

## Managerial Judgment Factors and the Real Options Approach in the Investment Appraisal Process: Evidence from UK Automotive Firms

**Dr. Oubay Mahmoud**

Tishreen University Business School  
Department of Finance and Banking  
Lattakia, Syria

**Dr. Bill Neale**

Formerly University of Bournemouth  
UK

### Abstract

This paper examines the extent to which the Real Options Approach (ROA) and Managerial Judgement (MJ) factors are deployed in the Investment Appraisal Process (IAP). It draws on a 73-firm survey aimed at finance directors of British Automotive Components Manufacturers (BACMs) to set out the relative importance of the strategic approach (ROA informed by MJ) and formal investment appraisal techniques: Pay back (PB), Return on Capital Employed (ROCE), Internal Rate of Return (IRR) and Net Present Value (NPV) when making Strategic Investment Decisions (SIDs) with growth options. The findings from the survey show the absence of the formal adoption of the ROA in the IAP. However, the impacts of the growth options regarding the deployment of MJ in the IAP are clearly evident. The analysis shows that MJ is considered when assessing both investments with growth options and risky projects.

**Keywords:** Managerial Judgement (MJ). Investment Appraisal Process (IAP). Real Options Approach (ROA). British Automotive Components Manufacturers (BACMs).

### 1. Introduction

The role of “Managerial Judgement Factors”-intuition, past experience and own judgement (collectively referred to here as MJ factors)-in the Investment Appraisal Process (IAP) has yet to be studied in any depth. Much of the research conducted on the IAP focuses on the use of various investment appraisal techniques (typically, discounting versus non-discounting approaches), and tends to neglect the revelation of growth opportunities, commonly referred to as “real options”, associated with the proposed investments, options that cannot easily be captured by these techniques.

Emphasising this omission, Myers (1984) asserts that:

*“DCF is less helpful in valuing businesses with substantial growth opportunities or intangible assets. In other words, it is not the whole answer when options account for a large fraction of a business’ value.”* (p.135). Moreover, some scholars (e.g. Brealey & Myers, 1988; Kensinger, 1988; Kulatilaka & Marcus, 1992; Phelan, 1997) argue that, not only are the valuable options embedded within a proposed investment often overlooked, but Those discounting-based investment appraisal techniques are inherently biased against long-term strategic investments by the discounting process itself.

The idea of viewing investment opportunities as “real options” dates back to Myers’ use of the phrase. Therefore, he is often considered the first to use the term after adapting the seminal work of Black & Scholes (1973) and Merton (1973). Following the principles of valuing financial options developed by these authors, later scholars (e.g. Dixit & Pindyck, 1994; Myers, 1984) also began modelling investment under uncertainty using the analogy of financial options. In other words, the real options approach (hereafter ROA) is the extension of financial option pricing theory to identifying and valuing real options.

The logic behind the ROA is that many corporate investment opportunities can be viewed as call options in the sense that real options offer the right or opportunity to invest in, or buy, a "real asset". Authors who use options theory to evaluate real assets include Amram & Kulatilaka (1999), Dixit & Pindyck (1994), and Trigeorgis (1997).

This interpretation of investment opportunities as "real options" prompted the deployment of a more overtly "strategic approach" (used here to connote ROA informed by MJ) that would likely encourage firms to more often override the formal appraisal techniques and approve otherwise low-yielding investments but offer compensating growth options.

Despite increasing interest in valuing the growth options associated with a project, the financial management literature still lacks a comprehensive framework that clearly and formally acknowledges the importance of the managerial judgement factors in assessing projects with growth options. Despite the strengths and sound arguments of previous studies and models, the integration of the ROA and MJ into the IAP has been overlooked in most of them. Consequently, developing such an investment appraisal framework to integrate the ROA and MJ into the IAP is a major aim of this study. This new model allows the assessment of projects with growth options that otherwise may be rejected by the deployment of the formal investment appraisal techniques in the IAP.

This paper thus aims to contribute to the development of the literature on capital budgeting in four ways. First, it adds to previous studies regarding the use of financial appraisal techniques in the IAP. Second, it establishes the prevalence of the ROA and MJ factors among members of a selected industry in the UK (British Automotive Components Manufacturers, or BACMs). Third, it establishes the relative importance of MJ factors compared with the formal capital budgeting techniques in the IAP when assessing projects with growth options by BACMs. And finally, it extends the IAP by combining strategic and financial approaches in the development of a framework that integrates the ROA & MJ into the IAP.

This study is conducted within the BACM sector for the following reasons: (1) it is important to the British automotive industry, a vibrant sector of the UK economy.(2) it offers the opportunity to complement the longitudinal study of Carr & Tomkins (1998) by focusing on the automotive firms within a single country rather than, as they did, focusing on automotive industry firms from different countries; (3) the arrival of overseas firms investing in the UK motivated by exploitation of growth opportunities, has led to increased business risk, the very setting within which the ROA can be applied;

The remainder of the paper is structured as follows. The next section provides an overview of the main theoretical issues arising in the debate, based on previous studies. This is followed by presentation of the framework that formed the basis for hypotheses development. The following section describes the research methodology, and outlines the research methods used. The research findings are then presented and commented upon. The final section contains more detailed discussion of the research findings, and presents conclusions.

