in Lingo software

Considering Figure 3, profitability criterion having the weight of 0.436 obtained the first ranking; consolidation and liquidity criteria, having the weights of 0.177 and 0.141 obtained the second the third rankings, respectively. Moreover, adjustability rate (Z) of this pair comparison was 0.027, showing a high adjustability.





Calculating the Weight of Consolidation Sub-Criteria Consolidation criterion had 7 sub-criteria, whose pair comparisons have been presented in Table 9. This pair comparison table has been derived out of arithmetic means of 6 experts' views.

| Table 9. | Pair | comparison | of | consolidation | sub- |
|----------|------|------------|----|---------------|------|
| criteria |      |            |    |               |      |

| во                                      | The most<br>important:<br>Tubin`s q | OW                                   | The least<br>important: Net<br>cash balance |
|---|-------------------------------------|--------------------------------------|---|
| Cash value-<br>added                    | 3.557                               | Cash value-<br>added                 | 3.175                                       |
| Comprehen<br>sive<br>liquidity<br>index | 3.888                               | Comprehens<br>ive liquidity<br>index | 2.884                                       |
| Cash<br>conversion<br>cycle             | 3.813                               | Cash<br>conversion<br>cycle          | 3.302                                       |
| Net cash<br>balance                     | 9.000                               | Net cash<br>balance                  | 1.000                                       |
| Tubin`s q                               | 1.000                               | Tubin`s q                            | 9.000                                       |
| P/E                                     | 2.621                               | P/E                                  | 4.610                                       |
| Asset cost                              | 3.147                               | Asset cost                           | 3.813                                       |

Considering Table 9, the linear model of BWM's consolidation sub-criteria was formed as the following.

min z  $|W5-3.557 \times w1| \le z$   $|W5-3.888 \times w2| \le z$   $|W5-3.813 \times w3| \le z$   $|W5-9 \times w4| \le z$   $|W5-2.621 \times w6| \le z$   $|W5-3.147 \times w7| \le z$   $|w1-3.175 \times W4| \le z$   $|w2-2.884 \times W4| \le z$   $|w3-3.302 \times W4| \le z$   $|w6-4.61 \times W4| \le z$   $|w7-3.813 \times W4| \le z$ w1+w2+w3+w4+w5+w6+w7=1

The above model was solved in Lingo software, whose output has been presented in Figure 4-2.

| Variable | Value         | Reduced Cost |
|----------|---------------|--------------|
| Z        | 0.2549468E-01 | 0.000000     |
| W5       | 0.3694336     | 0.000000     |
| W1       | 0.1110285     | 0.000000     |
| W2       | 0.1015762     | 0.000000     |
| W3       | 0.1035742     | 0.000000     |
| W4       | 0.3821544E-01 | 0.000000     |
| W6       | 0.1506785     | 0.000000     |
| W7       | 0.1254936     | 0.00000      |
|          |               |              |

Figure 5. The output of BWM model regarding the consolidated sub-criteria in Lingo software

Considering Figure 5, among the consolidation sub-criteria, Tubin's q having a weight of 0.369, obtained the first ranking. P/E and capital cost criteria, having the weights of 0.151 and 0.125, respectively, obtained the second and third rankings. The adjustability rate of this pair comparison, also, was 0.025.



Figure 6. Consolidated sub-criteria`s weight

# Having used this calculation method, the weights of other sub-criteria were also obtained. Final Weight of Sub-Criteria

Final weight of sub-criteria was obtained through multiplying the weight of criteria in the relative weight of sub-criteria, which have been presented in Table 4-16. This shows that "considering customer's need" had gained the first ranking among all indexes.

| Table 10. Final weight of sub-criteria |               |                              |                      |   |  |         |
|--|---------------|------------------------------|----------------------|---|--|---------|
| Row                                    | Criteria      | Weight<br>of the<br>criteria | Sub-criteria         | Relative<br>weight<br>of sub-<br>criteria | Final<br>weight<br>of sub-<br>criteria | ranking |
| 1                                      | Consolidation | 0.177                        | Cash value-<br>added | 0.111                                     | 0.0196                                 | 17      |
| 2                                      |               |                              | Comprehensive        | 0.102                                     | 0.0181                                 | 20      |
| 3                                      |               |                              | Cash                 | 0.104                                     | 0.0184                                 | 19      |

