Do Company-Specific Factors Influence the Extent of Usage of Risk Analysis Techniques in Strategic Investment Decisions?

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This study empirically examines the extent of usage of risk analysis approaches and techniques and the influence of company-specific factors on the extent of usage of risk analysis approaches and techniques in Strategic Investment Decisions (SIDs). Based on the responses obtained through a single cross-sectional mailed survey, from 36 senior finance professionals representing 36 automotive companies operating in India, this study gives four important conclusions. First, the respondent companies are using formal risk analysis techniques equally to the subjective/intuitive risk assessment techniques. Second, the selected firm-specific characteristics do not have a significant relationship with the overall scope of risk analysis in SIDs. Third, sensitivity analysis is the most preferred formal risk measurement technique used by the respondents, followed by probability distribution. Finally, shortening payback period is the most preferred formal risk adjustment method used by the respondents, followed by raising the discount rate.

Introduction

The business environment is rapidly changing all over the world. Especially, in the last two decades, there have been drastic and fundamental changes across the nations due to the process of globalization. Today, the term globalization has become a catchy-phrase though not a new phenomenon. What is new is its speed and reflexivity, given its complex nature and the gravity of impact on the Indian business environment (Bhardwaj and Hossain, 2001). The rate of technological and competitive change being witnessed by the manufacturing industry is extreme. For instance, automotive industry faces stiff competition, which is evident from the copious flow of models emerging in the automotive industry. Companies have introduced new models regularly, and their market shares have been fluctuating consistently. Companies must be able to diagnose these changes quickly and, most importantly, be able to respond to them in order to maintain or improve their competitive position in the market (Veronika, 2000).

This requires the most efficient and effective utilization of its resources, which involves the evaluation of the company's strengths and weaknesses in the light of the environmental threats and opportunities. Anecdotal evidence suggests that in business worldwide, efficient allocation of capital is an important and challenging task for
contemporary Decision Makers (DMs). Such decision making can be regarded as a complex managerial activity (Jose, 2005), as a key to managerial success, and is considered by many to have inspired multiple research studies over the last four decades (Cyert and March, 1963; Mintzberg et al., 1976; Kumar and Shesh, 1994; Dean and Sharfman, 1996; Papadakis, 1998; Burke and Miller, 1999; Nutt, 1999; Ekenberg, 2000; Ford and Gioia, 2000; Gunn, 2000; and Jose, 2005). While these studies have provided useful broad insights into the field of decision making, it is surprising that only few have studied investment decision-making in complex business environments, or focused on the subfield of Strategic Investment Decisions (SIDs). According to Northcott (1995), such work would be vital at two levels: for the future operation of individual firms making investment, and the functioning of the economy of the nation as a whole. At the firm level, SIDs have implications for many aspects of operations, and often exert a crucial impact on survival, profitability and growth, since it involves the allocation of substantial financial, human and organizational resources (Jacques-Bernard and Sauner-Leroy, 2004). Therefore, SIDs have a long-term and wide range impact on the firm’s performance, and they could be critical to the firm’s success or failure (Brown and Solomon, 1993).

The success of SIDs depends on proper selection, screening, evaluation, execution and monitoring of the proposals. The selection of a project is based on financial and nonfinancial information. However, information and alternatives are constrained as the time and resources to gain information or identify alternatives may be limited. Since decisions must be made within this constrained environment, one can say that the major challenge of decision making is about dealing with uncertainty, and a major goal of decision analysis is to reduce the level of uncertainty. The DMs can never have all the information needed to make a decision with certainty, so most decisions involve an undeniable amount of risk (Robert, 1998). Therefore, DMs need to address the critical nature of risk and uncertainty in the decision-making process; this is known as risk analysis (Smith, 1994). The degree of association between risk and uncertainty varies from one decision to another, and in such a case, may determine the decision makers’ choice of models, techniques, and processes that are used for making the investment decisions (Jacques-Bernard and Sauner-Leroy, 2004).

