Portfolio design for investment companies through scenario planning

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Abstract

Purpose – Scenario planning has significant applications in the field of strategic management and facilitating decision making under uncertainty, and hence this study aims to integrate scenario planning and the preference ranking organisation method for enrichment evaluations (PROMETHEE) method to propose a new methodology to design a portfolio.

Design/methodology/approach – The methodology has been designed in two stages, the first of which identifies the investment environment in Iran and defines possible scenarios for the future based upon the opinion of experts and uncertainties established in the identified environment. In the second stage, the views of experts are elicited on business area performance within each scenario. The business areas are subsequently ranked based on their final performance scores in each scenario area using the PROMETHEE method. Through use of a linear programming model, the percentage of investment in each business area is then determined according to the net flow of the area (i.e. the priority of a certain area relative to others).

Findings – The portfolio design in an Iranian investment company has been considered as a case study. The building industry and cement industry have been selected as preferable strategic business areas based on hypothetical scenarios for investment environment in Iran over five years (2008-2012) and the strategies of the investment company.

Originality/value – The integration of scenario planning and multi-criteria decision analysis (MCDA) holds great potential for strategic decision support due to the complementary nature of these two approaches. In this article, the authors provide a methodology to apply scenario planning alongside other MCDA methods to portfolio design, focusing on an innovative use of the PROMETHEE method with scenario planning.

Keywords Portfolio investment, Process planning, Uncertainty management, Financial markets, Iran

Paper type Research paper

1. Introduction

Portfolio strategy subsumes a set of decision-making rules which determine the composition and development of a portfolio in a strategic business area. A strategic business area (SBA) is a distinct environmental segment in which the firm does (or intends to do) business. In a turbulent environment, probable social, political, economic and technological perturbation may affect any estimations of profitability of each SBA

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and such evaluations should take account of probable fluxes in the future (Ansoff and McDonnell, 1990).

Strategic asset allocation (SAA) and determining the reference portfolio is the principal phase in investment. SAA not only establishes the composition of the long-term normal portfolio but also represents the interface around which tactical decisions can be made; this is necessary in taking advantage of imbalances in shorter-term market situations; in this regard, SAA is extremely important and has significant influence on the performance of the portfolio (Hin et al., 2006). The timeframe for SAA is normally around five years (Amence and Le Sourd, 2005).

Risk and uncertainty are key factors in determining investment strategies (Trappey et al., 2007). They are in fact distinct theoretical constructs (Alessandri et al., 2004) and may be differentiated based on the amount of information about states of nature and their probabilities (Golosnoy and Okhrin, 2008). March and Simon (1958) see risk as representing the “probability distribution of the consequences of each alternative”. On the other hand, uncertainty is when “the consequences of each alternative belong to some subset of all possible consequences, but that the decision maker cannot assign definite probabilities to the occurrence of particular outcomes” (Alessandri et al., 2004). According to Knight (1921), in both risk and uncertainty the states of nature are given; however, when dealing with risk their probabilities are given while in uncertainty the probabilities are unknown. Golosnoy and Okhrin (2008) write of cases in which the decision maker lacks any general certainty or structural knowledge, where even the states of nature are neither known nor can be easily modeled. The options open to a decision-maker in terms of models, techniques, and processes used for making the investment decision may therefore be affected by varying levels of risk and uncertainty (Alessandri et al., 2004).

Markowitz (1952, 1959) first described the mean-variance model. The amount of computation and the unusual nature of inputs required for Markowitz’s analysis instigated Sharp (1963) to propose a “single-index model”, which in turn led to the development of the capital asset pricing model by Sharp (1964), Lintner (1965) and Mossin (1966). For the purpose of selecting shares, however, this model is not used as widely as what may be suggested in the literature, and its validity has been questioned (Lofthouse, 2001).

