Ranking Companies by Financial Indices and MADM Technique
(Case study in companies affiliated to national company of petrochemical industries of Iran)

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Abstract: Ranking various companies in various industries can reflect the condition of companies compared to their competitors and it reflects internal strengths and weaknesses and external opportunities and threats of companies. Ranking companies based on financial indices leads to identification of internal and external strengths and weaknesses of companies and it provides planning, execution, supervision, control and improvement of better performance of companies and can compare the performance of a company with other companies and competitors. Thus, most potential investors due to the lack of adequate experience and knowledge can limit or stop their investment. Thus, trading volume is reduced and market efficiency is reduced. Under these conditions, MADM technique’s can consider all these indices in these decisions and they are necessary for guiding investors. The main purpose of study is that by financial indices and operational research techniques, the affiliated companies of national company of petrochemical industries are ranked as this ranking is a reasonable basis for evaluation of financial performance of these companies.

Keywords: Performance assessment, Financial indices, Excellence models of organization

Introduction
During two recent decades, financial performance is one of the attractive issues and this inclination in research and applied fields has led into many innovations. One of the important and applied achievements of performance assessment of companies is ranking of companies and to determine and rank companies, we are obliged to use comprehensive ranking models based on evaluation of financial performance of companies.

Ranking companies based on financial indices leads to identification of internal and external strengths and weaknesses of companies and planning, execution, supervision, control and better performance improvement can be provided and performance of a company is compared with other companies and competitors.

The review of literature using TOPSIS algorithm is as followings. In 2008, some international papers were published using AHP, TOPSIS techniques at the same time and some of them include as “Weapon selection using the AHP and TOPSIS methods under fuzzy environment (Dagdeviren et al., 2008,34). Another study is “Evaluation of Hazardous waste transportation firms by using a two step FUZZY –AHP and TOPSIS methodology (Gaumus , 2008, 8). Other studies were also applied in 2008 as Transshipment site selection using the AHP and TOPSIS (Onut, Semih and Selin soner, 2008; 1552-1559).

The main purpose of this study is ranking affiliated companies of national company of Petrochemical industry by financial indices and operating research techniques namely MADM methods. This ranking creates reasonable basis to evaluate financial performance of these companies.

The ranking goals of affiliated companies of national company of petrochemical industry are summarized as follows:
1-The comparison of company with competitors and each other, determining internal strengths and weaknesses and environmental opportunities and threats to formulate suitable strategies with environment and empowerment of company.
2-Improvement and guidance of performance of top managers of company and its various units based on assessment.
3-Revision about past investment and decision making about new investment based on performance-assessment ranking
4-Helping the creditors in selection of the best companies to give credits
5-Revision and decision making regarding purchase and loyalty of customers to better companies
6- Helping the revision and decision making of government and state organizations regarding support, intervention, encouragement or punishment and guiding the companies.
7-Ranked companies and other financial organizations by results of study can perform accurate financial planning to improve rank of company.

This study attempted to consider domestic and foreign normal conditions about petrochemical industry by financial indices and ranked affiliated companies of national petrochemical industry of Iran. The results were compared and analyzed by MADM method. In terms of study subject, this study is in financial science, math and operational study.

To perform the study, Farvardin 2003 to Esfand 2008 was considered.

**Study method**

The present study is descriptive-analytic in terms of purpose. It describes and achieves information of a definite subject and causal relationship between indices and the effect of indices on each other are investigated. From the process dimension, the study is “quantitative”. It means that with objective attitude collects and analyzes the quantitative data. In terms of method, it is an inductive study, it tries to design a general model based on empirical observations and quantitative data collection. In terms of purpose is an applied study, it tries to solve a specific subject.

By design and formulation of questionnaire, important indices are identified and ranked in terms of the opinion of lecturers and Ph.D. students and MA of accounting and financial management by AHP scale. To evaluate weights of indices and ranking choices (companies) AHP SAW and TOPSIS are used. For analysis of above items and hypotheses test, SPSS 17, Excel2007, ExpertChoice and (2005) TOPSIS are applied.