|          |                     |         | conversion                     |       |         |          |
|----------|---------------------|---------|--------------------------------|-------|---------|----------|
|          |                     |         | cycle<br>Net cash              |       |         |          |
| 4        |                     |         | balance                        | 0.038 | 0.0067  | 43       |
| 5        |                     |         | Tubin`s q                      | 0.369 | 0.0653  | 2        |
| 6<br>7   |                     |         | P/E<br>Asset cost              | 0.151 | 0.0267  | 12       |
| /        | Economic            |         | Asset Cost                     | 0.125 | 0.0221  | 14       |
| 8        | and Risk<br>focused | 0.100   | EVA                            | 0.252 | 0.0252  | 13       |
| 9        |                     |         | REVA                           | 0.124 | 0.0124  | 28       |
| 10       |                     |         | MVA<br>Pote                    | 0.109 | 0.0109  | 31       |
| 11       |                     |         | Capital asset                  | 0.099 | 0.0099  | 33       |
| 12       |                     |         | pricing                        | 0.099 | 0.0099  | 33       |
| 13       |                     |         | Value added                    | 0.092 | 0.0092  | 36       |
| 14<br>15 |                     |         | Sharp                          | 0.095 | 0.0095  | 55<br>48 |
| 16       |                     |         | Evaluation                     | 0.085 | 0.0095  | 40       |
| 10       | <b>T</b> • • ••.    | 0 1 4 1 | ratio                          | 0.085 | 0.0085  | 40       |
| 17       | Liquidity           | 0.141   | Current ratio                  | 0.272 | 0.0384  | 15       |
| 19       |                     |         | Cash ratio                     | 0.142 | 0.0200  | 15       |
|          |                     |         | Operating cash                 |       |         |          |
| 20       |                     |         | flow`s ratio to                | 0.102 | 0.0144  | 25       |
|          |                     |         | the sale<br>Operating cash     |       |         |          |
| 21       |                     |         | flow ratio to                  | 0.052 | 0.0073  | 42       |
|          |                     |         | the asset                      |       |         |          |
| 22       |                     |         | Operating cash                 | 0.107 | 0.0151  | 22       |
| 22       |                     |         | the debts                      | 0.107 | 0.0131  | 25       |
|          |                     |         | Operating cash                 |       |         |          |
| 23       |                     |         | flow ratio to                  | 0.080 | 0.0113  | 29       |
|          |                     |         | the current                    |       |         |          |
| 24       |                     |         | Debts to the                   | 0.102 | 0.01.15 | 24       |
| 24       |                     |         | current asset                  | 0.103 | 0.0145  | 24       |
| 25       | Leverage            | 0.045   | Debts to the                   | 0.126 | 0.0057  | 46       |
|          |                     |         | The current                    |       |         |          |
| 26       |                     |         | debts to the                   | 0.064 | 0.0029  | 50       |
|          |                     |         | overall debts                  |       |         |          |
| 27       |                     |         | The asset to the               | 0.200 | 0.0090  | 37       |
|          |                     |         | The current                    |       |         |          |
| 28       |                     |         | asset to the all               | 0.132 | 0.0059  | 45       |
|          |                     |         | asset                          |       |         |          |
| 20       |                     |         | Long term                      | 0.115 | 0.0052  | 47       |
| 2)       |                     |         | asset                          | 0.115 | 0.0052  | 7/       |
| 30       |                     |         | The growth                     | 0.363 | 0.0163  | 21       |
| 21       | Activity            | 0 101   | rate of asset                  | 0.006 | 0.0007  | 20       |
| 51       | Activity            | 0.101   | Current asset                  | 0.080 | 0.0087  | 39       |
| 32       |                     |         | turnover                       | 0.078 | 0.0079  | 41       |
| 33       |                     |         | Fixed asset                    | 0.035 | 0.0035  | 49       |
|          |                     |         | Long term                      |       |         |          |
| 34       |                     |         | asset turnover                 | 0.101 | 0.0102  | 32       |
| 35       |                     |         | turnover                       | 0.132 | 0.0133  | 26       |
|          |                     |         | The average                    |       |         |          |
| 36       |                     |         | collecting                     | 0.123 | 0.0124  | 27       |
|          |                     |         | debts                          |       |         |          |
| 37       |                     |         | Stock in hand                  | 0.184 | 0.0186  | 18       |
|          |                     |         | turnover<br>Cycling the        |       |         |          |
| 38       |                     |         | working capital                | 0.108 | 0.0109  | 30       |
| 39       |                     |         | Shareholder`s                  | 0.066 | 0.0067  | 44       |
| 40       |                     |         | equity turnover<br>Sale growth | 0.088 | 0.0080  | 38       |
| 70       |                     |         | Suc Slowin                     | 0.000 | 0.0007  | 50       |

