African Journal of Business Management Vol. 6(22), pp. 6560-6574, 6 June, 2012
Available online at http://www.academicjournals.org/AJBM
DOI: 10.5897/AJBM12.025
ISSN 1993-8233 ©2012 Academic Journals

Full Length Research Paper

Project selection and prioritisation in Iranian Aluminium Company (IRALCO)

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Accepted 6 March, 2012

This study proposed a method which is much innovative for the project selection, the proposed method is the one which is untouched by many due to the certain misbelieves and the comparison with the alternates available. The main aim and the objectives in the study are to analyse the analytic hierarchy process (AHP) methods and to identify the themes, ideas and the areas being investigated in the study. The AHP is the one content which is much trendy in current era so the idea and the areas of investigation play a significant role. The analytic hierarchy process (AHP) make use of many hierarchical structures to position compare criteria and option in categorise to give maintain in decision making responsibilities. The boundary of the study deals with the AHP as the process itself with much preference given to the hierarchy models and the sub hierarchy models associated, the criteria and the sub-criteria related. The methodology of the study mainly deals with the strategic objective; include the quantitative method in the selection of the process. The new framework combines the two main approaches; project selection models and AHP technique. It is powerful and useful tool which should be used to convert strategy into action.

Key words: Project selection and prioritisation, financial and non-financial models, multi criteria decision making, analytical hierarchy process.

INTRODUCTION

Project selection is a big task and both financial as well as non financial models are discussed in this research paper. A literature review has been done for various non financial models and financial models. Benefits and drawbacks of different models are drawn in a table format. “Project selection is making a commitment for the future. The execution of a project will tie up company resources, and as an opportunity cost the selection of one project may preclude your company from pursuing another project” (Graves et al., 2003).

Scarce resource is often critically one of the big constraints in decision making and project selection; in multi-project environments, scarce resources represent an important constraint and resource allocation is critical factor for success (Adler et al., 1995). In addition, the choice of best new product or project must consider consequences over multiple periods and uncertainty circumstance. Choosing the project selection practically determines the firm’s strategies for the future and is the responsibility of senior managers of the firms (Cooper and Kleinschmidt, 1998). The decision making process does not involve a linear analysis because decision cannot be taken on the basis of a single criteria, single attribute or single point of view. If a unidirectional approach is used, it will result in an oversimplified process of decision making leading to unrealistic decisions (Saaty, 1980). Therefore, while making the proper decision; all the relevant factors should be taken into consideration. The primary concern is therefore to assimilate the conflicting forces to generate a unanimous decision and test its authenticity before implementing it finally. For this purpose, the researchers use various statistical tools, arithmetic logic and operational research methodology (Cooper and Kleinschmidt, 1998).

However, the decision maker not always relies on such

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models, he or she often take into account the past experience and specific decision making policies. Therefore, all these factors should be taken into consideration while developing the decision making model. Similar problem is encountered by the management while selecting a project. The process of project selection entails project evaluation and selection of that project which is more potent in achieving the organisational goal (Dhillon, 2002). "The analytic hierarchy process (AHP) is due to Saaty (1980) and is often referred to eponymously, as the Saaty method. It is popular and widely used, especially in military analysis, though it is not, by any stretch of the imagination, restricted to military problems" (Saaty and Vergas, 2001). "The AHP is generally used to evaluate importance amongst criteria based on the concept of paired comparison" (Marde et al., 2009). It is well equipped with procedure, philosophy and problem (Saaty and Vergas, 2001). It has been developed by Saaty (1980) to exploit comparisons systematically.

LITERATURE REVIEW

Projects need to be prioritised after undertaking certain specific factors, as for example its profitability, its risk appetite, and its capability of fulfilling the required goals of the organisation. It should be well planned so that it can be completed within the given time frame and with the predetermined resources. These factors are as follows: profit margin, project risk, process change, resources, financial consideration, by-products, technology, project duration, size and corporate image of the company, clients, life-cycle phase, core competency, urgency and R and D (Cleland and Ireland, 2006). "Selecting and initiating projects turn strategy into action. Done thoughtfully, the process project selection can significantly improve the organisation's ability to execute its strategy and thereby enhance its results" (Eilertsen, 2004). Project selection is the process of evaluating projects or groups of project, and then choosing to implement some set of them so that the objectives of parent organisation will be achieved (Meredith and Mantel, 2009).

Project selection and prioritisation is concerned with resource allocation among project proposals – it is one of essential aspects that the project must be viewed together than isolation. "Projects are selected based on the need to maintain business advantage, if not business parity. Project criteria are usually prescribed per specific business, market, or industry indictors to include such items as the introduction of new technology" (Hill, 2009).

The process of project selection entails project evaluation and selection of that project which is more potent in achieving the organisational goal (Dhillon, 2002). Therefore, the primary concern is to identify the basis of project selection (Graves et al., 2003). To overcome this problem, it is important to first understand and analyse the problem. "A problem well structured is a problem half solved" (Belton and Stewart, 2002).

Therefore, before applying any decision making tool, the most essential task is to structure the problem. During this process, the hurdles should also be detected and analysed for the effective implementation of the project. "The project selection process should be designed to ensure that project proposals are evaluated fairly and objectively, with a focus on business value and project viability. Every project begins with a proposal, but not every proposal can or should become a project. In a world of limited resources, choices have to be made. Not every project has viability. And, amongst those that do, limited resources (people, time, money and equipment), and must be applied judiciously. Consider the risks if resources are misapplied" (Koppala, 2010).

NON-FINANCIAL MODELS

Sacred cow

According to Erick C. Jones, Christopher A. Chung in his book called Radio Frequency Identification (RFID) in logistics: a practical chapter says that, project choice methods are categorised into two broad categories. They are numeric method and non-numeric method. At the same time, non numeric method do not specially make use of values to settle on the status of projects. "Project selection methods can generally be classified as either numeric or non-numeric: numeric models are further subdivided into profitability and scoring categories.

Non-numeric models includes; (1) Sacred cow; (2) Operating necessity; (3) The competitive necessity: (4) Comparative benefit: and (5) The product line extension" (Verzuh, 2003). Non -numeric methods are older than the numeric choice method. At the same time, it is also very simple. The foundation of the Sacred cow is that a number of high-stage people have determined that it is suitable for the organisation to be concerned by any kind of technology to a particular process. In the case of Sacred cow, it is recommended by a senior and influential official in the company. "Management weights each criterion by its relative contribution and importance to the organisation's goals and strategic plan.

The project priority team evaluates each project proposal by its relative contribution or benefit to the selection criteria. The priority team assigns a spectrum of values for each criterion ranging from low (0) to high (10). This value represents the proposal's fit to the specific criterion" (Sifri, 2003). According to Shaw (1999), Mattison Public Relations in his article called A Guide to Performance Measurement and Non-Financial Indicators says that, Managerial control in the organisation is the procedure by which a company guarantees that it is following the strategies and proceedings, which will

permit it to accomplish its objectives and aims In simple meaning, Sacred cow means individuals irrationally seized to be immune to disparagement. This will help in the following ways:

1. To capture superior marketplace share.
2. To create it difficult for rivals to enter the marketplace.
3. To build up an enabler merchandise.
4. To build up core know-how that will be utilised in the next age group goods.
5. To diminish dependence on unreliable dealers.
6. To avoid government interference and rule.

