

**From Investment Rules of Thumb to Routines:
A Real Option Approach***

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Summary :

- This paper examines the role of budgeting and decision tools in the strategizing and decision processes and their effect on future routines of the firm. It argues that some conditions must be fulfilled by the decision tools to facilitate the change of the firm routines.
- The reflection is conducted by analyzing the condition of existence of routines. Routines, as a redundant pattern of action, are essential units of analysis in the evolutionary approach of the firm and in strategic change management.
- The argument of the work is that for being able to produce new routines a strategic decision –and the way this decision is formulated by using budgeting tools– must have as many common characteristics with the routines as possible. The principal strategic decision tools we study are scenario analysis and real option.
- The paper concludes that the decision tools can and do influence the routines and the further development capacities of the firm. Therefore if the representation of the future development of a firm is dependent on the vision of the manager, this vision finds a follow-up in the decision tools used.

Key words: Routines, Rules, Real Option, Decision Tools, Strategic Management

JEL Classifications: D21, L20, M10, M20

Introduction

In a recent survey Becker (2004) summarizes the main developments of the concept of routine in the economic literature. The analysis presented by the author on an extensive bibliography covers the theoretical and empirical literature on routine over the last twenty years. This survey lists the conditions to be satisfied for employing the word routine accurately. He describes also the effects of routines on organizations and those remaining points in the routine theories that are still lacking in development. These gaps are considered by Folin and Foss (2004) who add an important question that should be answered by future research on routines: the question of the genesis of the routines. This work proposes a possible research track by using a particular starting point, the study of some investment tools in the strategic management literature.

The tasks of managers include the analysis, organization and control of the activities of a firm. Many other jobs can be added, including forecasting, discovery and catching of opportunities. For example: the financial evaluation of a project includes, among other things, planning the possible developments of the project, evaluating the flexibilities and the possible developments that can occur in the future (these tasks can, of course, be carried out by several individuals, each specialised in one of the sub tasks). The result of this evaluation leads to the selection of the future development of the firm among alternative courses of action and changes. If these techniques of evaluation and of implementation of the projects are regularly used, the individuals interacting for implementing different sub tasks probably develop routines.

Figure 1 sums up the general idea of this work. Following Nooteboom (2000:184) we suppose that the growth of the firm occurs through a succession of exploration and exploitation phases. These phases are dependent on the strategic investment decision of the firm (on the right side of the Figure) and on the development of the routines of the firm (left side of the Figure). Between these two extremes the organisational structure of the firm, her operational planning, products and services are modified. These successions of developments influence the future strategic change capacity of the firm. We focus in this work on the lower part of **Figure 1**: the influence of the decision tools and processes on the routines.

– Insert Figure 1 about here –

The decision process we describe starts with an existing project, its evaluation and the decision to implement it. If it is implemented the project influences the behaviour of the individuals and their routines. However, projects do not exist as such and must first be imagined. Tools of investment creation exist at the level of a single project or at the firm level. Popular tools which have been the object of many developments in the last few years are scenario analysis and real option. Our proposition is that, if these tools are utilised as a long term planning procedure, the repercussion of this planning can change the routines in place, and eventually create new routines. Several works try to combine different investment tools in such a way as to obtain a richer view of the repercussion of investments, where the opinions of a large part of the participants of a firm are taken into account. Franklin (2001:361) notes that the mental models of the decision makers shape their action and that the budget-planning process is just another type of model. We insist in this work on the option planning tools. Options can be used in a financial formulation or in a more theoretical strategic form (Grundy, 2004). Franklin (2001:363) pinpointed, along with other authors, that the strategic management literature would benefit from the search for sameness rather than difference among competing schools of thought. To fulfil this objective Miller and Waller (2003) link the scenario analysis and the real option approach. The present attempt searches the sameness between the routines characteristics and some decision tools that can influence the future creation and utilisation of new routines.

The rest of the paper is organized in the following manner: first we present some background observations about routines and summarize the conditions that must be met for using the label routine. In a second point, we describe some investment evaluation techniques that come close to the characteristics highlighted by routines. In particular, we show how investment tools can trigger the development of routines. In a third point, we present some developments applying simulation, sample surveys or experimental economics for studying the usage of rules for investment appraisal and the way they are used by practitioners. A last point concludes and offers discussion.

Background observations about routines and decision making

Felin and Foss (2004:8) recall some historical reasons why routines were introduced in the economic literature. A separation from the neoclassical literature brings several streams of literature to consider routines. The behaviourist literature diverge from neoclassical literature because of the over-simplistic representation of decision making in the organization and Nelson and Winter's rationale for parting from neoclassical literature was the heterogeneity 'imposed' by the neoclassical point of view. Our approach on decision tools and the difference in development, interpretation and implementation of these tools is close to both of these arguments. The notion of skill allows Nelson and Winter to introduce rigidity in the behavioural repertoire that is necessary in an evolutionary approach, the argument being that skilled behaviour implies specialisation which in turn involves reduced flexibility. Unfortunately, there is no unique definition of flexibility (De Toni and Tonchia, 2005) and the definitions found are very context specific, depending on the economic, organizational, operational or strategic approach considered. Flexibility can be broadly seen as the variation of cost when a future variation in task must be performed by the firm. A strongly entrenched routine corresponds to a high cost when change becomes necessary. In this perspective the routine limits the search for flexibility. This link between the decreasing flexibility and the emerging routine process needs to be studied.