Modern portfolio theory has been developed on the basis of the mean—variance model of portfolio selection by Markowitz and its utilization for a capital market model by Tobin (1958) (Ballestero et al., 2007). An essential component of modern portfolio theory, according to Lofthouse (2001), is the idea of an efficient market. The evidence for this theory was good at first, but recently the evidence has been more mixed (Lofthouse, 2001). In recent years, a large body of research has been focused on these theories such as: probabilistic mean—variance models and efficient frontiers for portfolio selection problem (Zhang et al., 2007), portfolio selection with stochastic returns taking fuzzy information (Huang, 2007), multi-objective stochastic programming for portfolio selection (Abdelaziz et al., 2007), portfolio selection under strict uncertainty (Ballestero et al., 2007), asset portfolio optimization using fuzzy mathematical programming (Gupta et al., 2008), asset allocation using reliability method (Hanafizadeh and Ponnambalam, 2009). This increase in relevant research signifies an increase in the uncertainty of decision-makers and their inability in predicting model parameters in the real world; this reaffirms the fact that successful past or present measures may not be suitable for the future owing to constant changes in the enterprise environment. Thus, as the level of uncertainty increases, more qualitative approaches should be taken to manage
uncertainty in the decision process (Alessandri et al., 2004). Strong leadership and readiness to make strategic choices in the midst of uncertainty have been counted among the sine qua non prerequisites for managers to survive in the dynamic business world of today (Dewulf and van der Schaaf, 1998).

Alessandri et al. (2004) define scenario planning as a qualitative approach to decision making, employed when primary variables are not easily quantifiable; it involves the creation of coherent stories about “possible future conditions and aims at identifying and evaluating contingencies, uncertainties, trends, and opportunities” (Alessandri et al., 2004). Scenario planning emphasizes the development of a strategic plan that is “robust” and maintains integrity across different scenarios (Othman, 2008; Durbach and Stewart, 2003).

By themselves, scenarios do not make decisions (Dye, 2002). In order to formulate a typical decision under uncertainty, the decision makers must select an option that maximizes expected efficacy under the various evaluations (Trappey et al., 2007. Once the scenarios have been generated, the main undertaking of the decision makers is to devise a strong strategy that persists with the conditions represented in all of the final scenarios (Othman, 2008). Although one of the objectives of scenario planning is to provide a model of uncertainty, it employs relatively simple evaluation techniques to assess and compare the performance of various options (Durbach and Stewart, 2003).

According to Montibeller et al. (2006), the integration of scenario planning and multi-criteria decision analysis (MCDA) holds great potential for strategic decision support due to the complementary nature of these two approaches.

In this article, the authors attempt to provide a methodology to apply scenario planning alongside PROMETHEE to portfolio design.

The present article is organized in six sections: The introduction covers the principal concepts and previous research. It is then used as a basis to review prior work in Scenario Planning and the PROMETHEE method. The research methodology is introduced in the third section, leading up to a demonstration of its use in a case study in section 4. The fifth section contains an analysis and discussion of the research results and the final section presents the conclusion.

2. Theoretical considerations
2.1 Scenario planning
Scenario planning is commonly used in strategy development, especially in the presence of environmental change (Walsh, 2005). It has a long history in strategic management research and practice (Miller and Waller, 2003).

A dictionary definition of a scenario is “an outline of a natural or expected course of events”, but in the field of futures studies it has gained more specialized connotations (Ratcliffe, 2000):

Scenarios are descriptive narratives of plausible alternative projections of a specific part of the future (Fahey and Randall, 1998).

Scenarios are a management tool used to improve the quality of executive decision making and help executives make better, more resilient strategic decisions (Wilson, 2000).

A scenario is simply a means to represent a future reality in order to shed light on current action in view of possible and desirable futures (Godet, 2001).
According to Miller and Waller (2003), the origins of scenario planning lie in the Manhattan Project (Miller and Waller, 2003). RAND Corporation, the Stanford Research Institute (SRI) and the Hudson Institute adapted scenario planning for use in corporations. Its use by business companies was further popularized by Royal Dutch/Shell in the early 1970s (Miller and Waller, 2003). Klein and Linneman (1981) conducted surveys concluding that between 8 and 22 percent of the Fortune 1,000 companies had made some use of scenarios (Pollard and Hotho, 2006). In Europe, the studies of Malaska et al. yielded similar results, namely that the highest proportion of the users of scenarios were large companies operating in capital intensive industries with long strategic planning horizons (Bradfield et al., 2005).