Operating necessity

In the case of operating necessity, the project needs to retain the system successively. “The operating necessity model is based on the fact the organisation might have adopt an RFID project in order to keep the organisation functioning on a daily basis. This might occur in the case of internal tracking of manufactures assemblies” (Jones and Chung, 2007).

According to Campbell (2007) in his article called Non-financial Performance Measures and Promotion-Based Incentives says that, Non-financial Act procedures may play a great position in promotion resolutions in business establishment. Particularly, promotion in companies provides two significant purposes: matching and the proviso of inducements. Promotions offer inducements or incentives when they recompense past routine by means of enlarged recompense or payment and rank in the company. “If promotions simply generate greater effort allocation towards performance improvement activities, then rates of nonfinancial performance improvement should diminish in post-promotion periods for non-promoted managers” (Campbell, 2007).

Competitive necessity

“Projects are selected based on the need to maintain business advantage, if not business parity. Project criteria are usually prescribed per specific business, market, or industry indictors to include such items as the introduction of new technology” (Hill, 2009). It is essential to maintain a viable position.

Kureshi (2010) in his article called Project Selection Model says about the competitive necessity. The judgment to commence the project based on a wish to preserve the organisation’s competitive status in that marketplace. Competitive necessity is one of the models used in the case of Non-numeric Model.“

Investment in an operating necessity project takes precedence over a competitive necessity project, but both types of projects may bypass the more careful numeric analysis used for projects deemed to be less urgent or less important to the survival of the firm” (Meredith and Mantel, 2009).

Product line extension

The product development is an important aspect from the competitive advantage and the developments of the new products. The product extension in a mere sense means the extension of the number of products to the similar extension of a similar brand category. The product line extension is the main factor that contributes to the competitive advantage of the organisation. Product lines extension is assessed on how well the new products engage with the accessible product line to a certain extent than on general benefits.

The product line extension projects are moderated on how they are in shape with present product line, seal a gap, make a feeble link stronger, or expand the line in a new attractive way. “Line extensions happen when the brand launches the new product in the same category targeting a new segment through new flavours, added ingredients, package sizes, etc.

Category extensions happen when the parent brand is used to enter a different product category. So according the new definition, brand extension becomes the umbrella concept which can be used whenever a brand uses its name to any new product” (Kotler and Keller, 2011). The product line has a lot of benefits in the organisations.

Various kinds of benefits are much wider free gap for the company, increased potential customers to the firm offers much variety and preferences to the customers, increases the marketing efficiency by increasing the activities in the firm.

The production efficiency of the firm also gets increased by a lesser promotion costs and the increased profits in the organisations (Giddens, 2002). “Product line extensions both upscale and downscale are common occurrences in retail settings. For example, Best Buy recently added the upscale Magnolia home theatre line to complement its lower-priced electronics offerings and JC Penny has added the high-end Sphere brand, priced much higher than the rest of its cosmetics line. One of the reasons retailers vertically extend their product lines is to manage their price image” (Hamilton and Chernev, 2010).

Comparative benefit model

Comparative benefit projects are instinctively ranked and prearranged based on their apparent advantage on the company. Numerous projects are measured and the one with the most profitable to the firm is chosen. Very small variations in assumption and in the particular results identified among the various research and study make

certain differences in the analysis. These researches gradually affect the comparison and variations of interest of the cost benefits.

An elementary version of the Abecedarian Comparative Benefit Model provides an extensive application of the method (Masse and Barnett, 2002). As the comparative benefit models are considered there are various theoretical and empirical issues, which may distress the firm, among these are the corporate debt capacity, manager, incentives, ability to predict distress, data and computations for the default rate estimation, investment in securities of distresses firms, and the post organisation performance assessment. The models have evolved from the unvaried financial statement ratios to multivariate statistical calculations (Ross and Hiller, 2010).

Various economic models depend on certain prediction of future and the economic growth identification, inclusive of various models which are comparatively beneficial in numerous ways. Other models of the economic growth mainly include the macro-economic model for the growth. Certain other models are associated with the beneficial models that are also much helpful and give much input for making comparisons with various researches in finding a beneficial one (Gills et al., 1996). “Economic development is a process by which an economy is transformed from one that is dominantly rural and agricultural to one that is dominantly urban, industrial, and service in composition” (Kooros and Badeaux, 2007).

Financial models

Net present value

NPV which Frederick et al. (2000) identified as a tool which helps managers determine those projects that should be undertaken. Net present value is an analytical tool used for decision making after undertaking the time value of money in future. Though NPV is easy to calculate technique, it does not take into account the cost of capital and the risk associated with the project (Dreyer et al., 2006). While calculating the NPV of a project, both cash outflow as well as cash inflow throughout the life span of the project is taken into consideration (Hansen et al., 2007). It also fails to put into consideration that there are qualitative factors that affect a project choice choosing to full deal with the quantitative aspect in project choice (Mahmoodzadeh et al., 2007).

In additional, “net present value present a dynamic appraisal and discount cash flow method that assumption one euro today is more than one euro will be worth tomorrow” (Rudolf, 2008). Therefore, NPV is often used to measure the profitability of the project. While calculating NPV, all the cash flow occurring in the future should be converted to the present value with the help of appropriate discounting factor. Following which, the difference between the present value of total cash flow and present value of total cash inflow should be determined. This difference is called net present value of the project (Carroll and Pirnes, 2009).

NPV = (PV of cash outflow) - (PV of cash inflow)

If NPV is positive, it indicates that cash inflow is greater than cash outflow and the project can be accepted. On the other hand, if NPV is negative, it reflects that cash inflow is less than cash outflow, therefore this will lead to loss and the project should not be accepted. If NPV is zero, then the management should take certain other factors into consideration before deciding whether to accept such project or not (Groppelli and Nikbakht, 2006).

Internal rate of return (IRR)

Internal rate of return is the discount rate where the NPV of the project turns to zero (DeFusco et al., 2007). This rate is called internal rate because this depends on the project and does not take into account any other external factor. The concept of IRR can be made clearer with the help of the method of IRR calculation given as follows:

$$\mathrm{NPV} = \mathrm{CF}_0 + \frac{\mathrm{CF}_1}{(1+\mathrm{IRR})^1} + \frac{\mathrm{CF}_2}{(1+\mathrm{IRR})^2} + \cdots + \frac{\mathrm{CF}_N}{(1+\mathrm{IRR})^N} = 0$$

While taking decisions regarding any project, IRR of a project is calculated and is compared with the cost of capital. If IRR is greater than the cost of capital, the project can be accepted whereas if IRR value is less than the cost of capital, the management prefers not to accept the project. Therefore, decision is taken after considering the cost of capital as well as the profitability of the project (Brigham and Houston, 2007). The cost of capital can be considered as the required rate of return. If the management plans to use different sources for funding the project, for example equity, dept and reserves, then the cost of capital for each of the sources should be calculated.

It has been commonly seen, that cost of equity is quite higher than cost of debt but on the other hand the risk associated with debt fund is much higher than equity. Hence, the management should finalise the degree of leverage as per the risk appetite of the stakeholders. Those projects are only accepted whose IRR is greater than the required rate of return (Keown, 2004).