Felin and Foss (2004) suggest the following research steps for obtaining a stronger concept of routine: first explain the origins of routines, then introduce a general measure and finally show how routines are linked to the competitive advantage of the firm. We focus in the following on the first point: the origin of the routines.

If the flexibility creation process is realised by the implementation of new routines, or the change of existing routines, this process must come close to the condition of existence of routines. These conditions, that give reality to a routine, are listed by Becker (2004) and can be summarized in eight broad categories: routines are (1) patterns, (2) recurrent, (3) operated collectively, (4) can correspond to a mindless or effort full task, (5) a process, (6) context specific, (7) path dependent, and (8) depend on triggers to be activated.

Routines are a set of behaviours articulated according to a recurrent scheme (1). In the words of Winter (1954: 263) “*pattern of behaviour that is followed repeatedly, but is subject to change if condition change*”. Becker (2004) identifies four types of repetition, the repetition of a behaviour, action, activity or interaction. Interaction pinpoints the collective nature of routines distinguishing them from the habits that are retained by individuals. (2) The recurrence of this interaction shapes a routine. An infrequent behaviour does not meet the definition of a routine. (3) This interaction implies that the organizational routines are not localized in a unique place in the firm but are distributed through it. Each individual participating in a precise routine can perform a different precise action. The expertise developed by each individual leads to a dispersion of tacit knowledge across the firm such that only the firm as a whole comes to an efficient result. (4) A point of disagreement on routine arises on the nature of the effort each individual deploys for realising his/her precise task. Is this task realised without effort, in a semi-conscious way, conversely, with a conscious demanding effort? Becker (2004) notices that this differentiation matches perfectly with the type of study performed. A theoretical research describes the routine as effortless and an empirical research as effortful. (5) Empirical research uses the routine, or more precisely the modification of the organizational routines as an indicator of the process of change that modifies the firm. As routines are stable patterns, executed effortlessly, the cognitive resources of the individuals are saved and can be engaged in the refinement and improvement of routines. This improvement fosters change in the organisation and routines are an adequate measure of this process. (6) The context in which these changes occur is of importance since it impacts on the routine. Routines are specific to the firm, to her history and the beliefs of the interacting individuals (the corporate culture) and (7) are path dependent. The triggers of activation (also related to the switch from one routine to another) can be of a different nature depending on an individual participating in the routine or an interaction with an individual not being part of the routine. Individuals participating in the routines can give rise to their modifications or activation according to their satisfaction with the ongoing process. Individuals outside a routine can trigger it by sending a specific signal.

The next point will explore the relation possibilities between the implementation of a planning process and routines.

Evaluation techniques and routines for the firm and the decision maker

A large number of investment tools exist and research in finance and strategic management leads to a continuous creation of new tools or the improvement of existing ones (Rigby, 2001). Nonetheless, we can provide some broad categorization. As shown in **Figure 2**, two dimensions can be utilized to sort out existing tools.

A first dimension is the quantitative or qualitative nature of the tool. The quantitative approach, extensively linked to tools coming from the financial sphere (option, weighted cost of capital, NPV...) uses quantitative information (data) as sole input. The data come from previous observations or are forecast based on these observations.

A shift on the horizontal axis corresponds to a qualitative improvement, when not only the data are considered, but also the personal knowledge of the decision makers. In addition, this shift corresponds to a change in the origin of the value that fosters the investment. For example, at the lower left corner, techniques such as real option obtain their value by evaluating a possible choice between alternatives that already exist. On the right side of the Figure this alternative does not exist and must first be created by the firm. At the extreme right, the capabilities of the firm to create alternatives that are then evaluated form the value added.

The second dimension that can be considered is the level on which the evaluation and the decision are performed. At the micro level, only a single project is considered, at the opposite macro level the whole firm is impacted.

Our concern is to study tools that create new situations that can lead to changes in the firm practices. These tools appear on the right side of **Figure 2**. As we will see in the next point, scenario analysis creates new situations, or highlights situations that should be of concern to the firm. The second tool on which we focus, real option, allows a mix of the qualitative and quantitative approaches and brings us closer to a routine creation procedure. The label heuristic real option corresponds to the combination of scenario analysis and standard real option and is related to a trend in the strategic management literature on real option.