| 41 | Profitability | 0.436 | rate<br>Interest<br>coverage ratio | 0.099 | 0.0432 | 5  |
|----|---------------|-------|------------------------------------|-------|--------|----|
| 42 |               |       | Gross profit's ratio to the sale   | 0.149 | 0.0650 | 3  |
| 43 |               |       | Pretax income<br>ratio             | 0.071 | 0.0310 | 11 |
| 44 |               |       | Net profit ratio                   | 0.105 | 0.0458 | 4  |
| 15 |               |       | Pretax income                      | 0.027 | 0.0161 | 22 |
| 43 |               |       |                                    | 0.057 | 0.0101 | 22 |
|    |               |       | Administrative                     |       |        |    |
| 46 |               |       | public costs                       | 0.086 | 0.0375 | 8  |
|    |               |       | ratio to the sale                  |       |        |    |
| 47 |               |       | ROA                                | 0.090 | 0.0392 | 6  |
| 48 |               |       | Shareholder`s<br>equity            | 0.080 | 0.0349 | 9  |
| 49 |               |       | Earnings per<br>share              | 0.205 | 0.0894 | 1  |
| 50 |               |       | Net cash<br>balance                | 0.078 | 0.0340 | 10 |

| Tubin`s a                      | 0.0894               |
|--------------------------------|----------------------|
| rubin 5 q                      | 0.0055               |
| The ratio of net profit        | 0.0458               |
|                                | 0.0432               |
| ROA                            | 0.0392               |
|                                | 0.0384               |
| General administrative costs   | 0.0375               |
| Net profit growth rate         | 0.0349               |
| P/E                            | 0.031                |
| Capital cost                   | 0.0252               |
| Acid ratio                     | 0.02                 |
| Stock in hand turnover         | 0.0196               |
| Comprehensive liquidity index  | 0.0181               |
| Pretax profit to the capital   | 0.0161               |
| Liquidity to the current asset | 0.0145               |
| Turnover                       | 0.0133               |
| REVA                           | 0.0124<br>0.0113     |
| Working capital turnover       | 0.0109               |
| Long term asset turnover       | 0.0102               |
| Beta                           | 0.0099               |
| Excess return                  | 0.0092               |
| Sale growth rate               | 0.0089<br>0.0087     |
| Evaluation ratio               | 0.0085               |
| Operating cash flow to assets  | 0.0073<br>0.0067     |
| Net cash balance               | 0.0067<br>0.0059     |
| Debt to asset                  | 0.0057<br>0.0052     |
| sharp                          | • 0.0046<br>• 0.0035 |
| Current debts to the all debts | • 0.0029             |
|                                | AXIS HUE             |

Figure 12-4. Final weight of sub-criteria

### Aras Technique

Aras<sup>1</sup> method is one of the multiple attribute decision making methods, which means evaluating the cumulative ratio. This method was introduced by Zavadskas and Turskis in 2010. Multiple attribute decision making method of ARAS was based on comparing each item with the ideal presumed amount.

# Forming Decision Matrix

The decision matrix of this method is criterion-item based; it is a matrix in which, criteria are placed in the columns and items are placed in the rows and every cell is the score of each item to the criterion.

#### **Determining Presumed Ideal Amount**

In this step, an assumed item named A0 is created, regarding which, its ideal state is that its amounts for beneficial criteria equal the highest amount of columns and regarding nonbeneficial criteria, its amounts equal the least.

5  $x_0 = \max [x_i]$  [x\_i] , for beneficial criteria

6  $x_0 = \min_{\tau \in \mathbb{Z}} [x_i]$ , for non-beneficial criteria

Converting non-beneficial criteria to beneficial ones

Regarding this step, non-beneficial criteria's entries were reversed so that they could be converted to a beneficial criteria. This process converted the decision making matrix to the positive decision making matrix.

# Normalizing Decision Making Matrix

In this step, the following relation was utilized to normalize the decision matrix.

8

$$x_{ij}^* = \frac{\mathbf{x}_{ij}}{\sum_{i=0}^{m} \mathbf{x}_{ij}}$$

#### Weighing Normal Decision Making Matrix

In this step, normal matrix entries were multiplied to the criteria so that a weighing matrix could be obtained.