The major limitations for IRR method is that it fails to come up with a particular project especially when dealing with unconventional cash flows (results to multiple answers) and it may lead to a faulty decision when comparing mutually exclusive investments (Baker, 2000). IRR method is not appropriate for comparing several investments projects of varying amount, length and timing

(Rudolf, 2008).

Payback method

Payback is one of simple method in financial analysis that simply takes the capital cost of the investment and compares to value to net annual cash inflow (Mahmoodzade, 2007) and also payback period is a traditional methodology used in capital budgeting for evaluating project on the basis of the cash flow related to the project. This technique helps to calculate the time frame within which what the project will payback all the capital investment made at the start of the project (Schniederjans et al., 2004).

Often when the risk associated with the project is high; the management prefers to select those projects which will give high cash outflow in the early years. Hence, it becomes easier to get back the capital invested in the project as soon as possible (Kinney and Raiborn, 2008). Calculation of payback period of a project is quite simple; it is calculated as follow:

$$\text{Payback Period} = \frac{\text{Cost of Investment}}{\text{Annual Net Cash Inflows}}$$

For example, if the management has to decide between two or more projects, then as per payback period method the one with a smaller payback period will be selected. However, this is a too simple methodology as it does not consider the net profitability of the project. This method also neglects the time value of money (Needles et al., 2007).

It is completely ignorant of the time value of money, assuming that value of money at present will have the same value in future. The other limitation is that it fails to account for all cash flows resulting from a particular project and finally the reject or accept criterion is arbitrary (Regan and Holtzman, 1995). With time, many changes have been introduced in the payback period methodology used for evaluating projects.

Rate of return and return on investment

While evaluating any project or any investment, the management always takes into account the rate of return required. If the return from the project is above or even equal to the required rate of return, the project can be accepted but if the project is incapable of generating returns equal to the required rate of return, the project is simply rejected. Thus, the rate of return has an important role in the selection of a project or an investment.

However, the primary issue is to determine the rate of return (Rachlin and Sweeny, 1996). The required rate of return depends on the supply of fund in the market as well as the demand of the same. Therefore, it influences the cost of capital involved in making the investment. Often, the cost of capital is higher than the risk-free rate prevailing in the market (Moyer et al., 2009).

Apart from risk-free rate of return, inflation also affects the required rate of return; higher inflation rate will lead to higher rate of return (Correia, et al., 2007). Other risk factors such as economic risk, market risk, and political risk should also be taken care of while finalising the rate of return.

Return on investment can be expressed as “project’s net output divided by project’s total input and expressed as percentage” (Bidgoli, 2004). This ratio is used to find out the profitability of the project but this underestimates the time value of money. This technique should thereby be used with other project-evaluating techniques before taking the final decision. This method is very closely related to the Internal Rate of Return previously discussed, it is particularly useful in prioritising projects whose cash flows are difficult to project (uncertain), such as maybe the case with investments in new products, it is agreeable that the cash flows from these kinds of investments are impossible to determine as they are heavily dependent on the market reception which is itself difficult to determine (Amato and Remolona, 2003).

Role of multiple criteria decision making (MCDM) in project selection

Earlier, many researchers practised conflicting criteria for decision making process. Among them, Pareto was the first one followed by Koopmans who introduced such a concept and set the ground on the basis of which modern theory of multi criteria decision making (MCDM) was born (Romero and Rehman, 2003).

Later on Charnes and Cooper (1961) gave rise to the concept of MCDM in the form of goal programming (Dyer, 1992). Among several decision-making tools, analytical hierarchy process (AHP) is one that is commonly used. This was developed by Saaty (1980) and it assists in presenting the complex problem visually. Therefore, it facilitates comparison of alternative projects by contrasting at least two levels: objectives and activities. Therefore each alternative at a specific level is evaluated with other related factors (Badiru and Thomas, 2009).

Often the process of decision making is kept at the first level of the hierarchy, so that total levels become three”. The success of this decision making tools depends on the factors taken into consideration, therefore, a thorough analysis should be conducted and the factors having a direct impact to the project goal should be identified.

The external environment related to the problem and the participants associated with it should also be identified. Later on, other factors like the goal, issues, and the participants need to be arranged in the hierarchal order (Saaty and Vargas, 2000) (Figure 1).

Care should be taken to ensure that only the homogeneous levels are compared with each other.

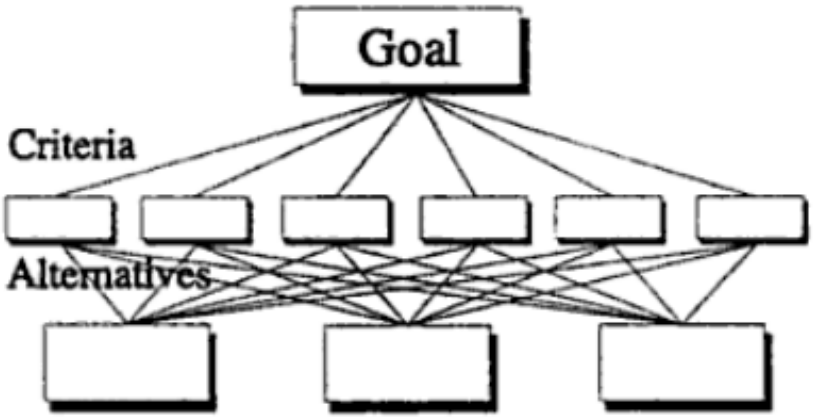

Figure 1. The three level hierarchy. (Source: Saaty and Vargas, 2000).

After developing the hierarchy, the less effective once should be eliminated according to the priority set up. "The analytic hierarchy process is a method for formalising decision making where there are a limited number of choices but each has a number of attributes and it is difficult to formalise some of those attributes. This example, we did not collect any data (like miles from a preferred point or salary numbers). Instead, we use phrases like "much more important than" to extract the decision makers preferences" (Satty, 1980).

The AHP is a theory of measurement for dealing with quantifiable and intangible criteria that has been applied to numerous areas, such as decision theory and conflict resolution (Kummar and November, 2004). AHP helps in making a pair-wise comparison of the elements that establish the relationship. Therefore, matrices along with the priorities of alternatives are developed.