– Insert Figure 2 about here –

Scenarios

Scenario planning (and real option) are two of the most diffused tools for evaluating projects and developing decisions when faced with uncertainty. Scenario planning has been developed since many years in strategic management. Originating in military research, a major early non-military utilisation of this tool was in the oil industry. Oil companies were (and still are) dependent on oil stocks, price fluctuations or war in certain producing lands. They develop scenarios of what they could do, and how they can do it, in case of major changes in their industry. This is done by group meetings, with individuals from different departments of the firms. Such scenario planning creates a blue print of what to do to obtain new routines as quickly as possible if previous ones became inadequate to a change in the environment. Recently scenario planning is regaining interest in the field of strategic management.

In the scenario planning process, stories are built relying on existing data, participant beliefs, tacit and explicit knowledge. From a broad (almost infinite) variety of possible futures, the most likely are selected and thoughtfully studied. The participants try to define the reaction of the individuals and the environment and define the best behaviour to adopt, the major risk and eventually the opportunities. In the following, we present the steps needed to perform a good scenario planning. This presentation is inspired by Miller and Waller (2003) who first linked scenario definition and real option analysis.

a) To define the aim:

The first step of scenario analysis consists of identifying what is expected from this process, what are the issues that should be explored and how far the timeline considered goes. In general, the scenario conception considers long-term horizons. In this step the scope of the study is defined, in general scenario planning is interesting because it considers the whole firm, or, if focused on a sub unit, it considers the influence of the sub unit within the firm as a whole.

b) To identify the participants and the information needed

This step corresponds to the formation of the work group. Selection of the individuals who have the required knowledge for evaluating the situation, and beforehand for defining the range of situations to which they can be confronted. This work group is preferentially transversal to the firm, including individuals from the different units of the firm directly concerned by the aim of the scenario or who can be affected by the decision taken. It is at this step, by integrating different individuals in a work group that individuals participating in different communities come together (Cohendet and Llerena, 2003).

c) To define what is known, what is certain

At this point, the working group previously selected defines the general trends of evolution for the whole firm and for the different sub units concerned. A major part of this point concerns the sharing of the tacit knowledge of each participant (Nonaka, 1994; Umemoto, 2002).

d) From certainty to uncertainty (from the known to the unknown)

From the previous step an image arises of what the firm is at the moment and what it will probably be in the future. Then the environment factors are selected that can significantly blur this picture, e.g. the outcomes of the next technology development, the behaviours of new entrants, the institutional changes that can happen in some countries, market conditions... Once these sources of uncertainty are defined, the implications these sources have on the firm, their importance (decisive, superficial), location (limited to a unit or overall in the firm), must be assessed.

e) The possible situation and the reactions

From the formerly defined uncertainty, the best or the worse case situation to which the firm can be confronted emerges. If a consensus between the members of the work group arises these two extreme situations allow the definition of a set of possible reactions, so that the reactions are limited to these extremes.

f) The plausible – Inside and outside – reaction to the situation

The plausibility of the functioning of the different scenarios after an exogenous shock must be questioned. In particular the links between the actions and the reactions between individuals of the same unit, between different units in the firm, and between the firm and the industry. Are these links logical ? Can such a behaviour reasonably be expected from the individuals? This step can lead to the elimination of several scenarios because many biases can be found at this stage. The constructed scenarios can reflect the actual circumstances more than credible futures. Also, dominant personalities in the working group can widely influence the outcomes. This is the case when working groups have been set up with too strong connection with existing hierarchies (or when one department sends a trainee who neglects the importance of scenario building, and when in another department the chief is involved).

g) To formulate strategy

On the basis of the conceived scenarios, the managers can determine the actions, the initiatives that must be undertaken to transform the routines, the structure of the firm in such a way as to be more flexible, to be able to give a satisfactory answer when one of the exogenous events arises. They transform partially uncertainty into risk (nonetheless pure uncertainty still exists, corresponding to what has not been imagined). This action serves to create not only a more flexible structure for responding to outside threats, but also a structure more able to seize or create opportunities.

As we have seen above the scenario building approach does not allow the clear determination of when an increase in the flexibility leads to an increase in the value of the firm. This comes from the non-quantifiable nature of scenarios. The real option perspective focuses on that point.

Real Options

The real option analysis has its origin in the field of financial derivatives and follows a development that has known recently an upsurge of interest in the strategic management literature. The origins of the real option are related to concepts of option values, flexibility and firm evaluation. Myers (1977) who first used the definition real option,

divides the value of a firm into two categories. The first category corresponds to the assets in place (tangible or intangible), the second to the opportunities the firm has for obtaining, in the future, new assets at a preferential price.

The preferential conditions to obtain new assets come from the assets already in place. The label real option, by analogy with financial option, stipulates that a firm can buy (or sell) new assets, but is not obligated to do so. Financial option determines rights on assets, the real option approach adds to the rights a possibility condition represented by the necessity of holding specific resources (tangible–intangible) for being able to exercise an option.