In order to make optimal decisions, the DMs often rely on analytical and quantitative approaches. Yet, on the other hand, as uncertainty increases, the DMs are unable to quantify the possible outcomes; hence they are forced to rely on judgment and past experience to a greater extent, i.e., employing a more qualitative approach to make the decision, even though they still attempt to go through the process of an analytical and quantitative analysis (Courtney et al., 1997; and Alessandri, 2003). Thus, the strategic investment process and its associated methods of financial analysis depend ultimately upon what influences the behavior of the decision maker in allocating resources among competing investment alternatives in a given context (Pike, 1989). The constantly increasing complexity of business environment, exchange rate fluctuations, difficulty in predicting competitors’ behavior, and increasing pace of change in technology, have also raised the importance of risk analysis in SIDs (Ho and Pike, 1992). Therefore, it is
important to identify the factors influencing the level of usage of risk analysis in SIDs. Apart from others, company-specific factors play an important role in the extent of usage of risk analysis in SIDs and hence this study has been carried out.

2. Literature Review and Research Hypotheses

Although companies are using more sophisticated evaluation techniques, they are neglecting risk (Blazouske et al., 1988). It is important to consider risk while evaluating the investment proposals, because risk is an inherent element of virtually every SID. Further, risk analysis is not a substitute of normal investment appraisal methodology, but rather a complementary tool that enhances its results.

2.1 Level of Risk Analysis

As discussed above, risk is inherent in all decisions. While looking at the risk of a decision, it is necessary to have a broader perspective. It is because of the following reasons:

- The impact on one project may have influence on other projects.
- The DM has to consider the nonfinancial influences of a project, which may have impact on the project. For example, business strategy is nonfinancial information that has impact on the extent of usage of techniques.
- Whether acceptance or rejection of a project influences the shareholders’ wealth or not?
- The DM has to account for the dependencies as well as relationship of other projects with the project in hand.

It is essential to account for the above listed aspects while making SIDs. The number of aspects while making SIDs varies from one organization to other. It is due to the firm belonging to different business and financial risk groups. This study has identified five objective measures, namely, standard deviation of the return on capital employed as a composite measure of market, technological, environmental and other volatility sources; coefficient of variations of the firm’s sales; firm's beta value as an indicator of the general economic climate in which a firm operates; firm size; and leverage, which influence the level of risk analysis. All these five measures were used by Shao and Shao (1996) and Ho and Pike (1998) and they found that these variables influence the level of risk analysis.

2.1.1 Sales Volatility (SV)

Sales volatility is one of the important measures of business risk. Sales of a company is affected by various factors such as industry-wide trends, general economic condition of a country, and seasonal variations in which a company operates. In order to measure the volatility of sales, this study has used the Coefficient of Variation (CV) of sales. Higher CV indicates that the sales of a firm are more fluctuating or conversely less consistent, less stable or less uniform. Depending on the environmental uncertainty, the DM tends to use risk analysis accordingly. Therefore, it is expected that:
$H_1$: Higher the sales volatility, higher is the level of risk analysis in SIDs.

2.1.2 Performance Volatility (PV)
This is another important measure of business risk. This measure is the composite yardstick of market, technological changes, and other volatility sources. The level of CV of Return on Capital Employed (ROCE) shows the environment in which the firm operates. The level of performance depends on the tools employed in making SIDs since there exists a relationship between sophisticated techniques and performance. Therefore, if the CV of ROCE is higher, then the firm tends to use risk analysis more extensively. It is expected that:

$H_2$: Higher the performance volatility, higher is the level of risk analysis in SIDs.

2.1.3 Beta Value
Beta is a measure of volatility or systematic risk of a security in comparison to the market as a whole. A company cannot eliminate or avoid systematic risks, because they affect all the companies’ securities, and all the securities traded in the market do not have the same level of systematic risk. It depends on the sensitivity of the security to the market fluctuations. This can be measured by Beta ($\beta$). It can be viewed as an index of the degree of the responsiveness of the security’s returns to the market fluctuations. It is important to understand the level of systematic risk before making SIDs. Therefore, it is expected that:

$H_3$: Higher the beta value, higher is the level of risk analysis in SIDs.