The analytic hierarchy process (AHP)

The analytic hierarchy process (AHP) (Saaty, 1980) is a very popular technique for aiding multi- criteria objectives problems (Zahedi, 1986; Shim, 1989). To use AHP, decision-makers compare all pairs of criteria and alternatives with ratio scale (Yahya and kingsman, 1999). In using AHP method to prioritize selection criteria, the strongest aspects of the AHP generate numerical priorities from the subjective knowledge expressed in the estimates of paired metrics of comparison (Liu and Hai, 2005). Also, there are some criticisms of the AHP, including identified problems of rank reversal (Belton and Gear, 1983, 1985; Schoner and wedley, 1989) aggregation and scale (Lootsma, 1991). According to Saaty (1990) the following steps was developed for applying AHP:

1. Define the problem and determine objectives.
2. Selecting criteria (Table 1) with decision maker's viewpoint form the top subsequently intermediate and lower levels (depend on criteria).
3. Construct a set of (size n × n) pair-wise comparison for each of the lower level with one matrix for all level. The pair-wise comparison are made using the relative measurement scale (Saaty, 1990)
4. There are n (n-1) judgements needed to expand the set of matrices in stage 3. Automatically, another matrices assigned in each pair-wise comparison.
5. Hierarchical function is used to weights the eigenvectors by the criteria, weight and sum of all weighted eigenvectors.
6. After the all comparisons are completed, this process should be repeated and reviewed for all of level, the consistency is determined by using the eigenvectors λ_{max}. So, consistency index: $(\lambda_{max} - n)/(n-1)$, where n is matrix size. Judgement can be checked by consistency ratio of CI Table 2 that CR is acceptable if it does not exceed 0.10 and if it is more judgement is inconsisitent decioion maker should imporoved and reviewed the criteria

RESEARCH METHODS

The aim of the research is to bring forward a scientific new framework for project selection using an integrated analytic hierarchy process and also this methodology begins by justifying the research method then develops and select the best projects with analytic hierarchy process in Iranian Aluminium Company. The research design would essentially focus on the following aspects of project selection (Figure 4):

1. Strategy and existing objectives
2. Pool of projects (portfolio management)
3. Project pre-evaluation
4. Project evaluation with AHP technique (final evaluation)
5. Projects

Practices in regards of the implementation of the project selection scheme are also very important (Kerzner, 2004). Almost every

Table 1. Pair-wise comparison scale for AHP preference.

Verbal judgments of preferences	Numerical rating
Extremely preferred	9
Very strongly to extremely	8
Very strongly preferred	7
Strongly to very strongly	6
Strongly preferred	5
Moderately to strongly	4
Moderately preferred	3
Equally to moderately	2
Equally preferred	1

Source: Saaty, T (1980). "The analytic hierarchy process", New York: McGraw- Hill.

Table 2. Average random consistency.

Size of matix	1	2	3	4	5	6	7	8	9	10
Random consistence	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Source: Saaty. T (1980) the analytic hierarchy process, New York: McGraw- Hill (1980).

business in today's global economy depends on the market, and a focus on the commercial aspects thus becomes an essential imperative (Frigeti and Comninos, 2002).

In a nutshell, the research design is supposed to deal with project selection in a stepwise sequence to mathematically evaluate the MCDM situation involved in it. This project selection model is new and embarks on an innovative application of AHP with Expert choice software. The detail of each element is discussed as subsequently.

Strategy / objectives

Strategy helps to explain the things that mangers and organisations do. "Strategies which are appropriate, feasible and desirable are most likely to help the organisation to achieve its mission and objectives" (Thompson and Martin, 2009).

The importance of aligning in project selection model the model utilising AHP can be used in fabricating highly specific systems and procedures for certain situations that involve rating, quantification, selection, allocation, assessment and management. It would evaluate the optimum scope of a proposed project in a sequential manner involving mathematical synthesis (Figure 2). Strategic projects are those that directly support the attainment of the goals and vision of the organisation as articulated in the strategic plan.

Prioritisation and selection of these projects should in fact represent the process by which the strategic plan is articulated and resulting portfolio should define the means by which the strategic plan is realized (Mullaly, 2003).

Business unit

Business unit or tactical initiatives generally support attainment of the goals and mandate of the business unit, which in turn support the organisation's goals. The focus of the initiatives is on creating the capabilities or capacity necessary to meet the business unit's overall objectives (Mullaly, 2003).

Pool of projects or project portfolio

The pool of projects would offer a portfolio of the available projects from which the selection is to be done. AHP can be deployed in a complex decision situation where there are multiple alternatives (even hundreds of alternatives). These alternatives among the projects are to be categorised and explored to obtain extensive results on planning, scheduling, allocation of resources and finally proper selection of the alternatives. The project portfolio would essentially focus on the following questions (Pennypacker and Renta, 2009):

1. Are we investing in the right things?
2. Are we optimizing our capacity?
3. How well are we executing?
4. Can we absorb all the changes?
5. Are we realizing the promised benefits?

Project pre-evaluation

Project pre-evaluation would focus on the practicality and profitability of the project proposed. At this stage, the project manager is supposed to scrutinise the proposal of the project and evaluate it. The project proposed must provide a comprehendible and realistic summary of the project which will be evaluated in order to match the different criteria. There should be an "expanded coverage of project risk management and how to implement a project management" (Lewis, 2007).

The criteria should be clearly put forward and the project should strictly be analysed according to them at this stage of multi criteria decision making. This is the point where quantification should be started (Triantaphyllou, 2000). The tools and techniques that can be utilised for the purpose of individual project evaluation include NPV, IRR and Payback, etc.

A common system of measurement must be deployed for the evaluation to allow trouble-free comparison and analysis of the individual projects. "As an evaluation tool NPV has many advantages. It takes into account the time value of money, and it

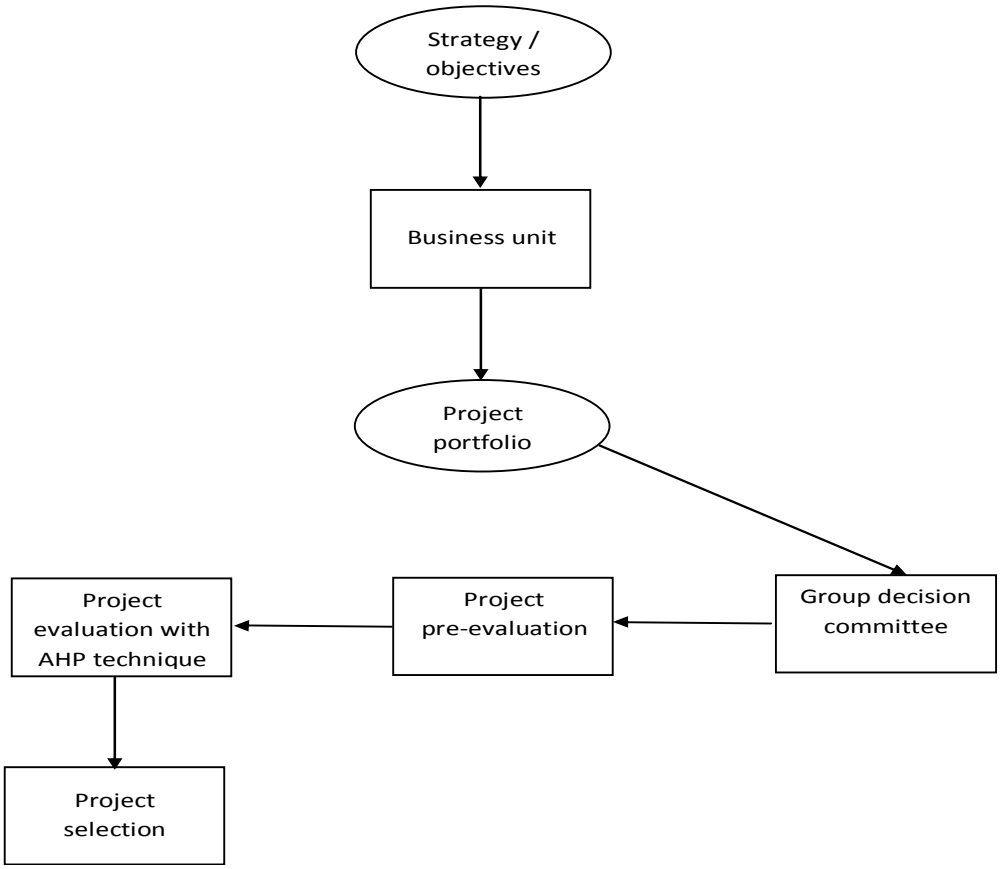

Figure 2. Framework for project selection using an integrated analytic hierarchy process.

gives a single project value for a given discount rate and set of cash flow assumptions" (Torries, 1998).