The purpose of scenario planning is neither prediction nor forecasting (Ratcliffe, 2000; Ringland, 2006) and the end result is not an accurate picture of tomorrow (Dye, 2002). Scenario planning takes a critical look at various social, technological, economical, political and environmental elements that influence the outcomes of significant events. Scenarios help decision-makers identify and establish contingency plans to respond with logic and purpose to environmental changes in a rational and timely manner (Dye, 2002).

Among the several different approaches to scenario planning Huss and Honton (1987) identify three prevalent methods:

1. intuitive logics;
2. trend impact analysis; and
3. cross-impact analysis.

Scenario generation can be accomplished through either an inductive or a deductive approach: in the former, the scenario planning team holds numerous brainstorming sessions, discussing probable events in the future, their initiating factors and possible consequences. The scenarios are thus generated based on events (Hanafizadeh et al., 2009a). In the deductive approach, the main driving forces are identified, a range of possible future values are assigned to them and then scenarios are generated based on the combination of the aforementioned values (Walsh, 2005).

A third approach to developing the scenario framework, identified by van der Heijden (1996) who termed it “the incremental approach”, may be observed in situations where the organization is less committed to the concept of scenario planning and its contribution towards strategy development (Walsh, 2005) (see Figure 1).

2.2 The PROMETHEE method

The preference ranking organisation method for enrichment evaluations (PROMETHEE) is a new class of outranking methods in multi-criteria analysis, the main features of which are simplicity, clarity, and stability (Brans et al., 1986). PROMETHEE was developed by Brans et al. (1986) and further extended by Brans et al. (1986); and Marcharis et al. (2004). Since 1985, PROMETHEE has successfully been applied in many fields such as Business and Financial Management (Behzadian et al., 2009). It is a relatively simple ranking method in concept and application in comparison to other methods for multi-criteria analysis (Albadvi et al., 2007).

In this study, the PROMETHEE method was chosen due to its user-friendly software and its capacity to simulate the tendencies and preferences of the human mind when confronting multiple incongruous decision perspectives (Mergias et al.,...
Moreover, the parameters in this method can be modified by the decision maker with no difficulty, as they all possess economic meaning (Brans et al., 1986).

PROMETHEE allows the direct use of data in a simple multi-criteria table. Instead of having to perform a large number of comparisons, the decision-maker is completely free to define his own scales of measure to indicate his priorities and his preferences for each criterion by focusing on value and without having to be concerned about the method of calculation. The implementation of PROMETHEE requires the definition of the relative importance (i.e. the weights) of the criteria considered and the decision-makers’ preference function for each criterion (Albadvi et al., 2007).

The preference function translates the difference between the evaluations (i.e. scores) obtained by two alternatives in terms of a particular criterion, into a preference degree ranging from 0 to 1. In order to facilitate the selection of a specific preference function, six basic types have been proposed by Brans et al. (1986): usual function, U-shape function, V-shape function, level function, linear preference and indifference area and Gaussian function.
The DM can use PROMETHEE I (partial ranking) and PROMETHEE II (complete ranking) to analyze the evaluation problem (Brans et al., 1986).

3. Research method
The proposed research method in this study subsumes two main phases, the first of which generates probable scenarios for the future environment, and the second deals with designing strategies based upon scenario requirements. The process described in the first phase has been derived from a review of literature available on various methods of scenarios planning based on the intuitive approach, as it “assumes that business decision are based on a complex set of relationships among economic, political, technological, social, resource, and environment factors” (Huss and Honton, 1987). Figure 2 depicts the research method and analysis tools, which will be described below.

3.1 First phase

(1) Define the critical issue/decision. The crucial starting point for any scenario planning process is to clearly define the critical issue, objective, or decision to be made (Dye, 2002). These decisions tend to be of a strategic or tactical kind, because scenarios tend to deal more with longer-term (five-to-ten year) trends and uncertainties, than shorter-term developments (Ratcliffe, 2000). The time horizon for the scenario is normally determined at this stage (Miller and Waller, 2003).

(2) Identify participants. The group of participants in scenario planning process should be selected from among individuals within the organization or other insiders who figure prominently in the issues being explored (Miller and Waller, 2003).