2.1.4 Firm Size
There is a potential relationship between firm size and firm performance, because a large firm possesses a favorable competitive position over a small firm due to availability of capital and hence its ability to invest in profitable large-scale projects. While discovering the existence of potential relationship between the performance and firm size, many researchers used firm size as an important variable in their studies (e.g., Pike, 1984; Shao and Shao 1996; Farragher et al., 2001; and Papadakis and Barwise, 2002) and discovered a significant positive relationship between them. Considering this argument, i.e., size of the firm influences its performance, a potential relationship between size and capital budgeting sophistication cannot be ignored. This is due to the following reasons:

• Typically large firms are more likely to have full-time staff members for making SIDs; and

• Large firms have the ability to make considerable investments for expansion, diversification, etc., which requires the use of more sophisticated techniques.

The relationship between firm size and capital budgeting decisions has been empirically tested in a few studies (e.g., Pike, 1984; Ho and Pike, 1991, 1992 and 1998; Klammer et al., 1991; and Helen et al., 2003). Firm size has a relationship with the extent
of usage of risk analysis (Klammer et al., 1991), because larger firms tend to use more risk analysis than the smaller ones as the larger firms are more likely to have available resources (Ho and Pike, 1998). From the above discussion, it is found that firm size is an important determinant of risk analysis in SIDs. Therefore, it is expected that:

\[ H_4: \text{Larger the firm size, higher is the level of risk analysis in SIDs.} \]

\[ H_5: \text{There would be a significant association between the firm size and the aspects to be considered in risk analysis in SIDs.} \]

2.1.5 Leverage

As discussed above, any SID needs substantial amount of capital which results in a change in the capital structure of the firm. The leverage indicates the level of financial risk of a firm. The leverage has a potential influence on the managerial compensation (Agarwal and Mandelker, 1987). This, in turn, affects the extent of usage of sophisticated techniques such as risk analysis while making SIDs. Leverage has been studied most frequently in the capital budgeting literature (Agarwal and Mandelker, 1987; Shimin, 1995; Shao and Shao, 1996; Ho and Pike, 1998; and Helen et al., 2003). These studies found that companies with higher level of leverage tend to use more of sophisticated techniques than the firms with lower level of leverage. Therefore, the hypothesis is formulated as:

\[ H_6: \text{Higher the leverage, higher is the level of risk analysis in SIDs.} \]

2.2 Risk-Adjusted Methods

It is a widely accepted fact that DMs expect returns from their investments to compensate the risk they bear for such investments. Financial theorists suggest that DMs should understand the risk involved in SIDs in a broader perspective in order to employ the techniques to adjust the same. There are some techniques, namely, shortening the payback period, certainty equivalent approach, raising discount rate, and adjusting the cash flows (Ho and Pike, 1991 and Shao and Shao, 1996), which are used depending on the risk level of projects and preference of the DMs. Ho and Pike (1991) found that almost all the companies employ some formal methods to adjust for risk. Further, among the formal methods, raising discount rates was used very frequently and was closely followed by shortening payback period. These findings were quite in contrast to the findings of Shao and Shao (1996). On the whole, raising discount rate and shortening the payback period were used more than other techniques (Ho and Pike, 1991). This difference in usage of methods to adjust for risk leads to the following hypothesis:

\[ H_7: \text{There is a significant difference among the methods used to adjust for risk in SIDs.} \]

2.3 Trends in the Use of Risk Analysis Approaches and Techniques

In recent years, risk analysis has become increasingly important because of unprecedented but fundamental changes in the Indian economic system, deregulation of all major industries, intensive competition from the global players, and rapid advances in technology (Blazouske et al., 1988). Considerable attention has been devoted to investigate...
the use of risk analysis techniques in capital budgeting. However, very limited studies have covered it in detail. For example, the extent of the usage of these techniques depends on various factors such as industry size, profitability, strategy, environmental factors/focus, reward systems, etc. The following literature review highlights the need for the current study. There are a number of techniques available for analyzing investment risk, which may be classified into subjective and formal techniques. Formal techniques include Sensitivity Analysis (SA), Simulation Models (SM), Probability Tree (PT), Adjustment of Required Payback Period (ARPP), and Adjustment of Discount Rate (ADR).