The management should finalise the degree of leverage as per the risk appetite of the stakeholders. Those projects are only accepted whose IRR is greater than the required rate of return (Keown, 2004). Both NPV and IRR are discounted cash flow methods used in project evaluation. "If the internal rate of return exceeds the required rate of return the project is accepted; if not the project is rejected" (Wachowicz, 2006) (Figure 2).

AHP technique and project selection

It has been developed by Saaty (1980) to exploit comparisons systematically. For instance, it helps to understand normalised matrices, and the hierarchical function (Figure 2) is utilised to evaluate the eigenvectors by the criteria. The comparisons that are accomplished in this process must be reviewed and repeated at all the levels. Consistency is ascertained by using eigenvectors λ_{max} and consistency index (CI) is $(\lambda_{max} - n) / (n - 1)$, where the n is matrix size.

Judgement can be checked by consistency ratio of CI (Table 2) that CR is acceptable if it does not exceed 0.10 and if it is more judgement is inconsisitent decioion maker should imporoved and reviewed the criteria (back to previous stage). The manager must model the given problem situation as a hierarchy that contains the decision goal using criteria and alternatives. Ascertain priorities by making sequential judgements on the basis of pair-wise comparisons.

Synthesise the judgements to obtain a set of the overall priorities to be used in the hierarchy and check consistency of the derived judgements. By means of scoring, the results are finally sophisticated and decision is reached (Tables 3-5).

EMPIRICAL STUDY

This study examines the relationship of factors among the Aluminium industry in Iran which includes: production, economic, politics and law, technology, marketing and human resource. Three top managers and fourteen middle-managers were invited to present opinions by brainstorming and Delphi techniques on the pair-wise comparison in terms of the best project selection in Iranian Aluminium Company between each factor and AHP technique used to analyse for best project selection by using conceptual framework. Qualitative information of following factors is:

Step 1: Calculating weight factors by Geometric Mean respect matrix.

$Z=Z_1+Z_2.....+Z_{17}$ /17

Step 2: Calculating the priority vector for a check whether the decision-maker's comparisons were consistent or

Table 3. Analysis of project selection methods.

Method	Benefits	Drawbacks
Net present value (Smythe and Fulmer,2000)	The NPV method of valuing an investment project takes into consideration the time value of money and gives the project's value by taking into account the discount rate and the cash flow assumption which is very important for project valuation.	In the NPV method, it is difficult to estimate the cost and the price of the project and also it is difficult to choose the right discount and tax rates.
	NPV is related to the maximisation of the wealth and it is one of the important criteria used in measuring an investment project.	NPV is determined externally and the discount rate has to be chosen by the investor.
	The NPV is a full proof method and decisions regarding projects can be taken easily. If the NPV is above or even equal to zero, then the project can be undertaken. But if the NPV is less than zero, then the project cannot be selected.	NPV does not specify the return for each invested worth of a currency.
Internal rate of return (Brigham and Houston, 2007)	IRR is the rate at which the initial investment and the future value of cash flows are equated. The cash flow determines the rate in IRR which is very good in the evaluation of projects.	In the IRR method there is no system to understand when the investments can be stopped
	Using the IRR method, comparisons can be made between the rates of return of a specific project against the rate of return on other feasible projects and so the correct project can be chosen.	In the IRR method, it is very difficult to calculate whether exactly the project is reasonable or not.
Payback (Kinney and Raiborn, 2008)	It is very useful in the early stages of project evaluation in order to identify and quantify risks. A project with short pay-back period is better than the project which has a big extended pay-back; provided all other investment criteria are same.	In this financial model, the future values of the investment are not compared with the discounted cash flows. In short, the time value of funds is ignored.
	This method is easy to use and the project's profitability can be easily calculated.	The proceeds of the investment project beyond the payback period are ignored in this model. So, the project evaluation cannot be accurately done and the discontinuation of pay-back point is ignored.
Return on investment (Rachlin and Sweeny, 1996)	Using this financial model, the cost effectiveness of projects can be measured.	The calculation of the ROI in different divisional projects is little harmful. Because, if one division of the project has less ROI; and in total the project is profitable for the firm, then the measurement of a project using this model is not good.
	Using this model, too much unnecessary speculations in operating activities is prohibited and so is beneficial for project evaluation.	Using the ROI method, a project is weighed in the short run. But, the long run is overlooked. Decisions are made by assessing in the short run at the cost of the long life of the project.

Table 3. Contd.

Analytical hierarchy process (Saaty, 1980)	This uses various criteria for decision making instead of sticking to anyone. Hence, effective decision will be the outcome.	It is a lengthy process and consists of various levels and hence, the process need be done carefully for correct results. Thus it is a complex process.
	It can be easily applied in various means of research such as in person, web ,telephone etc.	The software necessary to carry out the function is costly.

Table 4. Empirical study.

Parameter	Anode rodding (erection)	Power electronic distribution	Centrifuge erection	Molten metal	Reduction cells 75 k/aly	Production increment	Anode rodding (Building)
Budget ($ Million)	5.7	848	0.4	0.3	180	0.4	59
Production	Standards, energy productivity, raw material preparation , research and development in production, production rate, supply chain, production capacity, site position						
Economic	Recession rate , competition, oil rate, exchange rate, export and import policy, financial policies, stock exchange, privatization						
Politic and law	Tariff, ecosystem policies, mandatory standards, taxation, aluminum regulations, capital investment, labor and social security, foreign investment regulation						
Technology	Research and development, knowledge management, quality control, equipment and machine, technology change rate, rival technology						
Marketing	Distribution, advertisement, benchmarking, brand, production life cycle, exportation, product diversification, market share, market research						
Human resource	Age, education, HR training, HR productivity, experience, promotion and punishment, HR development, recruitment, selection and redundant						

not. A pair wise comparison is made between these factors in order to understand the importance of the best project.

As the value of production inconsistency is less than 0.1 so the judgement is acceptable. Similarly, the pair-wise comparison matrixes and priority vector for the remaining criteria can be found as shown as in Table 6-10. Now, expert choice software can do the rest of criteria automatically.

Figure 3 illustrates that most attention is given to the production factors respect in alternatives. Consistency is ascertained by using eigenvectors λ_{max} and consistency index (CI) is:

$(\lambda_{max} - n) / (n - 1)$

where, the n is matrix size. Judgement can be checked by consistency ratio of CI (Table 2) that CR is acceptable if it does not exceed 0.10 and if it is more judgement is inconsisitent decision maker should imporoved and reviewed the criteria

For prequalification purposes in project selection methodology, the best projects are now ranked respect to their overall priorities as follow as: Anode Rodding erection project, power electronic distribution project, centrifuge erection project, molten metal project, reduction cells project, production increment project and Anode Rodding building project, indicating Anode criterion such as production (Figure 4).