(3) Identify key decision factors/ driving forces. In this step, factors that will positively or negatively influence the scenario outcomes are identified. The abbreviation PESTEL refers to the Political, Economic, Social, Technological,
Environmental and Legal factors influencing the general environment in which an enterprise must operate (Walsh, 2005).

The driving forces can be categorized (Dewulf and van der Schaaf, 1998) into:
- predictable or so-called “predetermined forces”; and
- the uncertain but highly influential developments or “critical uncertainties”.

Trends are normally observed in demography and technology and are common in all scenarios. Scenarios consist of a set of trends and a number of uncertainties (Ringland, 2006).

(4) Identify critical uncertainties. The next step is the ranking of the key decision factors and the driving forces on the basis of two criteria (Dye, 2002; Ratcliffe, 2000); namely the degree of importance for the success of the issue designated in step one; and the degree of uncertainty surrounding those factors or trends. The point of this activity is to identify the three or four factors or trends that have the highest impact (importance) and are most uncertain (Ratcliffe, 2000)[1].

(5) Development of consistent scenarios. After identifying the critical uncertainties, a conceptual framework can be developed that incorporates the variables into clusters or along threads that link them either in a cause/effect relationship or through common themes (Chermack and Walton, 2006).

Initially, this step usually results in the development of between seven and nine scenarios, all of which need to be tested for internal consistency and plausibility (Walsh, 2005). Trends and events used to identify scenarios should be related through cause-and-effect linkages. Testing may lead to the omission of scenarios that are illogical, or merging and grouping of certain scenarios, which have the potential of logically evolving (Walsh, 2005). The objective is to simplify the set into a few scenarios in which “differences make a difference to decision makers” (Johnson and Scholes, 1993). The general principle in deciding the number of scenarios is to keep it between a minimum of two and a maximum of four (Ratcliffe, 2000). van der Heijden (1996) suggests that more than four scenarios are not organizationally practical, but in order to reflect uncertainty, at least two scenarios are required (Walsh, 2005).

The next action is elaborating or adding details to the scenario, and giving it an evocative, meaningful, and memorable name which covers the essential logic or background (Ratcliffe, 2000).

3.2 Second phase

(1) Identify decision alternatives (choices). This step considers the strategic implications of the task defined in step one within the context of the generated scenarios (Ratcliffe, 2000). As mentioned previously, in the context of portfolio design for an investment company, the decision alternatives are the SBAs-areas in which the company is active or intends to be active in the future.

(2) Performance evaluation for business areas in each final scenario. The performance of each area under the influence of every single scenario factor (i.e. critical uncertainties and trends of the scenario) is evaluated in order to assess the performance of each business areas within each scenario. The scoring for each factor is done on a seven-point Likert scale; areas in which performance is heightened by scenario factors score 7.
Conversely, a score of 1 is allocated to areas where performance is greatly weakened by factors in the scenario. The sum of scores for each business area in each scenario represents its performance therein. This stage is carried out for all final scenarios (Ringland, 2006)[2].

(3) **Ranking business areas in all final scenarios.** The tabulated business area scenario performance data output from step 7 is organized and used as the basis for ranking business areas via PROMETHEE. The priority function and function parameters are defined according to the views of DM (the investment company).

Since in scenario planning, the objective is not to determine the probability of each scenario or ranking scenarios based on the probability of their occurrence, the weights of all criteria (scenarios) are considered equal. These are maximizing criteria.

After the PROMETHEE ranking is completed, choices with positive net flow are recognized as desirable business areas. Positive net flow signifies that the priority of a certain business area when compared to others (positive flow) is consistently higher than the priority of other business areas when compared to that same BA (negative flow). Decision Lab is the software package used to carry out this stage.