At the heart of the real option analysis stands the asymmetric reaction the firm can have when an uncertain situation turns out to be good or bad. Following the financial option logic, the holder of an option can acquire specific assets if the environment develops favourably, but is compelled to invest if the environment develops unfavourably.

There are many examples of real option applications, e.g. investment in R&D, evaluation of industry extension, joint venture... Many of these analyses are done in sectors where the intangible assets are major components of the total value of the firm. When a firm decides for example to change the inputs needed for producing an output, or to expand a unit of production, some behaviours must be changed. Different routines must be employed to implement this action. Each type of routine corresponds to a specific endeavour from management to change the ongoing activities of the firm. This shift in activities corresponds, we assume, to a modification of the routines. In each case, it is an initial investment in flexibility that lowers future costs to be supported by the firm when the operations must be changed. This initial investment corresponds to the cost of setting up the support structure for the modification of the routines. Similarities can be found between the different categories of real option and the aim of routines, **Table 1** collects some of them.

– Insert Table 1 about here –

The major advantages of real option are that it evaluates flexibility by building on static tools such as the NPV and incorporates managerial decisions in forms of option. This

conception limits the losses if in the future the situation turns out badly by delaying investments in sunk costs. By using the mathematical tools of the finance option, this approach is more rigorous than other qualitative methods. Also, this model uses time as an input or output which makes it possible to determine when the different actions can or should take place.

Nonetheless, some flaws exist. In general, the real options are difficult to evaluate and need unrealistic assumptions or guessing some important parameters. But, in our view, the major gap is that the real option only evaluates existing situations and does not generate new investment situations or proposals.

Heuristic Real Options, the integrated approach

Heuristics are rules of thumb that direct the solution approach toward the best solution, but do not guarantee that it will be found. More specifically: *“A heuristic... is a short cut process of reasoning ... that searches for a satisfactory, rather than an optimal solution. The heuristic, which reduces the time spent in the search for the solution of a problem, comprises a rule or a computational procedure which restricts the number of alternative solutions to a problem, based upon the analogous human trial-and-error process of reaching acceptable solutions to problems for which optimising algorithms are not available”*, Hinkle and Keuhn (1988:61).

For these authors heuristics necessitates a trial and error process with feedbacks. In the case of a single utilisation a heuristic approach is of no use and it is then reduced to a single try. Also the description, the available data and action that can be done position the problem into a risk or an uncertain framework. In the case of uncertainty, the heuristic approach is preferable.

In this integrated approach, the analysis begins by scenario building but this time at the level of the projects in order to determine which activities are subject to the same environmental uncertainties. This allows us to determine the risk exposition of the activities of the firm in a portfolio like approach. This distinguishes this approach from the majority of the real option models which handle options separately and try to limit their interaction, mainly because this interaction enhances significantly the tractability and understanding difficulties of the model. The steps are the following:

a) To elaborate the scenarios

Ideally, the portfolio of activities should be grouped by routines. This is difficult if not impossible, so a grouping by activity is more likely to be done.

b) Identify exposure to risk

At this step, environment risks are defined. These risks can be at three levels. The most general level is the country level, then the industry level and finally the firm level. The country level corresponds to a macroeconomic risk, currency exchange rate, the industry level corresponds to industry competition: the availability of inputs, demand level of the outputs, and the firm level corresponds to specific risks for each activity, credit risk, pollution, outcomes of R&D... Then the effect of each of these risks on each of the activities (positive, negative, important, negligible) are defined, and by aggregation we can deduce the effect of each activity on the whole firm.

c) To choose the investment guided by RO

Now that the effect of the uncertainty of the activities of the firm are known, the investment must be built as real option, allowing the use of uncertainties in the more profitable ways. The cost of developing the investment project (the intangible or tangible) corresponds to the exercise value of the option.

d) The carrying out

The final step corresponds to the decision to implement a scenario, to develop or not assets transversal to several activities, assets on which future opportunities can be seized or better answers to situations can be given. This final step implies the creation of routines. The more the conditions needed to have routines are set, the easier this last step is. This fourth step encompasses the monitoring of the relation between the units using the same new resources that must be put in place, e.g. the financial department of the firm has to collaborate with the individuals in charge of financial processing in the different other departments.

The construct of the flexibility, as an expression of the improvement of the existing routines or their development, becomes concrete when the option is exercised or the routines are triggered by an exogenous shock.

Links to routines

We adopt the following procedure for determining the elements that lead to the development of routines. We identified in the previously described steps those which reflected the condition of existence of the routines. **Table 2** shows the intensity of the link by plus signs. A “+” sign corresponds to a significant link of this step on the considered characteristics of the routine. A “++” sign means that the step determines strongly the creation and the characteristics of the routines.

– Insert Table 2 about here –

Four characteristics receive a special treatment (pattern, recurrence, effortful, process) because the effects of these characteristics can be seen only at the end of the steps or because all the steps correspond to the expression of the characteristic. In this way, the procedural nature of the routines can only be observed when the routine is fully in use. But the first steps of the scenario analysis and heuristic real option that we have described match the process of change from one routine to another by creating the bases of change. Individuals involved in such a process, when they save on their cognitive resources by using routines in their activities, can invest them in the creative and demanding work of scenario building.