9  $\hat{\mathbf{x}}_{ij} = \mathbf{x}_{ij}^* * \mathbf{w}_j$ 

# Calculating Aras Index (S) and the Desirability Degree of Items

Using the following relations in this step, Aras index as well as items` desirability degree were calculated; based on which, final ranking was formed.

<sup>&</sup>lt;sup>1</sup> Additive Ratio Assessmen

10  $S_i = \sum_{j=1}^n \hat{x}_{ij}$ 

$$k_i = \frac{S_i}{S_i}$$

11

# The Results of Aras Method

The purpose behind using Aras method was ranking research items, including 104 companies. The first step of this method was forming decision making matrix. Decision making matrix of Aras method included 49 research indexes as well as 104 companies; every cell of matrix evaluated each company in terms of each index.

In the second step, the assumed ideal amount had to be created based on 5 and 6 relations. In case the criterion had a positive aspect, then the ideal amount would equal to the highest score of that criterion, and if the criterion had a negative aspect, the ideal amount would equal to the least score of that criterion. In this research, though, some of the criteria had an interval or numerical amount as the ideal. The kind of indexes have been presented in table 4-1.

| Table 4-1. Kind of indexes                      |                                       |
|---|---------------------------------------|
| Name of the index                               | Kind of the index                     |
| Cash value added                                | Positive                              |
| Comprehensive liquidity index                   | Positive                              |
| Cash conversion cycle                           | Positive                              |
| Net cash balance                                | Positive                              |
| Tubin`s q                                       | Positive                              |
| P/E   | The less the better 0 <x< td=""></x<> |
| Asset cost                                      | Close to zero 0 <x< td=""></x<>       |
| EVA   | Positive                              |
| REVA  | Positive                              |
| MVA   | Positive                              |
| Beta  | Close to one 0 <x<1< td=""></x<1<>    |
| Excess return                                   | Positive                              |
| Trainer   | Positive                              |
| Sharp   | Positive                              |
| Evaluation ratio                                | Positive                              |
| Current ratio                                   | Close to two 0 <x< td=""></x<>        |
| Quick ratio                                     | Close to one 0 <x< td=""></x<>        |
| Cash ratio                                      | Close to one 0 <x< td=""></x<>        |
| Operating cash flow ratio to the sale           | Positive                              |
| Operating cash flow ratio to the asset          | Positive                              |
| Operating cash flow ratio to the                | Desitive                              |
| current debts                                   | Positive                              |
| Liquidity to the current asset                  | Positive                              |
| The ratio of the debts of the asset             | Close to zero 0 <x<1< td=""></x<1<>   |
| The ratio of the current debts to the all debts | Close to 0.5 0 <x<1< td=""></x<1<>    |
| The ratio of the asset to the debts             | Positive                              |

| The current asset's ratio to the all | Class to $0.5$ , $0 \le V \le 1$    |
|--------------------------------------|-------------------------------------|
| asset                                |                                     |
| Long term asset to the all asset     | Close to zero 0 <x<1< td=""></x<1<> |
| Asset growth rate                    | Positive                            |
| Asset turnover                       | Positive                            |
| Fixed asset turnover                 | Positive                            |
| Long term asset turnover             | Positive                            |
| turnover                             | Positive                            |
| Average period of collecting debts   | Close to zero                       |
| Stock in hand turnover               | Positive                            |
| Cycling the working capital          | Positive                            |
| Cycling the shareholder's equity     | Positive                            |
| Sale growth rate                     | Positive                            |

The third step was using Aras method for converting negative criteria to positive ones based on relation 7. In other words, to convert negative criteria to positive ones, their scores had to be reversed and then, using relation 8, the decision matrix had to be normalized. To normalize, every entry should be divided into the sum of that column's entries. Normalized matrix has been presented in Table 5.

As the fifth step, weighing normal matrix had to be formed. To do so, the criteria's weights, which had been calculated using Entropy method, were multiplied in the normal matrix so that weighing normal matrix could be obtained; this has been represented in Table 6.

In the sixth step, as well, Aras index and items` desirability amounts have been calculated using 10 and 11 relations and based on that, items were ranked; the results of which, have been presented in Table 7 in an ascendant way.