(4) **Calculating the percentage of investment in the reference portfolio.** Consequent to the selection of preferred business areas, the share of investment in each is calculated through solving the linear programming model (1) in line with the net flows of every area and the investment constraints defined by the investing company (Albadvi et al., 2007):

\[
\text{Max} \sum \phi_i x_i (i = 1, 2, \ldots, n) 
\]

subject to:

\[
x_i \leq \text{Min} \left( \frac{\phi_i}{\phi}, \text{max}_{\text{Ind}} \right) (i = 1, 2, \ldots, n)
\]

\[
\phi_{i-1} x_i - \phi_i x_i \leq 0 (i = 2, \ldots, n)
\]

\[
\sum x_i \leq 1 (i = 1, 2, \ldots, n)
\]

\[
x_i \geq 0 \text{ (or } \text{min}_{\text{Ind}}) (i = 1, 2, \ldots, n)
\]

where:

- \(x_i\) = the percentage of the total capital to be invested in business area \(i\).
- \(\phi_i\) = the net flow of business area \(i\).
- \(\phi\) = the sum of all positive net flows for business areas.
- \(\text{max}_{\text{Ind}}\) = the maximum percentage to be invested in each business area.
- \(\text{min}_{\text{Ind}}\) = the minimum percentage to be invested in each business area.
- \(I\) = a counter (denoting the rank of the business area after evaluation).
In linear programming model (1), the objective is to maximize the percentage of investment in business areas that demonstrate a higher net flow. The first set of constraints express the maximum amount of investment in each BA based on the investment strategy and the ratio of positive net flow of a business area to the sum of positive net flows of all BAs. The second set of constraints is defined to maintain the relation of investment percentage in different areas in proportion to the percentage calculated through the model. The third line of constraints limits the sum of investment percentages in business areas so they do not exceed 1. The final set of constraints ensures the implementation of investment strategies regarding minimal investment in each business area. The linear programming model can be solved using the Lindo software package.

4. Case study
X, a conglomerate investment company (Hanafizadeh et al., 2009b), is the subject of this case study. The objective is to design a portfolio strategy for this company, which has invested in various areas. The timescale is approximately five years.

Experts holding higher academic degrees in economy, management, and accounting and a minimum of ten years of investment-related work experiences were invited to take part in the process as members of the scenario planning team: 14 managing directors, managers, and deputies for investment, planning and development in investment companies (including X), brokers, and several managers in the Tehran Stock Exchange Company and Stock Exchange Organization were invited to participate in the project. The participants held PhD degrees in the aforementioned fields and on average had more than 15 years of experience in investment.

Initially, the team members attended a briefing session meant to acquaint them with the fundamentals concepts of scenario planning and the goals of the project. They were provided with supplementary explanations and received a compelling booklet on the subject.

A list of factors influencing investment decisions was compiled based on the PESTEL analysis checklist and a study of research on investment topics. The experts were invited to review and provide feedback on this preliminary listing, which was then modified accordingly and finalized into an index of 42 factors:

(1) Stability of the government.
(2) Political ties with countries in the region.
(3) Outcome of the Iran nuclear issue.
(4) Government ownership.
(5) Government support.
(6) Regulations facilitating foreign trade.
(7) Value-added taxation policies.
(8) Global economic crisis.
(9) GNP.
(10) Interest rate.
(11) Savings rate.
The questionnaire for identifying critical uncertainties alongside any necessary details was handed out to the experts directly and gathered upon completion. The data obtained from the questionnaire were analyzed using Hsu and Yang Fuzzy Delphi Method and the opinions gathered from the experts were unified at one stage by constructing triangular fuzzy numbers. After defuzzing the fuzzy numbers and mapping influential factors onto the certainty/intensity of effect matrix the following factors were identified as critical uncertainties:
The degree of significance for the above factors is over five while their degree of certainty is less than five. Moreover, the national age distribution and the remarkably young population of the country is a prevalent and common theme in all conceivable scenarios.

It is now possible to generate the preliminary scenarios. A deductive approach to scenario generation has been adopted in this study. The possible states for each of the critical uncertainties have been delineated in Table I. Preliminary scenarios are derived from combinations of the states pertaining to various scenario components. In the beginning of this stage, there were eight scenarios; a number of these were discarded because of internal incongruence. For instance, if the global economic recession continues, it seems unlikely that the price of oil shall rise to over 100 USD; likewise, it can be expected that if the US and Europe plan military action against Iran, the world will no longer remain in a state of economic recession. On the other hand, international sanctions against Iran will affect the sales of oil on the global market; therefore it seems logical to presume a price under 40 USD in the light of the increase in the demand for oil and the socioeconomic situation of the world. Furthermore, some scenarios were left out because of their similarity to others.