The trends in the use of formal risk analysis techniques in capital budgeting are well documented in many countries. In addition, most manufacturing companies use more than one technique for analyzing risk in their SIDs. Among the risk analysis techniques, sensitivity analysis is the most popular technique, followed by scenario analysis. The increasing usage of these techniques is due to the availability of computer software packages which help in applying these techniques. This was found by Wong et al. (1987), Pike (1989 and 1996), Pandey (1989), Klammer et al. (1991), Jog and Srivastava (1995), Kester and Chong (1998), Farragher et al. (1999), Kester et al. (1999), Ahmed and Zaki (1999), Arnold and Hatzopoulos (2000), Manoj (2002), and Ashish and Bhavin (2006). According to the results of the survey conducted by Pike, 88% of large companies in the UK used SA. In India, Pandey (1989) opined that the sensitivity and conservative forecasts are two equally important and widely used methods of handling investment risk. Also, Manoj (2002) reported similar findings in his survey (90.1% of the respondents used sensitivity analysis, 61.6% of the respondents employed scenario analysis, and 31% of the respondents used risk-adjusted discount rate while assessing the project risk). Similarly, Ashish and Bhavin (2006) obtained similar findings in the context of Indian chemical industry.

In addition, these surveys revealed that companies do not normally rely on any single technique, but prefer to use a combination of techniques. According to Manoj’s survey there has been an increase in the use of risk analysis techniques (see also, Pike 1989 and 1996). Though the DMs often rely more on formal risk analysis, when uncertainty increases, they tend to rely on judgement and past experience to a greater extent. This is due to the fact that formal analysis needs more information to quantify the possible outcomes (Courtney et al., 1997; and Alessandri, 2003), the managers are unfamiliar with risk analysis, and there is lack of staff, time, and experience for carrying out formal analysis (Lazaridis, 2004). Further, Cooper et al. (1990) stated that companies do not use risk analysis in their formal analysis, but, they evaluate risk subjectively. Similarly Alessandri et al. (2004) identified a qualitative approach to evaluate capital investment projects as a useful method, because DMs make decisions, which involve high levels of uncertainty.

The above discussion suggests a substitution effect (a negative relationship) between the two methods of risk analysis. When DMs have all relevant information, then it leads to less reliance on subjective methods of risk analysis. In contrast, subjective methods are likely to become increasingly important in situations where uncertainty is high; as a result, DMs are unable to get all relevant information. The following hypotheses are formed from the above discussion:
\( H_g \): Formal risk analysis methods are used more extensively than the subjective methods in SIDs.

\( H_g \): There would be an inverse relationship between the formal and subjective risk analysis methods.

3. Research Methodology

3.1 Data Collection

This study adopted a quantitative, non-experimental, single cross-sectional mailed survey design in order to gain a broad understanding of the extent of the usage of risk analysis practices in SIDs made by the automotive companies in India. The financial data were obtained from Prowess, CMIE. The primary data were collected by using the survey method. Primary data related to scope of risk analysis, risk analysis approaches and techniques, and risk-adjusted methods were collected using a structured questionnaire (see Appendix). The questionnaire was adapted from Ho and Pike (1998) with a few modifications made to suit the Indian environment and the objectives of the study as well.

3.2 Sampling Design

The population of the research was confined to automotive companies operating in India. The study identified 95 companies as the relevant sample frame using three criteria: (1) Companies should be listed on the BSE and NSE; (2) Company should have a minimum of 10 years of operation; and (3) The availability of data for the study period. The questionnaire was sent to senior finance professionals (CFO, General Manager – Finance, Vice-President – Finance, Controller, etc.) of 95 companies, out of which, 36 questionnaires were completed (a response rate of 37.89%). The response rate is better than other previous studies (20% in the case of Ashish and Bhavin (2006) and 15.43% in the case of Manoj (2002)). The sample of 36 companies was a true representative of the population and the same was justified with help of one sample \( t \)-test. Table 1 shows that there is no significant difference between the sample mean and the population mean in terms of net fixed assets.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>N</th>
<th>Mean</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>t-Value</th>
<th>df</th>
<th>Sig.</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobile</td>
<td>19</td>
<td>81.3</td>
<td>10</td>
<td>845.71</td>
<td>1,165.19</td>
<td>0.089</td>
<td>9</td>
<td>0.931</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Ancillaries</td>
<td>76</td>
<td>113</td>
<td>26</td>
<td>108.89</td>
<td>107.35</td>
<td>0.196</td>
<td>25</td>
<td>0.846</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Overall</td>
<td>95</td>
<td>245</td>
<td>36</td>
<td>313.55</td>
<td>685.11</td>
<td>0.60</td>
<td>35</td>
<td>0.550</td>
<td>Insignificant</td>
</tr>
</tbody>
</table>