## **2. Literature Review**

This section gives an overview of research in capital budgeting procedures in the UK, and the real options approach in order to set the scene for the empirical research.

### *2.1. Research on Project Investment Appraisal in the UK*

Many studies have been conducted to investigate and present the usage of various investment appraisal techniques in manufacturing industry in the UK.

In Pike's (1996) longitudinal survey between 1975-1992, 100 large firms were involved. The results showed a substantial increase in the use of discounted cash flow (DCF) and various risk appraisal techniques; and a tendency to use a combination of techniques. McIntyre & Coulthurst, (1986) in a study of 141 small and medium firms, found increased use of DCF but not at the expense of payback (PB) which continued to gain support.

In a later study, Sangster (1993) found in a sample of small and large Scottish companies that payback was the most popular method, followed by Internal Rate of Return (IRR), widespread use of more than one method, declining usage of Annual Rate of Return (ARR) - also known as Return On Capital Employed (ROCE)-and high use of more sophisticated discounted cash flow techniques. Drury & Tayles' (1997) examination of 866 firms (small and large) revealed that DCF techniques are used far more extensively by the larger organisations - 90% of the large, and 35% of the smaller, organisations "often" or "always" used either Net Present Value (NPV) or Internal Rate of Return discounting methods.

Carr & Tomkins' (1998) study involved 71 vehicle components manufacturers based in Britain, USA, Germany and Japan. German and Japanese companies appeared to display a longer-term strategic orientation than Anglo-American firms. Amongst the UK firms, the most significant financial criterion in the investment appraisal process is payback, then ARR, then DCF techniques. Similar results appeared in Carr's later study in 2006. These studies did not all explicitly incorporate uncertainty and, as a consequence, cannot be thought of as capturing all dimensions of the IAP. The main drawback of these studies is that they have not revealed whether strategic opportunities are incorporated in the IAP, and how.

Many authors portray schematically the IAP and the techniques used to evaluate Strategic Investment Decisions (SIDs) *e.g.* King (1975); Dyson (1990); Harris (1999); Pike & Neale (2006) and Carr *et al.* (2010). The main features of these frameworks are (a) the overt financial focus of the IAP where project outcomes are expressed in terms of expected monetary or "tangible" benefits. Carret *et al.*, (2010) offer an exception whereby attitudes towards incorporating less easily quantifiable factors are considered. (b) Options embedded within the proposed projects are not considered in the appraisal process. (c) The treatment of risk associated with new investment is a unidirectional "risk aversion" where, typically, higher hurdle rates are applied for projects with a higher level of perceived risk. (d) In many models, the analysts are separate from the approval process and do not affect the investment decision-making process. Harris' (1999) model is an exception—here, the managerial judgement concept was introduced in the guise of "team views" and "team judgement".

## 2.2. The Real Options Approach (ROA) and Managerial Judgement (MJ)

As noted, it is nowadays not uncommon to deploy a real options analysis for projects with growth opportunities, or what are called "strategic projects" by some scholars (Kester, 1984; Sharp, 1991). However, recent debate on real options shows that there are many different points of view on what is meant by the "option" in the IAP. Moreover, different labels have emerged for the same concept. Prominent among these are: option pricing theory (Myers 1984), real options theory (McGrath *et al.*, 2004), real options approach (Broyles, 2003; Copeland, 2001), growth-option framework (Kester, 1984), real options paradigm (Brennan & Trigeorgis, 2000), real options analysis (Grant, 2002), and capital investment options (Pike & Neale, 2006). In essence, these concepts imply the same thing, the application of the options logic to the IAP in order to reveal and exploit growth opportunities.

Sharp (1991) identified two types of real options: those that are incremental in nature and those that are generated by flexibility. Similarly, Copeland & Keenan (1998) offered three types of real option: investment/growth options, disinvestment/shrink options, timing/ learning options. The latter classification is similar to Trigeorgis' (1993) classification of options. Given the overlapping features of these options, for this study, two main types of options were used:

- 1- Growth options: growth opportunities that require incremental investments.
- 2- Flexibility options: these include: the options to defer, scale (expanding or contracting), abandon, or stage, the proposed investment.

This "flexibility" is claimed to be at the core of real option theory (MacDougall & Pike, 2003; Trigeorgis, 1997). Studies in this respect (Morone & Paulson, 1991; Northcott, 1995) show significant roles for the "executive judgement" and cognitive analysis in the IAP. Kester (1984) argues that many companies have turned to methods other than financial appraisal techniques that rest heavily on the intuition and own judgement of key senior executives. Similar views are echoed by Sharp (1991) who argues that such an approach allows managers to assess new investments on the basis of past experience, intuition and judgement, so identifying whether strategic benefits outweigh any shortfalls in cash flow value. Triantis (2006) argues that the existence of such managerial flexibility is the key underpinning of a real option. In the context of the ROA, as adopted for this study, the option is the ability and the right, but not the obligation, to take advantage of opportunities becoming available at a later date, opportunities that would not have been possible without earlier investment (Amram & Kulatilaka, 1999; Folta & O'Brien, 2004; Sharp, 1991).