Ultimately, the four final scenarios were described as follows:

(1) **The storm scenario.** The USA and Europe persist on their stance and continue taking further measures towards issuing resolutions entailing the imposition of more sanctions (increasing international pressure) and military engagement. Stepping up sanctions may lead to rapid conflict escalation and the Hormoz Strait being closed off. Around mid-2009, global economy regains its previous rate of development and in 2010, a short period of recession ensues. In due course, a stable, albeit mild, economic growth, begins in 2011. The price of oil will also return to over 100 USD.

<table>
<thead>
<tr>
<th>Outcome of the Iran nuclear issue</th>
<th>Global economic crisis</th>
<th>Price of oil</th>
<th>Financial and monetary policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>International sanctions and US/European coalition for taking military action against Iran</td>
<td>Rapid improvement beginning mid-2009</td>
<td>Max 40 USD</td>
<td>Contractive</td>
</tr>
<tr>
<td>Stepping up of UK/US sanctions against Iran</td>
<td>Economic instability over 2009 and 2010</td>
<td>40100 USD</td>
<td>Expansive</td>
</tr>
<tr>
<td>Concurrence with the West and regulation of Iran’s nuclear activity within consortium frameworks</td>
<td>Prolongation of economic recession until 2012</td>
<td>Over 100 USD</td>
<td></td>
</tr>
</tbody>
</table>

Table I. Possible states for scenario components
(2) The recession scenario. Europe concurs with the reality of Iranian nuclear activity and continues negotiations accordingly. The USA and UK, however, issue a third resolution for imposing further economic, maritime and aviation sanctions against Iran. The global economic recession is prolonged beyond any precedent, until 2012. Iranian oil is sold at 40 USD at most, resulting in the government adopting expansive monetary policies due to a drop in revenue.

(3) The limbo scenario. Europe concurs with the reality of Iranian nuclear activity and continues negotiations accordingly. The USA and UK, however, issue a third resolution for imposing further economic, maritime and aviation sanctions against Iran. Around mid-2009, global economy regains its previous rate of development and in 2010, a short period of recession ensues. In due course, a stable, albeit mild, economic growth, begins in 2011. The price of Iranian oil rises within the range of 40 USD to 100 USD, resulting in the government adopting expansive financial and contractive monetary policies.

(4) The u-turn scenario. The West comes to terms with the reality of Iran’s nuclear program and attempts to regulate it through consortium activity, i.e. Iran enters trade ties with other states and is simultaneously controlled as a nuclear country. The economic state of the world swiftly improves in the second half of 2009. Iranian oil is sold at over 100 USD, and expansive financial policies are enacted in the country.

The scenarios must now be integrated into the decision-making process. The SBAs in which the X investment company is investing are the petrochemical industry, energy-intensive mineral and metal industries, the cement industry, construction, and financial and trade services. A performance analysis of these areas was carried out incorporating the opinions of the experts, the results of the fuzzy Delphi-based analysis of which are shown in Table II.

The business areas are ranked based on the information in Table II and a linear preference function with the parameters \( p = 2 \) and \( q = 1 \). The results of partial ranking (PROMETHEE I) considering the positive and negative flows of each business area can be seen in Figure 3.

It is clear that the construction and cement industries are preferable over all other areas, but financial and trade services and mineral and metal industries cannot be compared, as the output flows \((\Phi^+)\) indicate the preferability of financial/trade services to mineral and metal industries despite the fact that the input flows \((\Phi^-)\) are indicative of the contrary. This necessitates a complete ranking (PROMETHEE II), the results of which are displayed in Figure 4. The complete ranking is based on net preference flows.