3.3 Measurement

With the help of financial theory and previous research, this study identified a list of variables including sales volatility, performance volatility, firm's beta value, firm size, and gearing (leverage), representing firm's characteristics which may influence the use of risk analysis practices. These variables were measured on the basis of publicly available
information, i.e., annual reports of the concerned companies for five years (FY2003-04 to FY2007-08). To measure the sales volatility, the study used the CV of the firm’s sales for the period of five years. To measure the performance volatility of the company, it used the coefficient of variation of ROCE for the five year period which is a composite measure of the volatility in market, technological changes, and other sources of volatility. To measure the general economic climate, it used single year beta value. Gearing (leverage) ratio was calculated for each company using the formula: (long-term debt divided by total assets) multiplied by 100 for each year. Then the results were totalled and divided by the number of years (5) to obtain the average value. Further, net fixed assets were used to measure the firm size, because capital budgeting decisions are directly linked to the firm’s assets. The five-year average of net fixed assets was used as a second measure of financial variable. The amount of fixed assets for five years were totalled and divided by the number of years (5) to obtain the average value. The extent of usage of risk analysis techniques was measured on a five-point scale.

3.4 Analytical Tools

This study employed various techniques such as one sample t-test, independent samples t-test, correlation, chi-square, and Friedman two-way ANOVA, and data analysis was done using the SPSS Software Version 16.

4. Results

4.1 Level of Risk Analysis

Financial theorists suggest that risk should be the key consideration while making SIDs. The level/scope of risk analysis is not the same for all companies and/or all projects, because of time and resources constraints, and company-specific factors. Hence, it is not enough to know the level of risk at individual project level. Therefore, the DMs should have understanding of the combined effect of risk analysis. Understanding of the different aspects of risk analysis provides the complementary perspectives and criteria for making investment decisions (Ho and Pike, 1991). Therefore, the study investigated whether the DMs have accounted for each of the listed aspects of investment risk in their SID process. The results are presented in Table 2.

<table>
<thead>
<tr>
<th>Aspects of Risk Analysis</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact of nonfinancial uncertainties</td>
<td>47.20</td>
</tr>
<tr>
<td>Risk of each individual project</td>
<td>69.40</td>
</tr>
<tr>
<td>Effect of the project risk on overall corporate profitability</td>
<td>88.90</td>
</tr>
<tr>
<td>Effect of the project risk on shareholders’ portfolio</td>
<td>50.00</td>
</tr>
<tr>
<td>Relationship among various uncertainty factors</td>
<td>47.20</td>
</tr>
<tr>
<td>Relationship among the returns of different projects</td>
<td>41.70</td>
</tr>
</tbody>
</table>

*Note: Total percentage exceeds 100 as many respondents chose more than one answer.*
Do Company-Specific Factors Influence the Extent of Usage of Risk Analysis Techniques in Strategic Investment Decisions?

Table 2 exhibits that most of the respondents (88.9%) very frequently carry out analysis in order to find out the effect of project risk on overall corporate profitability. The second most opined response was the assessment of risk of each project individually (69.40%), followed by the measurement of the effect of the project risk on shareholders’ portfolio (50%). The analysis of the effect of nonfinancial uncertainties and relationship among the various uncertainty factors were responded equally (47.20%). The analysis of relationship among different projects returns was found to be lowest (41.70%) in use among the sample firms. In order to find the relationship between the level of risk analysis and firm characteristics, the study used aggregate measure of overall risk analysis. The authors assigned a score of one point for each aspect included in the risk evaluation process and then calculated an aggregate score of overall risk analysis. The higher scores indicate that the level of risk analysis performed in the investment process by the respondent companies is high. The results are presented in Table 3. Almost all the respondents analyzed at least two aspects of risk analysis. 22% of respondents have accounted all the aspects of risk analysis in their SIDs. These results are not consistent with the findings of Ho and Pike (1991).