## 2.3. Treatment of Business Risk in the IAP

Options analysis, either of the pure financial type or the real options form, concerns harnessing the variability of the proposed project's outcomes. To capture this, the concept of risk adopted is that used by most business people, although not strictly accurate in the theoretical sense. To business people, including those who answer questionnaires, risk is the situation where the future is uncertain *i.e.* there is no formal distinction between risk and uncertainty.

Risk is treated as a threat that influences adversely the value of the expected cash flows when applying the financial techniques. Paradoxically, under the ROA, it is considered as an encouraging factor that increases the value of the growth options embedded in strategic projects. McGrath (1999) has argued that the higher the variance in outcomes from making a real investment, the higher the option value of the investment, as with financial options. Such a positive relationship between volatility and investment is accepted by many others, among them, Hartman (1972), McGrath, Ferrier & Mendelow, (2004) and Triantis, (2006) who states that:

*“Rather than treating risk as something to be avoided, real options thinking encourage managers to view volatility as a potential source of value, with profound implications for the design of projects and corporate strategy.”* (p.78).

### 3. The Theoretical Framework and Statement of Hypotheses

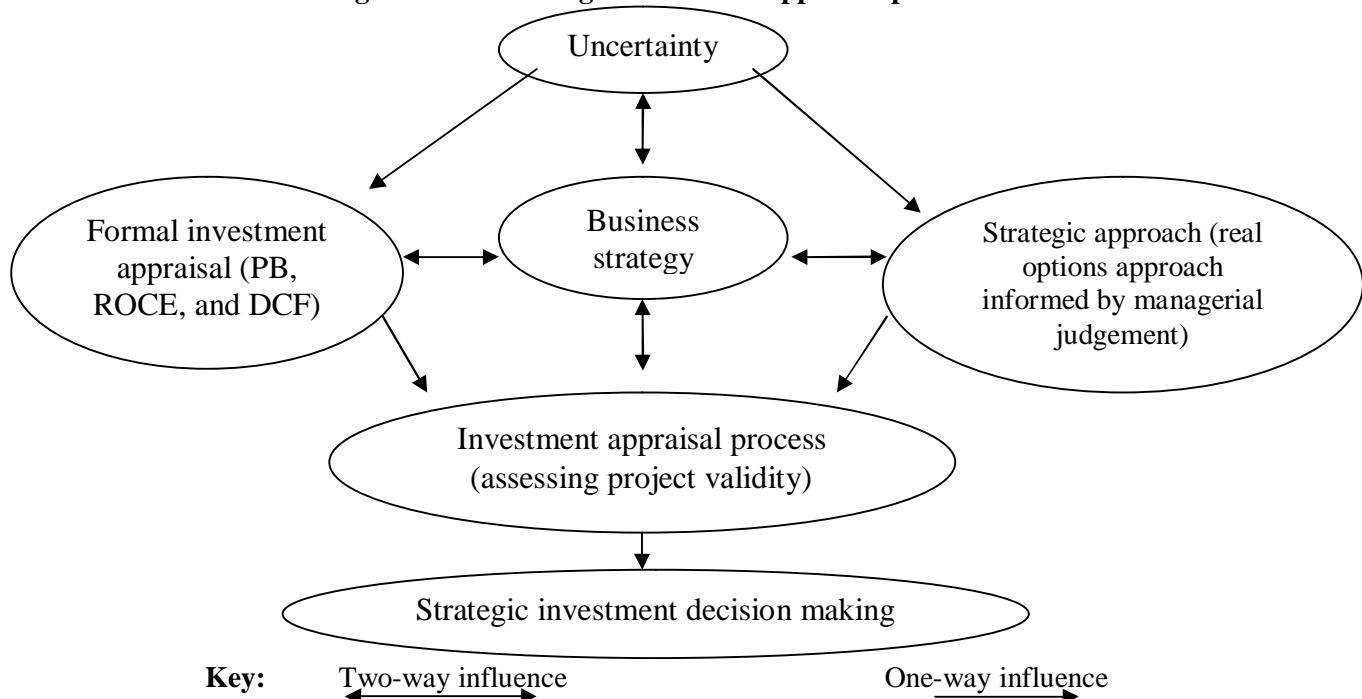
#### 3.1. The Theoretical Framework of the IAP

A conceptual framework was developed to show the link between the main themes in the literature in a logical sequence (Figure 1).

This process starts with the influence of business risk on investment appraisal. Since the risk could be perceived as either an encouraging (following options theory) or a discouraging factor (adopting risk aversion psychology) for investment, this means that there are three possible routes for the appraisal. These are “strategic” (the right hand route), “financial” (the left hand route), and the “combined” one (both routes). Central to the choice is the business strategy. Therefore, the strategic dimension of the investment decision is depicted. The final decision would be one of the following possibilities:

- 1- Carry out the investment (positive decision, full commitment).
- 2- Carry out the initial stages of investment (positive decision, partial commitment). Therefore, the firm might allocate some of the funds assigned for the project but keep other options open (deferring, scaling, staging, and abandonment). The decision as to which option to exercise then turns on what information that becomes available while executing the initial stage.
- 3- Postpone undertaking the investment (delay) where the proposed project’s scores on either, or neither, of the first two approaches fails to give sufficient justification for undertaking the project.
- 4- Reject the investment (negative decision) where the proposed project scores low on either approach or both.