# CONCLUSION AND SUGGESTIONS

Using above mentioned techniques, the best companies` ranking is as the following:

| Table 7. Aras index and ranking the items |             |            |                        |  |
|---|-------------|------------|------------------------|--|
| Rank                                      | Final score | Si         | Company name           |  |
|   | -           | 0.0767     | A0                     |  |
| 50  | 0.108       | 0.0083     | Aabsal                 |  |
| 79  | 0.066       | 0.0050     | AzarAb                 |  |
| 19  | 0.172       | 0.0132     | Alborz Darou           |  |
| 73  | 0.081       | 0.0062     | Electric Khodro Shargh |  |
| 86  | 0.057       | 057 0.0044 | Tractor Forging        |  |
| 00  | 0.037       |            | Company                |  |
| 65  | 0.088       | 0.0068     | Iran Transfo           |  |
| 45  | 0.115       | 0.0088     | Iran Khodro            |  |
| 95  | 0.040       | 0.0031     | Iran Khodro Diesel     |  |
| 26  | 0.152       | 0.0116     | Iran Pharmaceutical Co |  |

| 8        | 0.212  | 0.0163       | Iran Merinus            | 98       | 0.025  | 0.0019       | Saipa Diesel             |
|----------|--------|--------------|-------------------------|----------|--------|--------------|--------------------------|
| 57       | 0.101  | 0.0077       | Irca Part Sanat         | 64       | 0.091  | 0.0070       | Sarma Afarin             |
| 90       | 0.050  | 0.0039       | Behceram                | 29       | 0.147  | 0.0113       | Orumieh cement           |
| 61       | 0.097  | 0.0074       | Behnoush                | 18       | 0.176  | 0.0135       | Isfahan cement           |
| 51       | 0.106  | 0.0081       | Gorji Biscuit           | 39       | 0.126  | 0.0097       | Tehran cement            |
| 56       | 0.102  | 0.0078       | Pars Khazar             | 32       | 0.140  | 0.0107       | Shahroud cement          |
| 100      | 0.002  | 0.0002       | Pars Khodro             | 33       | 0.138  | 0.0106       | Sofian cement            |
| 7        | 0.215  | 0.0164       | Pars Pharmaceutical Co. | 11       | 0.208  | 0.0159       | Sina Darou               |
| 69       | 0.084  | 0.0064       | Pars Suich              | 99       | 0.013  | 0.0010       | Shahdiran                |
| 34       | 0.134  | 0.0103       | Pars Minoo              | 14       | 0.187  | 0.0143       | Shishe & gas             |
| 24       | 0.400  |              | Abadan Petrochemical    | 10       |        | 0.0005       | Darou Pakhsh Pharma      |
| 36       | 0.129  | 0.0099       | Company                 | 48       | 0.111  | 0.0085       | Chem. Co.                |
| 47       | 0.112  | 0.0086       | Iran glass wool company | 82       | 0.065  | 0.0050       | Sina Chemical industry   |
| 24       | 0.160  | 0.0123       | Pegah Azarbaijan        | 102      | -0.009 | -0.0007      | Iran casting industries  |
| 59       | 0.099  | 0.0076       | Pegah Isfahan           | 27       | 0.150  | 0.0115       | Barez industry           |
| 55       | 0.103  | 0.0079       | Pegah Khorasan          | 91       | 0.050  | 0.0038       | Butane industrial group  |
| 103      | -0.141 | -0.0108      | Plascokar saipa         |          | 0.400  | 0.01.40      | Khorramdarreh Minoo      |
| 10       | 0.440  | 0.000        | Tractor manufacturing   | 16       | 0.182  | 0.0140       | Industrial Company       |
| 43       | 0.119  | 0.0092       | company                 |          |        | 0.0155       | Iran refractories        |
| 93       | 0.046  | 0.0035       | Tolypers                | 6        | 0.230  | 0.0177       | company                  |
| 96       | 0.037  | 0.0028       | Charkheshgar            | 38       | 0.127  | 0.0097       | Iran Ferrosilice CO      |
|          | 0.446  | 0.0110       | Aburaihan               | 80       | 0.066  | 0.0050       | Khawar spring            |
| 30       | 0.146  | 0.0112       | Pharmaceutical Co.      | 60       | 0.098  | 0.0075       | Zae spring               |
|          |        |              | Osvah Pharmaceutical    | 3        | 0.240  | 0.0184       | Foolad Khuzestan         |
| 25       | 0.159  | 0.0122       | Co.                     | 4        | 0.239  | 0.0184       | Foolad mobarake isfahan  |
| 37       | 0.127  | 0.0098       | Exir Pharmaceutical Co. | 35       | 0.130  | 0.0100       | Foolad Khorasan          |
|          |        |              | Jaber Ebne Hayyan       | 94       | 0.042  | 0.0032       | Fibreiran                |
| 28       | 0.148  | 0.0114       | Pharmaceutical Co.      |          |        |              | Sugar factory of the     |
|          | 0.475  | 0.0128       | Razak Pharmaceutical    | 41       | 0.124  | 0.083        | world                    |
| 21       | 0.167  |              | Co.                     | 72       | 0.083  | 0.0063       | Alvand tile              |
|          |        |              | Zahravi Pharmaceutical  | 20       | 0.171  | 0.0131       | Pars tile                |
| 12 0.199 | 0.0152 | Co.          | 46                      | 0.112    | 0.0086 | Takceram co. |                          |
|          |        |              | Farabi Pharmaceutical   | 78       | 0.071  | 0.0054       | Hafez tile               |
| 31       | 0.145  | 0.0111       | Co.                     | 75       | 0.078  | 0.0060       | Saadi tile               |
|          |        | 0.080 0.0061 | Loghman                 | 17       | 0.176  | 0.0135       | Sina tile                |
| 74       | 0.080  |              | Pharmaceutical Co.      | 9        | 0.212  | 0.0163       | calcimin                 |
|          |        |              | Kosar Pharmaceutical    | 71       | 0.083  | 0.0064       | Iran carbon              |
| 42       | 0.120  | 0.0092       | Co.                     |          |        |              | Iran combine             |
| 54       | 0.103  | 0.0079       | Doodeh Sanati Pars      | 84       | 0.062  | 0.0047       | manufacturing co.        |
|          |        |              | Negin Tabas Coal        | 23       | 0.1650 | 0.0126       | Mapna group              |
| 52       | 0.105  | 0.0081       | Company                 | 2        | 0.374  | 0.0287       | Gol Gohar                |
| 76       | 0.075  | 0.0058       | Tractor Foundary        | 70       | 0.083  | 0.0064       | Pars Shahab Co.          |
|          |        | 0.125 0.0096 | Mashahd wheel           | 87       | 0.056  | 0.0043       | Pak Dairy co.            |
| 40       | 0.125  |              | manufacturing Co.       | 63       | 0.094  | 0.0072       | Kalber dairy co.         |
| 53       | 0.103  | 0.0079       | Zagros Pharmed Pars Co. | 68       | 0.085  | 0.0065       | Loabiran                 |
| 88       | 0.054  | 0.0042       | Zamyad Co.              | 81       | 0.065  | 0.0050       | Iranlent                 |
| 77       | 0.074  | 0.0057       | Saipa                   | 92       | 0.046  | 0.0036       | Luleh va mashinsazi Iran |
| 44       | 0.118  | 0.0090       | Sajna Azin              | 67       | 0.086  | 0.0066       | Nirou moharekeh          |
|          | ~      |              |                         | <i>.</i> |        |              |                          |