<table>
<thead>
<tr>
<th>No. of Aspects Analyzed</th>
<th>Number of Responses</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>2</td>
<td>05.60</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>05.60</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>27.80</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>11.10</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>22.20</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>05.60</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>22.20</td>
</tr>
</tbody>
</table>

The correlation between aggregate score and the selected firm characteristics along with its significance value are given in Table 4. The bivariate correlation analysis shows that SV ($r = 0.128$), PV ($r = 0.071$), beta ($r = 0.022$), average fixed assets ($r = 0.152$), and leverage ($r = -0.068$) were not significantly correlated with the overall scope of risk analysis at 0.05 level. The results of hypotheses 1 and 2 are consistent with the findings of Ho and Pike (1991 and 1998), whereas the results of hypotheses 3, 4, and 6 are not

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Value ($r$)</th>
<th>Sig.</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.128</td>
<td>0.693</td>
<td>Insignificant</td>
</tr>
<tr>
<td>2</td>
<td>0.071</td>
<td>0.456</td>
<td>Insignificant</td>
</tr>
<tr>
<td>3</td>
<td>0.022</td>
<td>0.899</td>
<td>Insignificant</td>
</tr>
<tr>
<td>4</td>
<td>0.152</td>
<td>0.376</td>
<td>Insignificant</td>
</tr>
<tr>
<td>6</td>
<td>-0.068</td>
<td>0.679</td>
<td>Insignificant</td>
</tr>
</tbody>
</table>
consistent with the findings of Ho and Pike (1991 and 1998). To examine the association between the firm size and the level of risk analysis in SIDs, chi-square test was conducted. This study has classified the companies into two groups, i.e., if average fixed asset size is below 100, it is labelled as Group 1, and if it is above 100, then it is labelled as Group 2. The results are presented in Table 5. The results indicate that firm size does not have any association with the aspects to be considered in the risk analysis in SIDs at 0.05 level.

<table>
<thead>
<tr>
<th>Association of Firm Size with</th>
<th>Value</th>
<th>Sig.</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact of non-financial uncertainties</td>
<td>0.000</td>
<td>0.985</td>
<td>Insignificant</td>
</tr>
<tr>
<td>The risk of each individual project</td>
<td>0.020</td>
<td>0.888</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Effect of the project risk on corporate overall profitability</td>
<td>0.892</td>
<td>0.345</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Effect of the project risk on shareholders’ portfolio</td>
<td>0.111</td>
<td>0.738</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Relationships among various uncertainty factors</td>
<td>1.839</td>
<td>0.175</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Relationship among the returns of different projects</td>
<td>1.685</td>
<td>0.194</td>
<td>Insignificant</td>
</tr>
</tbody>
</table>

4.2 Adjusting Risk for Project Decision

After knowing the level of risk analysis, it is important to adjust risk for project decisions. The DMs may aim at shortening the payback period, or raising discount rate, etc., which depends on the risk level of the project and preference of the DM. Respondents were asked to rank the various risk adjustment techniques used by them on a five-point scale. Table 6 presents the Friedman two-way ANOVA statistic and the associated p-value. In addition, mean ranks of treatments are also displayed in Table 6. The respondents have opined that shortening the payback period was the most important method used by them to adjust for project risk, followed by raising the discount rate (2.60), subjective adjustment of cash flows (3.04), adjustment of estimated cash flows according to the cost of risk premium (3.12), and the certainty equivalent of cash flows (3.78). It is observed from the mean rank that there are variations in the methods used to adjust risk among the sample companies. This has been tested using Friedman two-way ANOVA. The result shows that there is a significant difference in the use of risk-adjusted methods in SIDs by the sample companies (p < 0.05) (see Table 6).

<table>
<thead>
<tr>
<th>Risk-Adjusted Methods</th>
<th>Mean Rank</th>
<th>Calculated Value</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shorten payback period</td>
<td>2.46</td>
<td>17.462</td>
<td>4</td>
<td>0.002*</td>
</tr>
<tr>
<td>Raising discount rate</td>
<td>2.60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjust estimated cash flows subjectively</td>
<td>3.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjust estimated cash flows for cost of risk premium</td>
<td>3.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use certainly equivalent of cash flows</td>
<td>3.78</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * implies significant at 0.01 level.
4.3 Risk Measurement Approaches and Techniques

After understanding the scope of risk associated with a project, the next step is to assess the level of risk of a project. In order to know the extent of usage of risk analysis approaches and techniques in SIDs, the respondents were asked to respond on a five-point frequency scale. The listed options were drawn from the literature review discussed earlier.