**Figure 1: The strategic investment appraisal process**



Hence, rather than making a “Go/No Go” decision based on a single value (as with the formal investment appraisal approach), there are now four possibilities that could be reached via three routes, namely, strategic (the right hand route), financial (the left hand route), and combined (both routes). Moreover, rather than carrying out the investment now or not at all, there are other options that enable the firm to retain future opportunities without incurring financial losses (deferring, scaling, staging, and abandonment). Therefore, this model could be considered as a step forward in the development of a more coherent investment appraisal process for a wide range of proposed projects.

### *3.2. Hypotheses Development*

Some authors (*e.g.* Brealey & Myers, 1988; Dixit & Pindyck, 1995; Myers, 1984) suggest that formal investment appraisal techniques are inappropriate for evaluating investments with significant growth options because they usually exclude these valuable options embedded within the investments. Therefore, MJ factors are more important than formal investment appraisal techniques in addressing these growth options. Others, such as Hodder & Riggs (1982) and Kaplan, (1986), proclaim that formal investment appraisal techniques are not flawed but that the process of application can be defective. (Triantis, 2006) argues that the NPV technique works quite well if the project’s risk is similar to that of the overall firm.

These arguments support the statement of the following hypotheses:

**H1:** Companies rely more on MJ factors for assessing strategic investments with future growth options than on investment appraisal techniques.

**H2:** Investment appraisal techniques are applied to investment proposals regardless of the growth options embedded within them.

**H3:** More emphasis is placed on investment appraisal techniques than on MJ factors for assessing investments with no, or few, perceived growth options.

Advocates of the ROA (*e.g.* Busby & Pitts, 1998; Krinsky & Miltenburg, 1991; Meredith & Suresh, 1986) base their arguments on the likely presence of valuable options associated with investments with growth prospects. These options are crucial in dealing with risk and are overlooked by the investment appraisal techniques. These, which we will call “ROA factors”, are: timing, scaling, staging, and technical importance. Therefore, the following hypothesis is stated:

**H4:** ROA factors will explain the variation in the application of MJ for investments with growth options.

Some authors (*e.g.* Kester, 1984; Sharp, 1991) suggest that options are only valuable under uncertainty, their value increasing as uncertainty increases. The following hypothesis follows:

**H5:** The use of MJ factors increases with the level of risk of the investment project being evaluated.

Since every firm is comprised of a unique set of resources, capabilities, structure, and vision, and all of these are enhanced by firm size, this prompts the following hypothesis:

**H6:** The deployment of MJ factors for assessing new investments will vary depending on the size of the firm.

We now examine the research methodology applied in testing these six hypotheses.

## **4. Research Methodology**

### *4.1. Sample Selection and Data Sources*

This research was conducted among British Automotive Components Manufacturers (BACMs), using the FAME database (Financial Analysis Made Easy) which lists all registered companies operating in the UK. The Primary UK Standard Industrial Classification (SIC) for this industry is 34: Manufacturers of Motor Vehicles, Trailers and Semi-Trailers. This code is divided into three sub-groups as follows:

341: Manufacturers of motor vehicles.

342: Manufacturers of bodies (coachwork) for motor vehicles, manufacturers of trailers and semi-trailers.

343: Manufacturers of parts and accessories for motor vehicles and their engines.

Since the scope of this research is automotive components manufacturers, the first group (341) was excluded from the study. In all, 533 registered and operating companies appear under the 342 code, and 758 companies are listed under the 343 code [FAME, accessed on 26th Sept., 2005]. This brings the potential number of companies involved in the study to 1,291.

Companies with incomplete financial reports (mainly micro-firms) were excluded to avoid any bias that might result from using unreliable data. Consequently, the sampling frame for this research was reduced to 523 companies. The 8 firms that appear under two codes were considered only once.

Since the automotive industry is widely spread geographically, a mail survey was chosen for data collection. A structured questionnaire, divided into three parts with a total of 32 questions, was mailed to senior finance executives of the FAME-listed automotive firms. The resulting data conformed to three kinds of measurement scales: nominal, ordinal and interval.

Extensive efforts were made to ensure a good response rate from this postal questionnaire. The introductory letter was assigned the same code given to the first page of the questionnaire to identify non-respondent companies to enable a repeat mailing. The questionnaire was pre-tested in the field by conducting a pilot study, using a sample of 30 companies drawn randomly from the sampling frame of 523 companies. 7 responses (23%) were returned and analysed, a few amendments were made to some questions to generate the final format to be used in the main survey. Given the response rate from the pilot study (23%), and the response rate in previous studies in this area (ranging between 19-31% - see next section), a net usable response rate between 20-30% was expected.

Aiming for at least a 30% net response rate and to allow for invalid responses, a 32% expected total response rate was used to identify the sample size as follows: 493 (the sampling frame was reduced to 493 [523-30 = 493] companies) times 23% (net response rate from pilot study) = 113 (expected useable responses). Therefore, the sample size required was: 113 (expected usable responses / 32% (expected total response rate) = 353 companies. These 353 companies were drawn randomly (using SPSS random selection procedures) from the sampling frame of 493 companies.