The collective nature of the future routine can be found in several steps of the planning process. But some steps are more dependent than others on the interaction between the individuals from the different communities because the nature of the work to be accomplished in the step depends on the interaction between the individuals. For example, the final step, the carrying out of the routine corresponds to the practical implementation of a new procedure and to the exercise of the option leading to the formation of a routine. At this step the real interaction between the different individuals takes place and gives its effective form to the routine. The identification of the

participants, and the definition of the plausible reaction of the individuals are also steps necessitating a high interaction and a survey of all the members of the firm. Some other steps are collective, mainly when the effects and the reactions are determined and involve the project team. Steps such as the definition of the aim and formulation of the strategy are rather limited to the top management, involving a few individuals only.

The context dependence and specificity characterising the routines occur naturally at all the steps of the planning. The scenarios are firm specific. But some steps correspond to a strong interaction with the future routine. Especially the steps where the employability of the scenario is assessed are context specific. Cohendet and Llerena (2003) have developed this context specificity of the routine. The multiple actors that are involved in the routine forming and utilisation constitute different knowledge creating contexts that compose different kinds of communities. These authors investigate the effects of different forms of communities on the routines created. They distinguish hierarchical communities such as functional groups that are mainly employed in our planning procedure from epistemic and practice communities. Each community influences the routine emergence in such a way that the results diverge in terms of search potential, inertia and replication facility.

Closely connected to this preoccupation is the path dependence of routines. The path dependence appears in the way the history of the firm (chronology of the evolution) leads to the utilisation and actual form of the routine. This is recognized in theoretical and empirical works. Teece *et al.* (1997:522) in a theoretical work note that “...*a firm's previous investments and its repertoire of routines (its 'history') constrain its future behaviour*”. Betsch *et al.* (2001), in an empirical work related to investment decision, design an experiment where players have to define an aim, determine a strategy and perform investment strategies. The result shows that the players are strongly path dependent when their previous decision was successful and they omit in this case new information and stand close to the established scenario.

The extension of the scenario analysis with real option becomes significant when we consider path dependence with uncertainty in the steps of the strategy formulation (Step Ig, IIa,b,c). Courtney *et al.* (1997) show that the path dependence is lower when the

uncertainty and the pace of change increase. In case of absence of uncertainty and a slow continuous change, these authors characterise the future as clear with a single future path directly linked to the previous position of the firm. When uncertainty increases the future paths become numerous and the links with the previous positions (routines) become discontinuous or break. The path dependence fades when too many parameters are changed simultaneously and the previous routines become useless.

The triggers of a routine that are precise stimuli, internal or external to the firm, can be partially found in the analysis of the plausibility of the reaction. Thus, the reactions of the individuals after a shock can lead to the establishment of a recurrent behaviour (conform or not to the expectation formulated). For example, the introduction of a tool for the fabrication of a standard pizza in different franchised store is studied by Argote and Darr (2000). The new tool was either accepted or rejected by local managers of pizza shops and led to different routines in the pizza fabrication process. In case of acceptance, it corresponded to an application of the “scenario” intended by the franchise group.

The real option addition becomes of crucial importance when we consider triggers of routines. In conventional scenario analysis no threshold is given for putting the plan into practice. The addition of real option makes it possible to determine quantitatively such thresholds. These thresholds can be dependent on events external or internal to the firm. McGrath (1999) gives examples of internal thresholds in the form of manager’s satisfaction level depending on previous success or failure in investment projects. Her conclusion is that a real option approach lowers the threshold if it exists, or creates thresholds that foster the decision making process of the managers. The managers considering real options are favourable to change and the development of new routines in the firm. She mentions as a potential threat, when the options are not considered, that the firm rests on the utilization of a routine that proved its effectiveness in previous situations but shows reluctance to searching and developing new routines.

Evaluation techniques and routines explored by simulations, surveys and experimental economics

In this section we present some approaches for assessing evaluation techniques as routines. These developments utilise different methodologies: simulations, experimental economics and sample surveys. They try to define the importance of frequent utilisation of the same evaluation techniques and the dangers or advantages of applying them as routines. We focus mainly on the existence of a qualitative upgrading of the evaluation techniques when real options are added. Finally, the section concludes with explanations why some techniques that seem superior in theory are not frequently employed in practice.

Repeated investment in simulations

An early work employing simulation for appraising repeated investment behaviours is the work of Baumol and Quandt (1964). In this work, the authors test different rules for determining the optimal production decision of a firm. The *decision maker* represented in their framework has to choose between broad categories of demand and cost functions (linear, quadratic...). He only knows a couple of points from the real demand and cost functions to which he applies the mathematical relation from the category of function considered. Then the decision maker determines his production level and the simulation determines the profit associated with the real demand and cost curves. Baumol and Quandt, by repeating this procedure several times, determine the mathematical representations of demand and cost that are the most appropriate in this special situation. In their work, they show that the most elaborate rules do not (on average) give the best outcomes. They advocate that a rule of thumb, as an easily learned and easily applied procedure for approximately calculating or recalling some value, is a better procedure than trying to obtain the best information possible.