4.3.1 The Extent of Usage of Risk Measurement Approaches and Techniques

Table 7 reveals that the respondents use more than one technique, i.e., combination of methods is used in risk analysis. Surprisingly, the results indicate that informal risk measurement approach, i.e., subjective determination of risk was generally used more than the formal methods to assess for project risk. Among the formal methods, the most commonly used method is sensitivity analysis, followed by probability analysis with a mean score of 3.61, CAPM with a mean score of 2.58, and Monte-Carlo-type probabilistic simulation techniques with a mean score of 2.17.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Mean Score</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjective/Intuitive Assessment</td>
<td>3.33</td>
<td>1.095</td>
</tr>
<tr>
<td>Sensitivity Analysis</td>
<td>3.69</td>
<td>0.668</td>
</tr>
<tr>
<td>Probability Analysis</td>
<td>3.61</td>
<td>0.994</td>
</tr>
<tr>
<td>Risk Simulation</td>
<td>2.17</td>
<td>1.254</td>
</tr>
<tr>
<td>CAPM</td>
<td>2.58</td>
<td>1.156</td>
</tr>
</tbody>
</table>

4.3.2 Interrelationship Among the Formal Risk Measurement Approaches

In order to find the extent to which firms use a variety of formal risk measurement techniques in their investment process, the study employed bivariate correlation analysis (see Table 8). Sensitivity and probability analysis, probability analysis and risk simulation, and risk simulation and CAPM were found to be positively significant at 0.05 level. This indicates that companies frequently employ several risk measurement techniques either for the same project or for different projects. In order to examine the significant difference among the formal and informal risk measurement approaches, an independent samples t-test was conducted.

<table>
<thead>
<tr>
<th>Risk Measurement Techniques</th>
<th>Sensitivity Analysis</th>
<th>Probability Analysis</th>
<th>Risk Simulation</th>
<th>CAPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity Analysis</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Probability Analysis</td>
<td>0.390** (0.000)</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Risk Simulation</td>
<td>0.267 (0.115)</td>
<td>0.47** (0.00)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>CAPM</td>
<td>0.200 (0.241)</td>
<td>0.278 (0.101)</td>
<td>0.74** (0.00)</td>
<td>–</td>
</tr>
</tbody>
</table>

Note: ** implies correlation is significant at 0.05 level; and the significance levels are given in the brackets.
Table 9: Results of Independent Samples t-Test

<table>
<thead>
<tr>
<th>Approach</th>
<th>Mean</th>
<th>SD</th>
<th>t-Statistic</th>
<th>df</th>
<th>Sig. (Two-Tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formal</td>
<td>3.01</td>
<td>0.784</td>
<td>1.423</td>
<td>70</td>
<td>0.159</td>
</tr>
<tr>
<td>Informal</td>
<td>3.33</td>
<td>1.095</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Discussion of the Results

The literature suggests that the risk of a decision should be looked at from a broader perspective, which is a key consideration in the SID. If risk is ignored or being focused narrowly, it affects the performance of a decision adversely and thereby fails to achieve the wealth maximization objective of a company. It is necessary to account for the varying degrees of risk among the projects and how it affects other projects and objective of a company and so forth. Hertz and Thomas (1983) and Ho and Pike (1991) stress the importance of using different levels of risk analysis, and in case there is any conflict, it should be discussed among the DMs before reaching a decision outcome. The above stated results provide important insights for DMs. The results are quite contrary to that of Ho and Pike (1991). This may be due to difference in the operating business environment, availability of data, company-specific factors, SIDs evaluation process duration, and preference of information related to SIDs. Almost all the respondents employed some formal method to adjust the risk in SIDs process. This indicates that there is no gap between the techniques prescribed by theory and those used in practice. In order to adjust for risk, the DMs prefer to use the shorten payback period either individually or with other techniques as it is easy to use compared to other techniques. Raising the discount rate is another important method used by the DMs. The common reason for using this method is that it is more realistic, more accurate, and consistent with discounted cash flow evaluation framework (Ho and Pike, 1991; and Shao and Shao, 1996). In addition, the study found that there is a significant difference among the methods used to adjust for risk by different sample companies.