Step 3: Calculating the consistency ratio, calculating λ_{max} and calculating the consistency index, CI; with Expert choice software.

Step 4: selecting appropriate value of the random consistency ratio from Table 2; and checking the consistency of the pair-wise comparison matrix to Rodding erection project is the best qualified project to perform the project selection process.

Sensitivity analysis (gradient sensitivity and performance sensitivity)

The Expert Choice software‘s sensitivity graphs is used to test the probable changes which can be made in the decisions of the project. The sensitivity analysis is used to analyse whether the judgments made in the selection of projects are good or not. Sensitivity analysis helps in the identification of the effect of judgments to the user.

Table 5. Pair-wise comparison matrix for production.

Pro	AR (erc)	PEW	CE	MM	RC	PI	AR (BI)
AR (erc)		1.75	1.25	3.51	1.99	2.99	3.68
PEW			2.18	2.69	4.01	3.35	3.64
CE				4.03	3.25	2.78	3.89
MM					2.99	3.04	3.88
RC						3.01	3.44
PI							3.34
AR (BL)							

Synthesising the pair-wise matrix is used by dividing each element of the matrix by its columns Inconsistency = 0.09 < 0.1 ok. Priority for production = 0.368.

Table 6. Pair-Wise comparison matrix for economic.

Pro	AR (erc)	PEW	CE	MM	RC	PI	AR (BI)
AR (erc)		1.52	2.35	3.24	2.21	3.99	4.03
PEW			3.12	2.25	3.37	1.99	3.36
CE				2.58	3.35	3.44	2.19
MM					2	2.24	2.19
RC						2.78	2.99
PI							3.55
AR (BL)							

Inconsistency = 0.08< 0.1 OK. Priority for economic = 0.232.

Table 7. Pair-wise comparison matrix for politic and law.

Pro	AR (erc)	PEW	CE	MM	RC	PI	AR (BI)
AR (erc)		2.65	3.33	3.48	3.89	4.2	3.58
PEW			2.29	1.89	3.35	3.21	2.18
CE				2.11	1.52	3.14	1.12
MM					2.28	3.35	1.97
RC						3.34	3.1
PI							1.24
AR (BL)							

Inconsistency = 0.07< 0.1 OK. Priority for politic and law = 0.153.

Table 8. Pair-wise comparison matrix for technology.

Pro	AR (erc)	PEW	CE	MM	RC	PI	AR (BI)
AR (erc)		1.89	3.64	3.61	2.17	3.31	3.42
PEW			1.57	2.85	2.48	3.37	2.58
CE				2.66	4.8	3.34	2.15
MM					2.28	2.99	3.34
RC						2.18	2.36
PI							2.12
AR (BL)							

Inconsistency = 0.08< 0.1 OK. Priority for technology = 0.122.

Table 9. Pair-wise comparison matrix for marketing.

Pro	AR (erc)	PEW	CE	MM	RC	PI	AR (BI)
AR (erc)		3.35	3.24	2.74	2.75	3.34	3.15
PEW			1.28	3.99	2.25	3.36	3.25
CE				1.14	1.02	3.24	2.68
MM					2.35	3.95	2.47
RC						2.49	1.59
PI							1.48
AR (BL)							

Inconsistency = 0.06< 0.1 OK. Priority for marketing = 0.71.

Table 10. Pair-wise comparison matrix for human resource.

Pro	AR (erc)	PEW	CE	MM	RC	PI	AR (BI)
AR (erc)		3.33	2.27	2.15	2.84	2.34	2.35
PEW			2.25	2.34	2.69	3.58	3.49
CE				1.69	3.18	2.65	3.34
MM					2.14	2.35	3.69
RC						2.18	2.24
PI							2.33
AR (BL)							

Inconsistency = 0.07< 0.1 OK. Priority for human resource = 0.53.

Figure 3. Priorities with respects to weights.

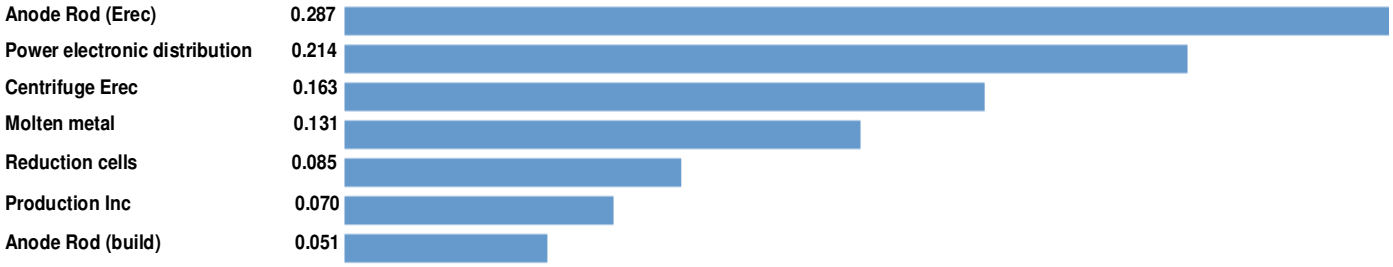

Figure 4. Syntheses with respect to final rating.

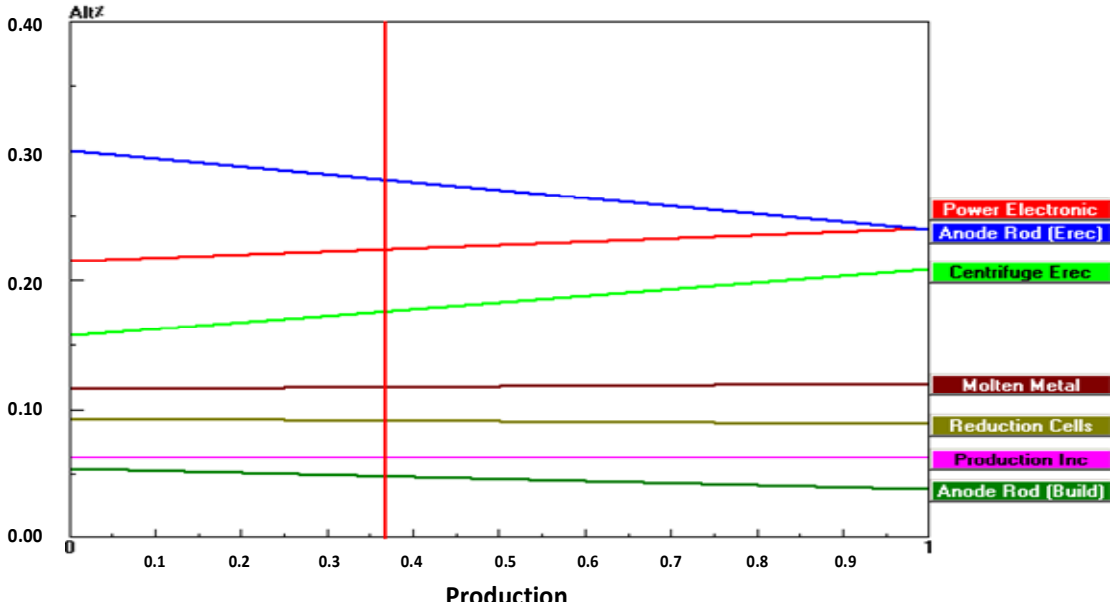

Figure 5. Gradient sensitivity.