<table>
<thead>
<tr>
<th>Business area/scenario</th>
<th>Storm</th>
<th>Recession</th>
<th>Limbo</th>
<th>U-turn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrochemistry</td>
<td>16.1</td>
<td>18</td>
<td>21</td>
<td>31.1</td>
</tr>
<tr>
<td>Minerals and metals</td>
<td>15.1</td>
<td>19</td>
<td>22.3</td>
<td>29.9</td>
</tr>
<tr>
<td>Cement</td>
<td>16.6</td>
<td>21.1</td>
<td>23.2</td>
<td>30.3</td>
</tr>
<tr>
<td>Construction</td>
<td>19.4</td>
<td>23</td>
<td>23.3</td>
<td>31.3</td>
</tr>
<tr>
<td>Financial and trade services</td>
<td>14.9</td>
<td>20.1</td>
<td>20.9</td>
<td>31.2</td>
</tr>
</tbody>
</table>

Table II. Performance analysis of business areas in the final scenarios
According to the PROMETHEE complete ranking, the net flows for the construction industry and cement industry are positive and as such, these are the preferred business areas for the future. The net positive flow shows that in the four final scenarios, these two business areas are preferable over the others. The investment percentage for each industry can now be calculated based on their net flows through PROMETHEE and considering the investment policies of X. The results generated from using Lindo to solve the linear programming model are represented in Table III.
5. Discussion and analysis of results

In decision making under uncertain situations, the decision maker selects activity that maximizes the expected desirability. Using scenario planning for designing the portfolio of company X has resulted in determination of a portfolio combination that is stable in the four scenarios defined in this research. The stable combination of portfolio does not mean the optimal combination of portfolio in all final scenarios (storm, recession, limbo, and U-turn). According to the results of PROMETHEE multi-criterion ranking results, the building, cement, mineral and metal, financial and commercial services, and petrochemical industries ranked 1 to 5, respectively (Figure 4). While in U-turn scenario, the petrochemical industry and financial and commercial services overweight cement, mineral and metal industries. Or, in the storm scenario, petrochemical industry is prioritized over mineral and metal industries. Thus, it is very important for senior and executive managers of the company to know as soon as possible which scenario is facing to be able to make necessary changes in their portfolio combination.

The conclusion that can be reached from the expert opinions regarding business area performance in the final scenarios is that in the storm scenario, financial and trade services and mineral and metal industries will perform less effectually. In the recession scenario, the performance of mineral and metal industries and the petrochemical industry will be weakened but that of the cement industry and financial and trade services will remain almost unaffected, while the construction industry shall remain unchanged or perhaps will see a slight improvement.

Further to the above, in the limbo scenario none of the industries will be weakened and the construction and cement industries will remain first and second in rank respectively, showing minor changes for the better. Also, the performance of the construction and cement in the regression and limbo scenarios are almost the same, but the mineral and metal industries, the petrochemical industry and financial/trade services can be expected to perform better in limbo than in regression. In the U-turn scenario, a significant performance boost of the industries is predicted, as is the fact that they will perform in the best possible manner.

One of the reasons for choosing PROMETHEE for ranking business areas is that it not only creates an approximation of the mindset of the experts and combines the preference of choices rather than contradicting parameters in decision-making, but also, by virtue of incorporating the preference function, it does not create a sudden shift in the choice of the decision-maker from indifference to absolute preference; when encountering uncertainties, many values may be defined within the range of [0,1]. In this way, the sensitivity of the result to minor dissimilarities among expert opinions is also eliminated.

It is worth noting that the definition of the preference function and its parameters directly affects the ranking results and consequently the net flow of the choices, which

<table>
<thead>
<tr>
<th>Table III. The investment percentage for each industry in portfolio</th>
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<tbody>
<tr>
<td>Strategic business area</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>Ranking</td>
</tr>
<tr>
<td>Investment percentage</td>
</tr>
</tbody>
</table>
are specified in accordance with the requirements of the decision maker. As the linear programming model is based on the net flow of choices, it may be concluded that the percentage of investment will be dependent upon the strategies of the investing company.

As mentioned before, scenario planning does not aim to determine the probability of occurrence for scenarios, nor to rank them on that basis; hence equal probability of occurrence is assigned to all scenarios. The Decision Lab software, however, does allow for the calculation of problem sensitivity to the probability of each scenario taking place. Results with equal and unequal probability of occurrence for all four scenarios are displayed in Figures 5 and 6 respectively. It can be seen that despite negligible variations in the net flow of choices, the rankings remain unchanged.

No process, however stable it may be, is ever perfect and flawless. Scenario planning deals with variables pertaining to the future; therefore the possibility of errors arising therein is considerable and like other methods, one cannot overlook the presence of ambiguities and uncertainties in relevant research and answers. In this study, an attempt was made to reduce the margin of error and uncertainty using the fuzzy Delphi method.