**Variables**

Variable is anything accepting different values. Independent variable is the one by which dependent variable is determined or predicted and dependent variable is the one observed and measured to determine the effect of independent variable and by introduction, elimination or determining independent variable is appeared, hidden or changed. Dependent variable is the probable effect of independent variables.

Various of this study are financial variables. One of the most important stages of this study is selection and determination of variables (financial indices) creating reasonable basis for ranking companies. Financial indices of this study should have the following features:

- Financial indices should compare the organizations active in similar industries. The goal of computation of each of financial indices should be clear. The data collection methods and calculation of each of financial indices should be defined clearly.
- Ratio financial indices are preferred to absolute values. Financial indices shouldn't be controlled by evaluated organizational unit, objective financial indices are preferred to subjective indices.
- Financial indices should be associated directly with long-term and short-term strategy of company. The indices of non-financial performance should be taken into attention and be selected if possible. This is of great importance about financial indices and by changing environment, indices are also changed. Financial indices should be simple to compute and analyze by users. Financial indices should provide rapid feedback for organization.
- Financial indices should be designed as they can lead to continuous improvement of organization and don’t rely only on simple control and these indices should provide required information of economic analysts and investors.

**Hypotheses**

Hypothesis is a wise guess of solution of a problem, hypothesis is defined as logical relationship between two or some variables as expressed as testing sentence. These relations are visualized based on communication network as rooted in theoretical framework of study.

The hypotheses of present study include:

- Identified financial indices in this study are suitable tools for ranking companies.
- MADM techniques are suitable methods for ranking companies based on financial indices. Sub-hypotheses of second hypothesis are as followings:
  - AHP model is a good tool for ranking companies.
  - TOPSIS model is a good tool for ranking companies.
  - SAW model is a good tool for ranking companies.
  - BORDA method is a good tool to rank companies and compare the above methods.

Results of ranking based on financial indices have significant difference with the results of ranking based on the best MADM methods.

Affiliated companies of national company of petrochemical industries of Iran are dispersed in Iran Geography. The major center of industrial and manufacturing activity of affiliated companies of national company of petrochemical industries in this study are Mahshahr and Asaluye. Some of these companies have central office in Tehran city.
Statistical hypotheses

First statistical hypothesis
H0: Identified financial indices in this study are not suitable tools for companies ranking.
H1: Identified financial indices in this study are suitable tools for companies ranking.

Second statistical hypothesis
H0: MADM techniques are not good methods for ranking companies based on financial indices.
H1: MADM techniques are good methods for ranking companies based on financial indices.

Third statistical hypothesis
H0: The results of ranking based on financial indices are not significantly different from the results of ranking based on the best MADM method.
H1: The results of ranking based on financial indices are significantly different from the results of ranking based on the best MADM method.

Measurement scale
In this study, based on purpose, hypotheses and questionnaire of this study, Likert scale is selected among other scales (Bogardus, Thurston, Guttman, Osgood and combined) and scale 1-9 AHP to fill matrix of pairwise comparison. The specialized questions of questionnaire and pairwise comparison matrices of financial indices and companies are filled with scale 1-9 AHP.

All financial indices of this study are numerical indices as measured in Rial. These weights are used for rank king affiliated companies of national company of petrochemical industry in TOPSIS, SAW decision making methods and required explanation is presented in the following.

Simple cumulative weighting method
This method is the simplest compensation techniques and multi-criteria decision making is important in central measures in descriptive statistics.

After determining importance coefficient of indices based on decision maker opinion or common math methods as weighted mean, importance coefficient of each of choices is achieved and the highest weight is considered as optimal choice (Momeni, 2008, 21). The next measurements include as:

- Formation of decision matrix
- Separation of indices in terms of positive or negative effect on problem purpose.
- Quantification of decision making matrix
- Scalessness of decision making matrix
- Weighting required indices
- Selection of best choice by the following criterion:

TOPSIS method
TOPSIS model is one of the decision making models based on some indices solving many decision making problems for managers and planners.