#### 4.2. Main Survey

The questionnaire was mailed to named senior financial executives of the sample of 353 companies. The main survey took place in the first week of November 2005, and a reminder was sent to non-respondents in the first week of December 2005. In all, 117 responses were received, a total response rate of 33.2%. Of these, 44 responses were invalid for a variety of reasons (*e.g.* “company not wanting to disclose information”, “lack of time”, “company policy not to participate in surveys”, sheer reluctance to participate, and incomplete responses). Consequently, the sample size dropped from 353 to 309. Therefore, the net usable response rate or “active response rate” (Neuman, 2000) was thus 23.6% [73 completed questionnaires/309 potential respondents]. This response rate compares reasonably with some other similar surveys such as those of Chen, (1995) 20%, McIntyre & Coulthurst, (1986), 19%; Sangster, (1993), 22%, and rather less favourably with Lefly, (1994), 28%; and Alkaraan & Northcott, (2006), 31%. A relatively low response rate in this type of study can be explained by pressure on senior executives’ time. A low response rate is a common problem with self-completion questionnaires (Robson, 2002; Saunders *et al.*, 2007).

Wallace & Mellor’s (1988) methods of testing for non-response bias were employed. Early responses were compared with late responses. As the inquiry was conducted over four weeks, responses received within the first two weeks were compared with responses received within the last two weeks and also with those received after the reminder. In addition, responses received from the first wave were compared with those received after the reminder. The non-parametric Mann-Whitney test for two unrelated samples, and the Kruskal-Wallis one-way ANOVA test, also non-parametric, for three or more unrelated samples were used. No significant differences were found between responses received from companies over the periods described above. Based on company turnover as the grouping variable, the results show comparable mean ranks of the groups with significance levels greater than 0.05.

### 5. Findings

#### 5.1. Descriptive Statistics

**Respondents:** Although the questionnaire was addressed to the named finance director at each company, as commonly occurs, some responses came from other senior people -managing directors (27), CEOs (4), and senior accountants (2). The remainder (40) came from finance directors. However, this was no real cause for concern as investment decision-making process is usually a collective activity, involving people with a common perspective and business memory that should have enabled them to answer the questionnaire with authority.

Moreover, in small firms, some executives occupy several roles (*e.g.* the Managing Director doubles as Finance Director). The vast majority (92.4%) of respondents possessed an academic and/or professional qualification. The average working experience of the respondents was just over 12 years with 66.2% of them having a working experience more than 6 years. The high median value (9 years) reflects the extensive experience possessed by respondents.

**Firms:** Companies involved in this research were of three main types by status - 20 Head Office, 25 Business Unit, 27 Stand-alone, 1 other, and covered a wide size spectrum by turnover ranging from under £2 million to over £800 million while the number of employees ranged from 10 to over 6,000.

On average, these firms undertook 15 investment projects annually, with more than 73% of companies undertaking at least four projects per year. The number of projects was considered more appropriate than the value of investments to express investment activity as this shows the frequency of operation of the IAP and selection of SIDs.

### 5.2. Investment Appraisal Techniques Used

Respondents were asked to rank the four main investment appraisal techniques (PB, IRR, NPV and ROCE) according to frequency of use on a scale ranging from 1 ("low usage") to 4 ("high usage") in the IAP. The predominance of PB over other techniques (Table 1) is evident with 69.4% of the surveyed companies using this technique with moderate-to-high usage levels. It is used by 22% ( $69.4/56.9 = 1.22$ ) more companies than ROCE, the second most popular method. The NPV and IRR techniques ranked third and fourth respectively with 31.9% and 26.4% usage. These results parallel those reported by Lefly (1994), 94% of whose respondents used the PB technique, while only 69% used a DCF method.

**Table 1: Incidence of investment appraisal techniques**

Techniques	Level of usage	Incidence	Valid percentage (%)	Cumulative percentage (%)
PB	High usage(4)	34	47.2	47.2
	Moderate usage(3)	16	22.2	69.4
IRR	High usage(4)	9	12.5	12.5
	Moderate usage(3)	14	19.4	31.9
NPV	High usage(4)	12	16.7	16.7
	Moderate usage(3)	7	9.7	26.4
ROCE	High usage(4)	22	30.6	30.6
	Moderate usage(3)	19	26.4	56.9

To test whether the ranking of the investment appraisal techniques is significant, a Friedman two-way analysis of variance test was carried out. The results indicate the same ordering, as in Table 1, the differences in ranking being very significant at the 95% confidence interval. A comparison of the results of this study with previous ones confirms the popularity of the Payback method and the tendency by the companies to use more than one technique. However, compared to earlier studies, this research finds a lower use of DCF techniques and a higher use of ROCE. This could be due to small firm bias in this industry if compared with very large firms involved in some previous studies.

For assessing proposed investments with growth options, PB and ROCE are the most important among the investment appraisal techniques. "Not important" or "slightly important" have combined scores of less than 20% for each of PB and ROCE, compared with 50% and 60% for IRR and NPV respectively. These results match those reported by Carr & Tomkins (1998) who found that payback is considered the financial measure of prime importance in the evaluation of strategic investment for 69% of UK automotive companies. Here, the second most significant method was return on capital, ranked as the primary measure by 19% of UK automotive companies.

### 5.3. The Strategic Approach in the IAP

No firm claimed to have formally adopted ROA in the IAP. 49.3% of responding companies declared that they did not use ROA formally in the IAP and 50.7% of them did not answer the question, suggesting that the very concept was new to them. Indeed, many of those who answered "no", may simply not recognize it. Interestingly, there was no evidence to suggest that the characteristics of the sample members affected the answers to this question.