|     |              |                   | machine tools co.        |
|-----|--------------|-------------------|--------------------------|
| 80  | 0.052        | 0.0040            | Vehicle axile            |
| 89  | 0.053 0.0040 | manufacturing co. |                          |
| 66  | 0.088        | 0.0067            | Bahonar Copper           |
| 62  | 0.096        | 0.0074            | Iran Manganese mining    |
| 1   | 0.424        | 0.0325            | Iran mineral salts co.   |
| 5   | 0.227        | 0.0182            | National Iranian Copper  |
| 3   | 0.237        |                   | industry                 |
| 15  | 0.185        | 0.0142            | Daroupakhsh products     |
| 58  | 0.101        | 0.0077            | Mehram                   |
| 22  | 0.166        | 0.0127            | Mehr Cam pars            |
| 83  | 0.063        | 0.0048            | Borujerd textile         |
| 49  | 0.110        | 0.0085            | Nasir machine            |
| 10  | 0.211        | 0.0162            | Behran oil company       |
| 13  | 0.191        | 0.0146            | Pars oil company         |
| 101 | 0.000        | 0.0000            | Navard aluminium         |
| 85  | 0.059        | 0.0046            | Navard rolling and steel |
| 97  | 0.037        | 0.0028            | Tnm co.                  |

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