Briefly in TOPSIS method, matrix n×m with m choices and n criteria is evaluated. In this algorithm, it is assumed that each index and criterion in decision making matrix has uniform increasing or reducing suitability. In other words, many values achieved by criteria in this matrix, if of profit type, the higher its value, the higher its suitability and if it is cost, it has lowest suitability. One of the important benefits of this method is as objective and subjective criteria and indices are used at the same time (John F & Affisco, 1998, 2). In this model, to compute math calculations, all attributed values to criterion are quantitative and if they are qualitative, they are turned into quantitative values (Lolachi, 2005, 2). It is proposed that TOPSIS method is used when available indices and information are limited (Naumann & Felix, 2003, 8). This technique is based on the concept that selective choice has the lowest distance with positive center (best state) and highest distance with negative center (worst state).

The main assumption is that suitability of each index is increasing or decreasing uniformly. Based on the results of TOPSIS method, petrochemical companies of Bandar Emam, Iran petrochemical business, technological petrochemical had highest importance weight in first, second and their ranks.

One of the most important advantages of TOPSIS method is weighting ranking. Ranking by above method shows that each of companies with high rank has high weight. Knowing these weights in case of resources allocation is useful for managers.

Borda method
Borda method is another method to combine the results of techniques. In this method, based on ranks of decision making techniques, a pairwise comparison matrix is formed based on the number of choices and in this stage, the choices are compared two by two in terms of achieved rank in decision making techniques. If one of the choices was preferred in terms of Borda, comparative pairwise element M is considered, otherwise it is replaced in pairwise comparison element X.
Now, the number of Ms are counted in each row and is written in front of each row, then based on the greatest M, competing choices are ordered and their rank is defined (Momeni, 2008, 75).

In the following Table, ranking of companies affiliated with national company of petrochemical industry in two various methods of SAW, TOPSIS is shown. To provide majority rule matrix, ranking by Borda method is used and alternatives are the affiliated companies of national company of petrochemical industry of Iran.

Majority rule

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Based on the results of Borda method, petrochemical companies of Bandar Emam, Petrochemical trading of Iran and Fanabaran petrochemical industry are in first, second and third ranks.

Results of ranking based on financial indices have significant difference from the results of ranking based on the best MADM methods. In this stage, solutions of first hypotheses are compared with the solutions of second hypothesis.

H0: Results of ranking based on financial indices have no significant difference from the results of ranking based on the best MADM methods.

H1: Results of ranking based on financial indices have significant difference from the results of ranking based on the best MADM methods.

Based on the results of ranking based on financial indices and maximum maxima technique, it is defined that for each of financial indices in ranking, for affiliated companies of national petrochemical industries of Iran, a different result is achieved.

One of the most important disadvantages of the above method is as the simultaneous effect of all indices in these rankings is ignored. Also, similar weight is given to all indices and companies in the study and these important shortcomings are eliminated in using MADM techniques. Math logic of MADMA methods namely AHP, SAW, TOPSIS techniques and Borda lead into different weights of indices and companies. All indices are considered at the same time in decision making. Thus, the achieved ranks are close to reality and by combining results of various techniques, the results are close to reality.

As prioritization results are shown in first and second hypotheses, the results of ranking based on financial indices have significant difference from the results of ranking based on the best MADM methods.
Conclusion

Based on the study findings and opinions from respondents for MADM techniques and financial indices in ranking of affiliated companies of national company of petrochemical industry, the following recommendations are presented:

To increase scientific ability of students in using computer in financial issues namely ranking companies and classification of investment portfolio in higher education institutes and Universities, theoretical and practical courses are held and lecturers of Universities in financial and accounting fields consider decision making with multiple indices.

Relevant organizations and namely TSE and industrial management apply MADM techniques namely AHP, SAW, TOPSIS to introduce the best companies.

By publication of new papers and journals in MADM, the mentioned techniques are trained as applied to market investors and analysts.

Specialized conferences and seminars by professional centers to introduce MADM techniques and software to investors and analysts and experts, lecturers and students of financial and accounting fields and other experts.

Required frameworks and standards are provided to determine and rank the best companies. For the companies achieving the best ranks in these rankings, special reward is considered.

References
Darvish, Majid. 100 best companies in Iran. Based on fiscal year information 2005. Ranking 2006. Industrial management organization.
Yi-Fan Tsai and Herg Huey Wu (2007) TOPSIS methods for development of desertification Indicators System Adel Sepehr and M. Moayeri.