6. Conclusion
The dynamicity of today’s environment in which organizations operate gives rise to many uncertainties. Accordingly, the portfolio strategy performance of the country is impacted by the dynamicity of the environment. The main objective of portfolio design is to determine the right combination of profitable industries, which enable the

![Figure 5. The results with equal probability of occurrence for all four scenarios](image)
organization to achieve its expectations of the investment strategy. The present financial methods for selecting portfolio have lost their efficiency in today’s uncertain and agitated environment. The reason is that these methods are based upon explicit or implicit predictions of the general movements in the market and evaluation of the commercial areas according to indices such as growing demand for industry products, stability of products sale, prediction of industry growth, industry P/E, the common value of industry and the average of industry transactions. Few predictions rely upon historical data and may overlook the uncertainties and factors affecting the future. In general, by increasing the uncertainties, the focus of planners has changes for prediction to foreseeing. Scenario planning is an appropriate method for investigating and confronting uncertainties. It treats uncertainties as if they are learning opportunities and can create a learning organization.

In this respect, the present study proposes a new method for portfolio design in investment companies from scenario planning together with the PROMETHEE multi-criterion ranking method. Using scenario for evaluating commercial areas and designing portfolio of company X caused the company to see beyond “its common business method” and analyze global and local conditions affecting the performance of its commercial areas. To this end, and in order to assess the investment environment in Iran over the next five years (2008-2012), political, economic, social, technological, environmental and legal factors influencing the success/failure of investment decisions were explored. Out of the 42 factors that were initially identified, the following were chosen as key driving forces: the outcome of the Iran nuclear issue, the global economic
crisis, the price of oil and financial and monetary policies. A deductive approach was taken in developing four compatible and probable scenarios labeled storm, recession, limbo, and U-turn; these signify the possible investment environment in Iran for the next five years. The strategic business areas of the case study company were the petrochemical industry, energy intensive mineral and metal industries, the cement industry, construction, and financial and trade services. These were designated as the decision choices. Performance evaluation of the business areas in each scenario was carried out based on opinion polls by experts in the field of investment. PROMETHEE ranking was utilized to prioritize the business areas, and the output, in conjunction with the constraints of the X investment company, was used to solve a linear programming model to determine the percentage of investment in each area within the portfolio.

It must be noted that scenario generation is not an isolated, solitary activity; it must be linked closely to the main processes in the investment company, such as professional investment management, diversity building, prediction and market research. Also, scenario planning is not a disjointed, one-time process. Environment monitoring and scenario revision must be carried out on a regular basis.

Notes
1. Scenario building is essentially a team exercise. Therefore, the Delphi technique is one of the techniques which have been adopted in scenario building (Ratcliffe, 2000). Fuzzy Delphi methods (FDMs) have been investigated by a few researchers (Chang et al., 2000). Hsu and Yang (2000) applied triangular fuzzy numbers to create a framework for expert opinions and established the fuzzy Delphi method. The max. and min. values of expert opinions are taken as the two terminal points of triangular fuzzy numbers, and the geometric mean is taken as the membership degree of triangular fuzzy numbers to derive a statistically unbiased effect and avoid the impact of extreme values (Hsu and Yang, 2000). It features the advantage of simplicity, and all the expert opinions can be encompassed in one investigation, allowing for unification of ideas and facilitating consensus. This method also reduces time and cost in comparison with the traditional Delphi method (Kuo and Chen, 2007).

In this research, the Fuzzy Delphi method proposed by Hsu and Yang has been used to analyze information and compile expert opinions in the 4th and 7th steps. To collect the opinions of experts, a two-part questionnaire may be provided regarding the identified driving forces, the first part of which determines the importance of affective factors while the second part establishes their level of predictability or determinacy. The range of the answers should be based on a scale of 1-10, with 10 representing the most important, or most definite factor and 1 indicating the least significant or least definite factor.

2. As in step 4, since this step is also based on the opinion of experts, the fuzzy Delphi method is used to process the questionnaire data and summarize views.

References


Knight, F.H. (1921), *Risk, Uncertainty and Profit*, Beard, Washington, DC.


Further reading


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