The literature suggests that risk should be measured properly which is critical for proper evaluation and success of the capital investment decisions. If risk is not measured properly, it not only affects the particular project, but also affects the firm as a whole. Therefore, in order to make effective decisions, it is necessary to assess the risk objectively and accurately. The findings on project risk measurement techniques are consistent with those of Pike (1989 and 1996), Ho and Pike (1991), Klammer et al. (1991), Sullivan and Smith (1994), Abdel-Kader and Dugdale (1998), Kester et al. (1999), and Arnold and

Sensitivity analysis is the most formal risk measurement technique used by the respondents followed by probability analysis. It is probably because it is considered as a good technique and easy to use and understand. An interesting finding of this study is that respondent companies use formal risk analysis techniques and the subjective/intuitive risk assessment techniques equally. An increase in the usage of formal methods is due to the availability of software packages in risk analysis tools which assist in making SIDs (Pike, 1996; and Manoj, 2002). The literature indicates that whenever uncertainty increases, the DMs tend to use qualitative methods more than quantitative methods (Courtney et al., 1997). But this study indicates that both the methods are equally used, which shows that DMs are unable to get the required information on time for some decisions and informal techniques are considered as a useful method in those circumstances. The literature shows that there exists an inverse relationship between the formal and informal methods, but the findings of this study do not support this view. There exists a positive correlation between the formal and informal approach, but it was not statistically significant. Further, respondents employed more than one technique either for the same or different projects. This may indicate that one technique is not sufficient to measure the risk associated with the projects. The findings are similar to those of the above-mentioned studies.

Conclusion

The results of this study provide a clear and up-to-date picture of the current practices of risk analysis within the automotive industry in India. The relationship between the extent of usage of risk analysis in SIDs and firm-specific characteristics, such as firm size, sales volatility, performance volatility, beta, and leverage is discussed. The results do not show influence of firm-specific characteristics on the level of risk analysis in SIDs. An analysis was performed on the approaches and techniques used to assess the project risk besides the techniques used to adjust the risk. It was found from the analysis that formal and informal methods are equally used by the respondents. It was also revealed by the study that among the formal methods, the DMs rely heavily on sensitivity analysis and probability theory to assess the project risk.

Researchers believe further investigation on the following to be worthy: (1) This study can be extended to make comparison among different industries in the context of risk analysis in SIDs; (2) Further studies can be carried out to identify the benefits and barriers of adopting sophisticated risk analysis techniques; (3) The influence of methods of forecasting and quality of information on the effectiveness of the risk analysis can be studied; (4) Whether adopting these techniques improves the performance of the companies or not, can also be studied; and (5) Research can be done regarding the influence of organizational and decision makers’ characteristics on the use of risk analysis in automotive industry and the results can be compared with that of the other industries.
Bibliography


Appendix

1. Does your company account for
   a. The impact of nonfinancial uncertainties?  
   b. The risk of each project individually?  
   c. The effect of the project risk on overall corporate profitability?  
   d. The effect of the project risk on shareholders' portfolio?  
   e. The relationship among various uncertainty factors?  
   f. The relationship among the returns of different projects?

2. How does your company analyze and assess the project risk in Strategic Investment Decision? (Please indicate the extent of usage of each approach by circling one number in each row.)

<table>
<thead>
<tr>
<th>Risk is</th>
<th>Never</th>
<th>Rarely</th>
<th>Some</th>
<th>Often</th>
<th>Very Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Assessed subjectively as low, medium, high, etc.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>b. Analyzed via ‘what-if’ sensitivity analysis by giving (as %) change to each key factor one at a time</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>c. Analyzed by giving probability distribution of net cash flow for each period and producing expected value of NPV</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>d. Analyzed via Monte-Carlo-type probabilistic simulation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>e. Analyzed via Capital Asset Pricing Model (CAPM)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>f. Other approaches if any.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

3. How are project returns adjusted for risk and uncertainty? Please rank all applicable methods, 1 = most frequently used, ...)

   a. _____ Shorten payback period
   b. _____ Raise discount rate/required rate of return
   c. _____ Adjust estimated cash flows subjectively
   d. _____ Adjust estimated cash flows for costs of risk premium (e.g., Insurance)
   e. _____ Use certainty equivalents of cash flows

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