Both “no” or “no answer” results came from a variety of people in different positions with diverse qualifications and characteristics, and in comparable numbers. This finding matches that of a survey published in the *Economist* (1999) where only 4 out of 100 respondents from British firms had even heard of the real options approach. These results show that the ROA was still largely unknown by British firms at this time.

Anticipating the threat to validity of subjects not recognising the ROA, the authors included in the questionnaire instrument, the elements of each concept to represent it. The elements of MJ (past experience, intuition and own judgement, and the elements of the ROA (deferring, scaling, staging, and abandoning were included within the wording of relevant questions. Hence, both concepts are controlled in the questionnaire. The aim of one question in the questionnaire was to check whether ROA is formally recognized as part of the investment appraisal process, and to cross-check with the *Economist* survey.

As there was **no** evidence of **formal** adoption of the ROA in the IAP, the nature of the **informal** adoption was tested by examining the extent to which the growth options embedded in a project would likely trigger the deployment of MJ factors (and potentially facilitate formal adoption of ROA in the future). Firms with a high level of MJ deployment in the IAP for projects with growth options are expected to be more ROA-orientated (*i.e.* greater readiness to buy the right to invest in growth option) than those with low levels of MJ deployment in the IAP for projects with growth options. To explore the role of the MJ factors (past experience, intuition and own judgment) in assessing investments with growth options, respondents were asked to express their opinion about the importance of these factors on a scale from 1 “not important” to 5 “extremely important”. A high importance rating for these two factors was expressed, with “important” and “extremely important” adding up to 68.1% and 61.1% for “past experience”, “intuition” and “own judgment”, respectively. While this represents the overall attitudes of the sample members towards MJ factors, these attitudes became clearer when firms were grouped according to degree of commitment to MJ factors.

A clear distinction could be made between Managerial Judgment-Orientated firms (MJOs) and Non-Managerial Judgment-Orientated firms (NMJOs) according to their attitudes towards these factors. These factors are perceived to be far more important by MJOs than NMJOs (see Appendix 1).

#### 5.4. Hypotheses Testing

Since the ROA had not been adopted formally in the IAP by these firms, respondents were asked to express the extent to which they used MJ factors (past experience, intuition and own judgment) when assessing investments with growth options on a scale ranging from 1 (“never”) to 4 (“always”). This formed the dependent variable (Managerial Judgment). Based on the responses received, four levels of prospective adoption emerged.

**Table 2: Level of MJ deployment amongst respondents**

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Never	2	2.7	2.8	2.8
	Rarely	24	32.9	33.3	36.1
	Frequently	37	50.7	51.4	87.5
	Always	9	12.3	12.5	100.0
	Total	72	98.6	100.0	
Missing		1	1.4		
Total		73	100.0		

Since there are small numbers in the first and last groups, each was combined with its adjacent group that implies a similar attitude. Therefore, groups 1 and 2 (“never” and “rarely”) were combined to form one group (Non-Managerial Judgment Orientated, NMJOs) and groups 3 and 4 (“frequently” and “always”) were combined to form the opposite group (Managerial Judgment Orientated, MJOs). Such a combination of adjacent groups is evident in many studies (*e.g.* Graham & Harvey, 2001; Ryan & Ryan, 2002). The appropriate test (one sample Chi-Square) was carried out to check whether these two groups are equivalent or not in the population. The results showed that these two groups are not equivalent and that there is a significant difference between the two groups. (Chi-Square value = 5.55, df =1, Asymp. Sig. = 0.018).

This distinction between MJOs and NMJOs is essential to explore the relationship between MJ and ROA because a high level of MJ means firms are prepared to undertake projects with growth options and to override the appraisal techniques and rely on MJ factors. Consequently, MJOs firms are the more likely group to buy the right to invest in the investment opportunity (growth option) and adopt the ROA to capture this opportunity.

#### 5.4.1. Testing Hypotheses 1, 2 and 3

The Mann-Whitney test was carried out on the importance of appraisal techniques and MJ factors for projects with growth options within the two groups. The high mean rank of MJ factors for projects with growth options among MJOs indicates that they are crucial in assessing these types of projects. More importantly, the big difference between mean ranks of these two variables (past experience, intuition and own judgement) among these two groups has a significance level well under 0.05. This means that growth options embedded in the proposed projects influence MJ involvement in the IAP and SIDs. This supports H1.

**Table 3: Results of the Mann-Whitney test for appraisal techniques and MJ factors within two groups**

	Ranks			Asymp. Sig. (2-tailed)
	MJ	N	Mean rank	
The importance of PB in assessing investments with growth options	NMJOs	26	29.63	.041
	MJOs	45	39.68	
	Total	71		
The importance of ROCE in assessing investments with growth options	NMJOs	26	35.58	.980
	MJOs	44	35.45	
	Total	70		
The importance of IRR in assessing investments with growth options	NMJOs	26	46.13	.001
	MJOs	44	29.22	
	Total	70		
The importance of NPV in assessing investments with growth options	NMJOs	26	46.90	.000
	MJOs	44	28.76	
	Total	70		
The importance of past experience in assessing investments with growth options	NMJOs	26	28.87	.015
	MJOs	46	40.82	
	Total	72		
The importance of intuition & own judgement in assessing investments with growth options	NMJOs	26	24.23	.000
	MJOs	46	43.43	
	Total	72		