In their pioneering simulation work for determining and testing rules of thumb, they did not push the argument to encompass routines creation, as a repeated behaviour, and the effect of these rules of thumb (or routines) on the organization. Neither did they employ more sophisticated techniques such as real option (it was not the aim of their work, and these notions had not been discovered at that time).

An attempt at using simulation and testing the accuracy of real option against standard decision criteria is made by Kumaraswamy *et al.*(2003). They explore whether the use of evaluation and organizational routines that help a firm to recognize and realize the value of flexibility options attached to her R&D opportunities/projects pays off in terms of improved R&D performance. Specifically, they use a computer-simulation-based approach to compare the baseline (or traditional) version of two evaluation techniques – the Net Present Value (NPV) technique used in finance and the Multifactor Evaluation Process (MFEP) technique used in decision analysis – with their respective option-enhanced versions. Their simulation results indicate that the use of the option-enhanced version of either technique resulted in a significantly higher success rate of funded projects and overall R&D productivity when compared to that achieved using the baseline version. An implication is that the consistent application of straightforward evaluation and organizational routines can capture the intuition behind complicated real options mathematics and yield improved R&D performance. However their representation of routines are rudimentary and would be better qualified as a repeated behaviour.

In Zott (2003) a simulation study is done on how dynamic capacities can influence the structure of an industry. In this simulation work the hypothesis is formulated that the firm acts as a unique entity without separating the routine into pieces that each agent performs. A model is presented in which dynamic capabilities are treated as a set of routines guiding the evolution of a firm's resource configuration. The model centers on the endogenous choice firms make between resource deployment through imitation and experimentation in order to generate alternative resource configurations. The author found that timing, cost, and learning effects foster the emergence of robust performance differences among firms with strikingly similar routines. Nonetheless all the evaluation and the choice decision between imitation and experimentation are done with a standard NPV technique. Miller and Arikian (2004) remedy that point by introducing real option reasoning versus evolutionary modelling, but neglect the interpretation of a repeated action as a routine.

Repeated investment in experimental economics and surveys

The above-mentioned three simulation works show a significant link between investment procedures that can lead to routines in the organizational behaviour. The theoretical importance of this link suggests considering empirically the influence of investment techniques on the general habits and routines of a firm. Especially when these techniques are close to the option planning we described.

The experimental work of Miller and Shapira (2004) explores the evaluation of projects with real option. Their study is based on a questionnaire submitted to 64 individuals, practitioners in finance (average age 37). The result shows that the habit of using standard evaluation techniques without considering the options leads to frequent under-evaluation. In addition, by presenting the investment by stories to the participant of the experiment, the authors saw that parameters that do not influence the option value are taken into account and significantly perturb the evaluation (which highlights the importance of a correct planning, e.g. the step IIb). Despite the wrong calculation, the option part of the evaluation is seen as a useful addition to the standard evaluation factors by the participants.

Yavas and Sirman (2005) carried out another experimental study focusing on the importance of the option for determining the timing of the investment (e.g. the option as investment trigger, steps IIc,d). Their study shows that in the different investment stories (scenarios) presented, the individuals often invest too early. They show also that, when uncertainty increases, the importance of the option for the participant increases.

One can be puzzled to see how few firms use real option in practice (Busby and Pitts, 1997; Rigby, 2001). This can be explained by several facts: first, the mathematical background needed to use option techniques can be too demanding (Luehrman, 1998). Secondly a manager can encounter problems to represent option cognitively and difficulties to implement them in practice due to a reluctance of the organization to the change of the routines (Kogut and Kulatilaka, 2004). Howell and Jäggle (1997), in a study on five different industries, note that the values attributed to options are systemically over or under-evaluated depending on the industrial sector of the manager interviewed. They also note that the option is most misevaluated in the industry, or firm, with the highest pace of change. Accordingly, firms where the routines have been

longest in use, saving the more cognitive resources, are the most able to perform a clean scenario planning and evaluate the options rightly.