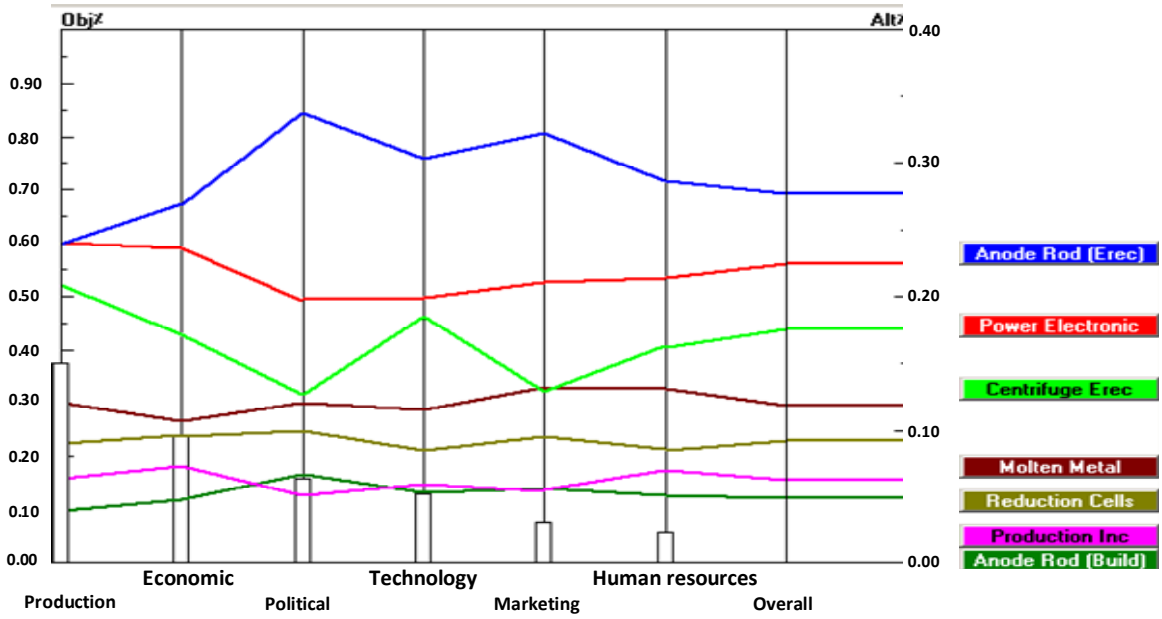

Figure 6. Performance sensitivity analysis.

When the relative scores of each project are fed, then the sensitivity analysis develops graphs in such a form that by examining the graph we can determine the most feasible project. Gradient sensitivity analysis (GSA) of expert choice software, which is shown in Figure 5, represents the variation of projects` rating to changes in production priority which is higher than other criteria, it shows how change priority has effect in another sides.

Figure 5 illustrates the role of priority in seven alternatives and also shows project hierarchy for best selection which represents the variation of projects s' rating to changes in production priority. It illustrates that if the production priority, which is 0.368, increases or decreases, the projects s' rating do not change.

That means GSA the projects' ratings are not sensitive. Another sensitivity analysis in expert choice is performance sensitivity analysis, which is shown in Figure 6, represents weight of best project in terms of

priority, criteria and share of each criterion in projects.

Conclusion

The framework is very useful where groups of people work together on complicated problems. These problems generally the high stakes that further entail human judgements and perceptions. The AHP design requires various criteria on the basis of which various alternatives are evaluated against each other and suitably prioritised. This framework is equipped mathematical judgements for the given decision problem.

Computerised methods and database administration can be used for entering and creating the judgements using even the complicated tools like fuzzy systems. There can be various applications of an AHP supported project selection framework. This model supported research design would provide ample scope for project selection in most complicated and multifaceted environment in Aluminium Industry.

The main aim of the study was to implement the hierarchical structure, identify the sub-contract and understand how they are useful, evaluate certain criteria of the study and analyse them by weights, and identify the various weights that are associated with one another. To develop and implement the system of managing benefits and finding out the databases related to the study, the selection module was used for the study.

The main limitation of the research is using another MCDM technique and mainly analytical network process and compares results with AHP technique and also calculating data with Statistical Package for the Social Sciences (SPSS) software and analysis data with other decision making techniques. The recommendations for the future study are to be considered and how strategies could affect selection process is identified and the success of the business operations is considered.

REFERENCES

Adler PS, Mandelbaum A, Nguyen V, Schwerer E (1995). From Project to Process Management: An Empirically Based Framework for Analyzing Product Development Time. J. Manag. Sci., 41(3): 458-484

Amato JD, Remolona EM (2003). The credit spread puzzle. J. BIS Q. Rev., pp. 51-63.

Badiru AB, Thomas MU (2009). Handbook of Military Industrial Engineering. CRC Press.

Baker S (2000). Perils of the Internal Rate of Return. [Online] available at: http://hadm.sph.sc.edu/courses/econ/invest/invest.html [Accessed 29 December 2011].

Belton V, Stewart TJ (2002). Multiple criteria decision analysis: an integrated approach Springer.

Belton V, Gear AE (1983). On the Shortcoming of Saaty's method of Analytic Hierarchies. J. Omega, 11: 228-230.

Belton V, Gear AE (1985). The legitimacy of Rank Reversal - A comment, J. Omega, 13: 143-144.

Bidgoli H (2004). The Internet encyclopaedia, 3th edition. John Wiley and Sons.

Brigham EF, Houston JF (2007). Fundamentals of financial management. Cengage Learning.

Campbell D (2007). Nonfinancial performance measures and promotion-based Incentives. J. Harv. Bus. School, (3): 1-44.

Carroll CL, Pirnes A (2009). From Innovation to Cash Flows: Value Creation by Structuring High Technology Alliances. John Wiley and Sons.

Charnes A, Cooper W (1961). Management Models and Industrial Applications of Linear Programming. John Wiley and Sons, New York, 1&2: 52-53.

Cleland DI, Ireland LR (2006). Project management: strategic design and implementation. McGraw-Hill Professional.

Correia C, Flynn D, Uliana E, Wormald M (2007). Financial Management. Juta and Company Ltd.

Cooper RE, Kleinschmidt J (1998). Portfolio Management for New Products. Reading, MA: Addison-Wesley.

Dyer JS (1992). Multiple Criteria Decision making, Multi-attribute Utility Theory: The Next Ten Years. J. Manag. Sci., 38(5).

DeFusco RA, McLeavey DW, Pinto JE (2007). Quantitative investment analysis. John Wiley and Sons.

Dhillon BS (2002). Engineering and technology management tools and applications. Artech House, pp. 42-44.

Dreyer KJ, Hirschorn DS, Thrall JH. (2006). PACS: a guide to the digital revolution. Birkhäuser.