However, this is not at the expense of appraisal techniques. The PB technique is more important for such projects among MJOs than NMJOs. The difference between mean ranks of these two groups on this variable (PB) is very significant (0.041) with a confidence interval of 95%. Both groups rely comparably on ROCE. In brief, this means two appraisal techniques (PB and ROCE) are reported to be important for this kind of project. This gives support to H2. Companies that do not apply MJ factors (NMJOs) rely mainly on two appraisal techniques (IRR and NPV), and to some extent, on ROCE. The high mean ranks of these techniques in this group (46.13, 46.90, and 35.58) respectively compared with the corresponding values for MJOs (29.22, 28.76, and 35.45) indicates the tendency of these companies (NMJOs) towards relying heavily on appraisal techniques (except in the case of PB where the NMJOs group have a lower mean rank compared with MJOs). The difference between mean ranks of these two groups on these two variables (IRR & NPV) is very significant (0.001 & 0.000) with a confidence interval of 95%. This is confirmed by low mean ranks for this group (NMJOs) given to MJ factors. Moreover, the mean ranks for MJOs on the appraisal techniques are lower than those on MJ factors. This suggests that they use the appraisal techniques for projects with low growth options (low risk) since they can predict the cash flows with a higher degree of certainty. This supports H3.

#### 5.4.2. Testing Hypothesis 4

To test this hypothesis, the Mann-Whitney Test was applied. The results show a comparable mean rank for each factor expressed by members of these two groups (MJOs and NMJOs). The small differences between the mean ranks are not significant. This means that both groups realise the importance of MJ factors.

However, merely recognising these factors is not sufficient to trigger their application for projects with growth options. In other words, the deployment of MJ factors in the IAP is not solely reliant on recognising these factors. Thus, there is no evidence to support H4.

**Table 4: Results of the Mann-Whitney test for the importance of the ROA factors within two groups**

	Ranks			Asymp. Sig. (2-tailed)
	MJ	N	Mean rank	
Staging	NMJOs	26	35.67	.785
	MJOs	46	36.97	
	Total	72		
Timing	NMJOs	26	33.83	.341
	MJOs	46	38.01	
	Total	72		
Flexible capacity	NMJOs	26	36.62	.971
	MJOs	46	36.43	
	Total	72		
Technical importance	NMJOs	26	33.08	.266
	MJOs	46	38.43	
	Total	72		

#### 5.4.3. Testing Hypothesis 5

The descriptive statistics of the responses received show that directors in the majority of the companies view MJ factors (past experience, intuition and own judgement) as crucial factors for assessing risky projects with 82.2% and 78.1%) respectively. The mean values and standard deviation values for both factors indicate a high level of agreement with the statement. To test the correlation between the use of MJ factors and the risk associated with the proposed investment, Kendall's tau-b test statistic was applied. The results show a significant correlation between past experience and risky projects at the 0.01 level (1-tailed, P-value=0.000<0.05), with correlation coefficient = 0.410. Similarly, a significant correlation is found between intuition and own judgement and risky projects at the 0.01 level (1-tailed, P-value=0.000<0.05) with correlation coefficient = 0.507. There is a strong correlation between MJ factors and the level of the risk associated with the proposed investment. Therefore, the riskier the project, the bigger is the chance for MJ to be considered in the IAP. This analysis supports Hypothesis 5.

#### 5.4.4. Testing Hypothesis 6

To explore whether there are mean differences between MJOs and NMJOs on the size variable, the Mann-Whitney test was applied. The results show a very significant difference in mean ranks between these two groups (P-value = 0.009, 2-tailed) with a confidence interval of 95%. Where mean ranks are 44.85 for NMJOs and 31.78 for MJOs. This means that small companies tend to apply MJ factors more than large ones. In other words, the smaller the company, the more likely it is to override appraisal techniques and make SIDs on the basis of MJ. Since the Mann-Whitney test indicates that there are significant differences in the mean rank of groups, it is important to test whether these two variables (MJ and company size) are correlated. Kendall's tau-b test was used for this. It is concluded from the low P-value (0.005) that there is a significant association between these two variables below the 0.01 level with a correlation coefficient of -0.274. More interestingly, the association is significant in both cases, (two-tailed) and (one-tailed). This analysis supports Hypothesis 6. Therefore, it can be concluded that the larger the company, the less likely it is to apply MJ Factors.

## 6. Discussion and Conclusions

### 6.1. Discussion of Findings

It seems that responding firms can be divided into two groups, differentiated by their attitudes to MJ factors, as confirmed by Appendix 2, these groups being termed Managerial Judgment-Orientated firms and Non-Managerial Judgment-Orientated firms. These groups displayed different degrees of commitment towards the formal investment methods. The Non-Managerial Judgment-Orientated firms appeared to be more influenced by these than their counterparts. In terms of the diagram presented in Figure 1, they are more likely to follow the left hand route of the developed framework. In contrast to Managerial Judgment-Orientated firms, Non-Managerial Judgment-Orientated firms are less likely to override the appraisal techniques in the investment appraisal process. The strongly significant difference in mean ranks of these two groups regarding this variable suggests a stronger inclination among Managerial Judgment-Orientated firms to downplay formal investment appraisal than among Non-Managerial Judgment-Orientated firms when they think that the growth options may outweigh the financial shortfalls. Thus, they are more likely to follow the right-hand route of the framework.