The previous work showed that evaluation tools can influence the investments of a firm, thus they can create significantly different routines. Experiments and surveys pinpoint that, despite their appealing characteristics, real options are not well used in practice. A reason for this is that their correct use necessitates a behaviour that is non-natural for many individuals in the firm. Adner and Levinthal (2004b) precisely underline this issue. For these authors the theoretical superiority of real options runs into the practical difficulty for a manager to respect the thresholds or the strictly binary decision that they imply. Organizational and cognitive biases can distort the evaluation of R&D investment and technology developments. Using investment rules of thumb correctly is a difficult task for an organization because its search and evaluation routines are limited by cognitive and organizational constraints. Four themes from evolutionary theory help us understand the limitations of an organization investment process: (1) The scarcity of management attention that limits the search capabilities to a small set (Cohen, March, and Olsen, 1972); (2) The difficulty to obtain adequate performance target triggers (Adner and Levinthal, 2004a); (3) The organizational structure, processes, and personnel shape the context for resource allocation decisions, which imply rigidities and reluctance to implement the best decision for the firm and favour individual aspiration (Kogut and Kulatilaka, 2004); (4) Managers are susceptible to myopia (Levinthal and March, 1993). Temporal myopia involves focusing on short-term outcomes and neglecting the future. The description of organizational decision processes in the evolutionary literature stands in marked contrast to the hyper-rationality required to apply real option pricing models from finance.

Routines, by their repetitive patterns of action, are examples of behaviours that can prove reluctant to the exploitation of the options. Hence, there is a theoretical opposition between routines that save cognitive resources and authorize the creation of options for the firm, and the same routines that block the exercise of the option. This duality shares common ground with the exploitation exploration debate (Nooteboom, 2000) and the entrepreneur vs. manager literature (Cohendet *et al.*, 2000).

Conclusion

This work tries to tie together different approaches for linking real option decision making to routines and to see their effect on the firm. We first described the basic characteristics of a routine and, in a second point, we linked these characteristics to a scenario planning procedure. This endeavour shows that a careful planning, using scenarios and real option meets several conditions of existence of routines. We can assume that such a planning allows a better understanding of a firm investment and its effects on the organization. In addition, it prepares the firm to a modification of the existing routines.

In the third point we discussed some studies, using different methodologies, about the effects of real option and their links with the routines of a firm. We formulate the assumption that, even if theoretically the real option shows better results, its utilisation is difficult from a practical point of view.

As pinpointed by Dosi *et al.* (2000) “*routines carve a crucially important aspect of knowledge right at its joints, namely, its application*”. We see that the practical aspect of routines limits the theoretical qualities of real option.

Of course the unique culture of each company, the specific circumstances she is facing influence her strategies and strategic planning process requirements. The culture of the organisation will affect the content of the changes recommended as well as how the changes are communicated (Bloodgood, 2000:246). Therefore each decision tool influences more or less directly the organisation and the routines of the firms (and reciprocally). In this work we try to give a general overview of how routines and real option are linked.

Palmer and Dunford (2002) proposed an image of change management, focusing on two dimensions, namely whether the outcome was intended or not, and whether the management had a controlling activity or rather a shaping activity. They conclude that where management is viewed as shaping capabilities it might be accepted that transformation might be managed but there will be variable answers in terms of the extent to which change outcomes are intentionally achieved. Smith and Graetz (2006), in a study of organisation forms, conclude that change is continuous at the micro level but discontinuous at the macro level. Therefore the relations between organising and

strategizing could be non-linear and recursive. Based on our **Figure 1**, the continuous change at the micro level happens at two points, on the decision behaviour of the manager (including the decision tools used) and on the routines. These two micro elements of the firm should change, or rather co-evolve in an integrated manner to achieve a better growth performance at the macro level. In an empirical work Bloodgood (2006) showed that this is particularly true for big firms who need to focus more on change motivation within their organisation. However these points deserve further research to clarify the links between routines and strategic decision making.

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Figure 1. Linking routines, resources and decision making

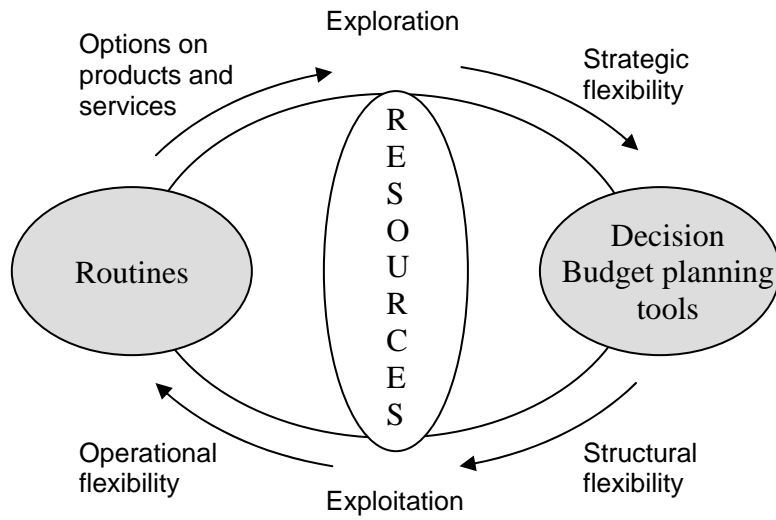


Figure 2. Map of decision tools (adapted from Mun 2002:65)