Eilertsen S (2004). The art of project selection. [Online] Kollner, p.1. Available at: http://www.kollnergroup.com/wp-content/uploads/2009/11/The-Art-of-Project-Selection.pdf [Accessed 2 December 2011].

Frigeti E, Comninos D (2002). The Practice of Project Management: A Guide to the Business Focused Approach. Milford: Kegan Page Publishers, pp. 68-71.

Frederick J, Thomas I, Smythe JR, John G, Fulmer JR (2000). Use of Net Present Value Analysis by Electric Cooperatives; J. Manag. Q., 41(2): 2000.

Giddens N (2002). Building Your Brand with Brand Line Extensions; Agricultural Extension Value Added Marketing Specialist, Missouri Value-added Development Centre. J. Agric. Manag., 42(3).

Gillis M, Perkins H, Roemer M, Snodgrass RS (1996): Economics of development W. W. Norton & Company, New York.

Groppelli AA, Nikbakht E (2006). Finance. Barron's Educational Series.

Graves SB, Ringuest JL, Medaglia AL (2003). Models & methods for project selection: concepts from management science, finance, and information technology Springer.

Hamilton R, Chernev A (2010). The Impact of Product Line Extensions and Consumer Goals on the Formation of Price Image. J. Mark. Res., 47(1).

Hansen DR, Mowen MM, Guan L (2007). Cost Management: Accounting and Control. Cengage Learn., pp 42-48.

Hill GM (2009). The Complete Project Management Methodology and Toolkit. CRC Press.

Honningsvag B (2001). Hydropower in the new millennium: proceedings of the 4th Intl Conference on Hydropower Development. Taylor & Francis, 4(5).

Jones EC, Chung CA (2007). RFID in logistics: a practical introduction. CRC Press.

Kerzner H (2004). Advanced Project Management: Best Practices on Implementation. 2nd ed. Hobokon. John Wiley & Sons, Inc.

Keown AJ (2004). Foundations of finance: the logic and practice of financial management. Pearson Education Asia Limited.

Koppala G (2010). Managing the project selection process. [Online]. Available at: http://www.articlesbase.com/management-articles/managing-the-project-selection-process-from-pome-by-gautam-koppala-vt-2266437.html [Accessed 22 December 2011].

Kotler P, Keller K (2011). Marketing Management, 14th edition, prentice hall.

Kureshi N (2010). Projects in contemporary organization. [Online] available at: http://nadeemkureshi.net/documents/Pres2.pdf

Kummar S, November S (2004). AHP-Based Formal System for R&D Project Evaluation. J. Sci. Ind. Res., 63: 888-896.

Kooros SK, Badeaux LM (2007). Economic development planning modals: A comparative assessment.

Kinney MR, Raiborn CA (2008). Cost Accounting: Foundations and Evolutions. Cengage Learning, pp. 52-56.

Lewis JP (2007). Fundamentals of Project Management. New York:

AMACOM division of American Management Association.
Lootsma FA (1991). Scale Sensitivity and Rank Preservation in a Multiplicative Variant of the Analytic Hierarchy Process, Delft University of Technology, Report of the Faculty of Technical Mathematics, 91(20).
Liu FHF, Hai HL (2005). The voting analytic hierarchy process method for selecting supplier. Intl. J. Prod. Econ., 97(i3): 308-317.
Mahmoodzadeh S, Shahrabi J, Pariazar M, Zaeri S (2007), Project Selection by Using Fuzzy AHP and TOPSIS Technique; J. World Academy of Science. Eng. Tec., 30(64): 333-338.
Marde S, Herrero I, Pascoe S (2009). Management Objective Importance in Fisheries: An Evaluation Using the Analytic Hierarchy Process, J. Environ. Mgt., 33: 75-105.
Masse LN, Barnett WS (2002). A benefit cost analysis of the Abecedarian early childhood intervention. New Brunswick, NJ: NIEER.
Meredith JR, Mantel SJ (2009). Project Management: A Managerial Approach: A Managerial Approach. John Willey and Sons.
Moyer RC, McGuigan JR, Kretlow WJ (2009). Contemporary Financial Management. Cengage Learning, pp. 70-73.
Mullaly ME (2003). Get your priorities straight: Defending a formal approach to making project choices, cutter consortium press
Needles BE, Powers M, Crosson SV (2007). Principles of Accounting. Cengage Learning, pp. 112-114.
Pennypacker J, Renta S (2009). Project Portfolio Management-a view from the management trenches. John Wiley & Sons, Inc.
Rachlin R, Sweeny A. (1996). Accounting and financial fundamentals for nonfinancial executives. AMACOM Div American Mgmt Assn.
Regan P, Holtzman S (1995) "R&D decision advisor: An interactive approach to normative decision System model construction", Eurp J. OR, 84(1): 1995.
Romero C, Rehman T (2003). Multiple criteria analysis for agricultural decisions. Elsevier.
Ross S, Hiller D (2010). Corporate Finance, 8th Edition. McGraw-Hill.
Rudolf S (2008). The Net Present Value Rule in Comparison to the Payback and Internal Rate of Return Methods. Available at: http://university.akelius.de/library/pdf/the_net_present_sascha_rudolf.pdf [Accessed 11 December 2011].
Saaty TL, Vargas LG (2000). Models, methods, concepts & applications of the analytic hierarchy process. Springer.
Saaty TL (1980). "The analytic hierarchy process", New York: McGraw-Hill
Saaty TL (1990). Decision Making for Leaders. Pittsburgh, PA: RWS.
Saaty TL, Vergas LG (2001). Models, Methods, Concepts & Applications of the Analytic Hierarchy Process. Norwell: Kluwer Academic Publishers.
Schniederjans MJ, Hamaker JL, Schniederjans AM. (2004). Information technology investment: decision-making methodology. World Scientific.
Shaw A (1999). A Guide to Performance Measurement and Non-Financial Indicators. [Online]. Available at: http://www.fpm.com/journal/mattison.htm [Accessed 12 December 2011].
Schoner B, Wedley WC (1989). Ambiguous criteria weights in AHP: consequences and solutions, J. Decis. Sci., 20: 462-475.
Shim J (1989). Bibliography research on the analytic hierarchy process (AHP). J. Socio-Econ. Plan. Sci., 23(3): 161-167.
Sifri G (2003). Choosing and deploying a project priority selection system. J. Technol. Republic, 22(2): 143-150.
Thompson J, Martin F (2009). Strategic Management-awareness and change, 5th edition. Thomson press.
Triantaphyllou E (2000). Multi-Criteria Decision Making Methods: A Comparative Study. Kluwer Academic Publishers, Dordrecht.
Torries TF (1998). Evaluating mineral projects: applications and misconceptions. SME.
Verzuh E (2003). The portable MBA in project management. John Wiley and Sons.
Wachowicz JM (2006). Fundamentals of financial management. Pearson Education Inc.
Yahya S, Kingsman B (1999). Vendor rating for an entrepreneur development Programme: A case study using the analytic hierarchy process method. J. OR Society, 50: 916-930.
Zahedi F (1986). "The analytic hierarchy process: a survey of the method and its applications." Interface, 16(4): 96-108.