The stronger commitment by the Non-Managerial Judgment-Orientated firms towards the financial numbers in the Investment Appraisal Process is reflected in the criteria they employ in the strategic investment decisions. Specifically, projects with a negative NPV have a greater chance of rejection by Non-Managerial Judgment-Orientated firms than by Managerial Judgment-Orientated firms. The difference in the mean ranks for both groups on the variable "NPV as appraisal criterion" is strongly significant ( $P= 0.011$ ) at a confidence interval of 95%. Moreover, both groups take account of risk differently in the investment appraisal process. Non-Managerial Judgment-Orientated firms seem to rely heavily on the DCF techniques to allow for the project's risk, and they appear to apply these techniques for all projects regardless of the risk associated with them. They apply DCF techniques not only for projects with low risk but also to projects with high risk (growth options). On the contrary, Managerial Judgment-Orientated firms showed a lower tendency towards using DCF techniques for projects with low risk. They rely more heavily on two appraisal techniques (PB and ROCE) as complementary techniques even for projects with growth options, and on managerial judgement factors for high risk projects.

The recognition of the failure of DCF to accommodate the growth options associated with proposed projects by the Managerial Judgment-Orientated firms seems to contribute to the preceding result. A comparison of the mean ranks of both groups of respondents on the suitability of DCF for long-term projects and for strategic investments showed that Managerial Judgment-Orientated firms have strong attitudes against using DCF for such projects, whereas Non-Managerial Judgment- Orientated firms expressed a lower tendency in this respect, and think it is appropriate for all types of projects. It appears that Managerial Judgment-Orientated firms are less influenced by the expected financial outcomes from the projects than Non-Managerial Judgment-Orientated firms. Comparing the mean ranks for both groups (40.96 for NMJOs and 33.13 for MJOs) on this variable shows that Non-Managerial Judgment-Orientated firms are more committed to the formal investment appraisal and tend to apply DCF for all new projects. However, both groups show comparable attitudes regarding managers' short-term earning vision where mean ranks are 34.77 for NMJOs and 37.48 for MJOs with Asymp. Sig. (2-tailed) =0.583 with Managerial Judgment-Orientated firms recording a higher mean rank than Non-Managerial Judgment-Orientated firms. The strong orientation by Non-Managerial Judgment-Orientated firms towards a financial perception of the investment appraisal process could be ascribed to their attitudes towards risk.

### 6.2. Conclusions

This research has revealed no evidence of formal adoption of an options approach among a sample of British Automotive Components Manufacturers. Although there is evidence that options-oriented thinking is adopted among a sizeable proportion of the sample, it seems that many firms are not giving sufficient attention to the growth options embedded in new investment projects. Not surprisingly, all firms give greater prominence to financial criteria where cash flows can be relatively easily predicted, generally those with lower levels of risk. Firms that are more inclined to pay attention to Managerial Judgement factors lean more towards a strategic perspective that encompasses hard-to-value options. Those firms more influenced by more narrow financial criteria are likely seeking the exploitation of valuable growth options. However, it is beyond the scope of this paper to assess the relationship between performance and the adoption of an outright, or quasi-, real options approach. Perhaps when the ROA, currently in its infancy, is more widely adopted, it will be possible to examine this issue.

## Appendix 1

### The breakdown of MJ factors among study groups

	MJ			
	NMJOs		MJOs	
	The importance of past experience in assessing investments with growth options	The importance of intuition &own judgement in assessing investments with growth options	The importance of past experience in assessing investments with growth options	The importance of intuition &own judgement in assessing investments with growth options
Not important	1	1	2	1
Slightly important	5	9	2	3
Moderate important	5	8	8	6
Important	12	6	15	21
Extremely important	3	2	19	15
Total	26	26	46	46

## Appendix 2

### Results of the Mann-Whitney test for underlying motives for MJ within two groups

#### Ranks

	MJ	N	Mean rank	Asymp. (2-tailed)	Sig.
Business environment scanning	NMJOs	26	33.98	.401	
	MJOs	46	37.92		
	Total	72			
DCF for assessing low risk projects	NMJOs	26	42.23	.041	
	MJOs	45	32.40		
	Total	71			
High discount rate for high risk projects	NMJOs	26	39.96	.205	
	MJOs	45	33.71		
	Total	71			
NPV as appraisal criterion	NMJOs	26	43.79	.011	
	MJOs	45	31.50		
	Total	71			
Short term orientation	NMJOs	26	34.77	.583	
	MJOs	46	37.48		
	Total	72			
DCF is biased against long-term projects	NMJOs	26	30.94	.098	
	MJOs	45	38.92		
	Total	71			
DCF is biased against strategic investments	NMJOs	26	34.25	.563	
	MJOs	45	37.01		
	Total	71			
Overriding formal investment appraisal	NMJOs	26	31.12	.058	
	MJOs	46	39.54		
	Total	72			
Business strategy as criterion	NMJOs	26	37.98	.572	
	MJOs	46	35.66		
	Total	72			

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