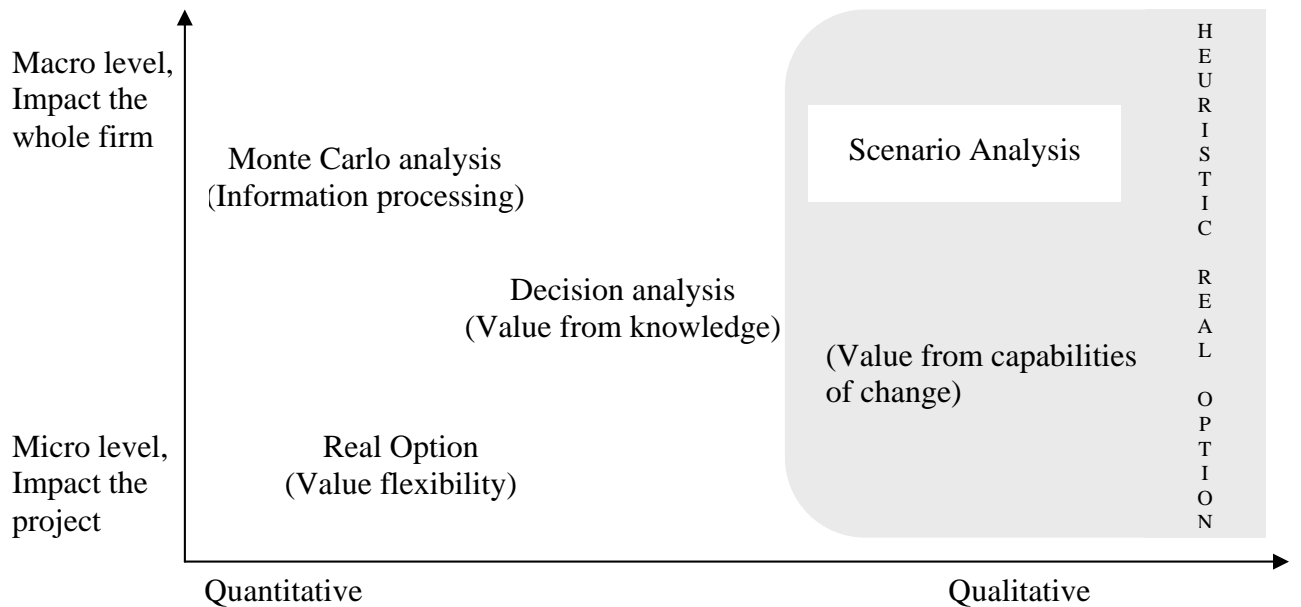


Table 1. Real option and corresponding routines

Type of Option	Description	Corresponding Routine
Option to defer (McDonald and Siegel, 1986)	Management can wait x years to see if output prices justify construction of building or developing a plant.	Time lags and delays (March 1994)
Time-to-build option staged investment (Majd and Pindyck, 1987) and Growth options (Kester, 1984)	Staging investment as a series of outlays creates the option to abandon the enterprise in midstream if new information is unfavourable. Each stage can be viewed as an option on the value of subsequent stages and valued as a compound option. In case of success this option is a growth option.	(Macpherson A., Jones O., Zhang M., 2004)
Option to alter operating scale e.g. to expand; to contract; to shut down and restart (Trigeorgis and Mason, 1987) and Option to switch e.g. outputs or inputs (Kulatilaka, 1993)	If market conditions are more favourable than expected, the firm can expand the scale of production or accelerate resource utilisation. Conversely, if conditions are less favourable than expected, it can reduce the scale of operations. In extreme cases, production may be halted and restarted. Or if prices or demand changes, management can change the output mix of the facility (product flexibility). Alternatively, the same outputs can be produced using different types of inputs	The speed of executing routines, of changing their contents, and of switching between them (Cohen 1991)
Option to abandon (Myers and Madj, 1990)	If market conditions decline severely, management can abandon current operations permanently and realise the resale value of capital equipment and other assets on second-hand markets.	The speed of decay of routines, the need to maintain routines (Cohen, 1991)
Multiple interacting options (Trigeorgis, 1996)	Real-life projects often involve a collection of various options. Upward-potential-enhancing and downward-protection options are present in combination. They may interact with financial flexibility options.	Frequency and fashion of shifting from one routine or set of routines to another (Hannan and Freeman 1989)

Table 2. Common characteristics between HRO and routines

Planning Steps		(1) patterns	(2) recurrent	(3) collective	(4) effortful	(5) process	(6) context specific	(7) path dependant	(8) triggered
I	(a) Define the aim								
	(b) Identify the participants			++			+		
	(c) Define what is known			+					
	(d) From certainty to uncertainty			+					
	(e) The possible situation			+			++		
	(f) The plausible reaction			+			++	++	
	(g) Formulate strategy							++	
II	(a) Elaborate the scenarios			+					
	(b) Identify exposition to risk			+					++
	(c) Choice of the investment by RO			+			+		++
	(d) The carrying out			++			++		++