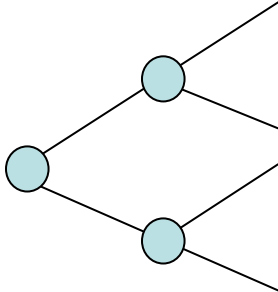


A Pattern for Real Options

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A real option represents a set of contingent commitments over future economic exchanges and/or conversions.

Context

Traditional methods¹ of investment valuation, such as Net Present Value (NPV), are coming under increasing scrutiny. One of the major criticisms of this orthodox theory (Dixit & Pindyck, 1994) is that it fails to recognize the value of adaptation (i.e., flexibility) inherent in many business projects and investments; or in other words, it assumes that management is passive about the on-going management of options (Smit & Trigeorgis, 2007). Recognition of such shortcomings within investment valuation practices has led to the advancement of real options² thinking as a way to value options derived from managerial flexibility. Real options provide management the right but not the obligation to invest in a project.

Increasing criticism of the orthodox theory to valuing investments has also contributed to increasing dissatisfaction with the traditional capital budgeting process. Under this approach, after all possible investments are submitted for consideration, those investments whose expected returns exceed the organization's cost of capital are approved, subject to capital rationing constraints. The main criticism of the traditional approach to resource capital allocation is that it may fail to adequately recognize that capital investment decisions are made within a wider strategic management context, which calls for a more coordinated and holistic view towards setting and achieving strategic objectives (Maccarrone, 1996; Mouck, 2000). Consequently, a number of authors have argued that adoption of a real options approach to capital allocation can provide a method for actively managing and coordinating multiple investments (see, e.g., Smit & Trigeorgis, 2006). Barnett (2005) recently stressed that the real options literature has moved beyond valuation of independent projects to promoting real options thinking as a normative framework for corporate strategy.

The degree that the strategic management function is formalized into stable non-autoschediastic processes will vary across organizations. For example, McKiernan & Morris (1994; cited in Peel & Bridge, 1998) advocate that effective planning systems in smaller-to-medium

¹ The terms *method*, *technique*, *approach*, and *practice* largely appear to be used interchangeably within the investment valuation literature.

² The term "real options" is used to reflect their association with real assets, rather than with purely financial ones (Brandão, Dyer & Hahn, 2005).

enterprises tend to de-emphasize the need for written documentation and formal procedures. Moreover, Maccarrone (1996) considers that the identification of investment opportunities cannot be easily formalized. Furthermore, specific strategy processes will be embedded within an environmental and organizational context (Pettigrew, 1997). Consequently, such processes will be molded by numerous exogenous (e.g., dynamism, politics, environmental munificence) and endogenous factors (e.g., organizational size and structure) (Hutzschenreuter & Kleindienst, 2006). In short, one should expect to find considerable variation in the design of the strategic management function across organizations.

Notwithstanding the possible variation in the design of strategy processes, several authors (see, e.g., Braeutigam, Mehler-Bicher & Esche (2003); Heikkilä, 2002; Maccarrone, 1996) have attempted to develop high-level conceptual models of the strategic management function and associated capital allocation processes. One such model is Maccarrone's (1996) conceptual model of the capital budgeting process (which is reproduced in Figure 1). This model divides capital budgeting activities into strategic planning processes (i.e., the identification and selection of investment opportunities), and processes associated with the authorization, implementation, control, and post-auditing of investments. Braeutigam, Mehler-Bicher & Esche (2003) have recently present a similar model³, which includes four layers: the first layer focuses on organizational aspects (e.g., makeup of the team involved in the capital budgeting process); the second layer addresses option identification and related issues, such as measuring uncertainty; the third layer focuses on the valuation of the options; while the last layer focuses on controlling and monitoring investment decisions, such as ensuring options are correctly exercised.

The design of any capital budgeting system is important as it will typically become the key coordination mechanism used to ensure the proper functioning of many interrelated strategic sub-processes. Capital budgeting systems will also help ensure that investments (i.e., capital resource allocations) are sufficiently justified, recorded, implemented, monitored, and reviewed in a systematic and on-going fashion. Adoption of a more formalized capital budgeting process also fits with warnings that the application of the real options approach requires periodic monitoring, re-evaluation, and redesign of the investment program (Balasubramanian, Kulatilaka & Storck, 2000). In addition, a formalized capital budgeting process may help to mitigate the concerns recently expressed by Kim (2006), who considers that some managers involved in the capital budgeting process may lack proper incentives to collect all important relevant external information about potential investments.

Given the importance of the capital budgeting process to most organizations,⁴ a number of commercial COTS applications are now available to specifically support the capital budgeting process. For example, *ARCHIBUS*⁵ recently released a module to support capital budgeting. The description given to this module is that it will provide a method for tracking the capital budget cycle from request, evaluation, approval and funding.

Problem

The extended REA model (McCarthy, 1982; Geerts & McCarthy, 2000, 2002), as a domain ontology for enterprise information systems, will increasingly become a valuable ontological

³ It should be noted that this model is specifically presented as a framework for the valuation of real options. However, we believe that the layers presented within are generic enough to apply to capital budgeting processes using a variety of approaches.

⁴ Kim (2006) recently characterized capital budgeting as potentially the most important decision made by corporations.

⁵ This company describes themselves as the leading facilities and infrastructure management solutions provider.

reference framework for the design of information systems supporting the planning, control, and monitoring of resource allocation decisions and the management of intangible asset portfolios.

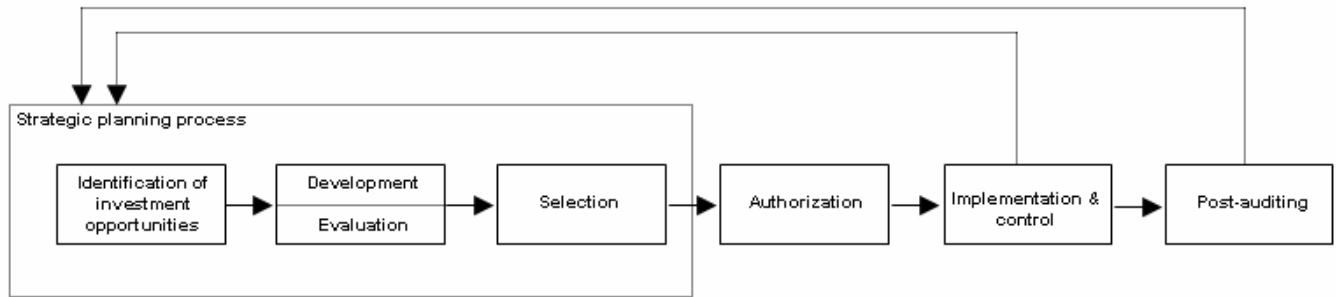


Figure 1: Structure of the capital budgeting process (Maccarrone, 1996).

Given that resource allocation decisions are increasingly being conducted within a real options framework, how do we represent real options within a REA-based enterprise model?

Forces

The solution needs to acknowledge or balance the following forces:

- **When valuing potential investment opportunities, managers would like to know what types of real options are associated with a particular investment / project.**

The real options pattern outlined herein will be of interest to organizations who view making strategic investment decisions based solely on orthodox financial theory fails to fully recognize the value of certain investment opportunities. Specifically, management may structure investments to include the flexibility to defer, abandon, expand, or contract an investment. At the heart of the real options approach is such flexibility holds value. For example, assume that an unforeseen competitor enters a market and offers a superior and cheaper product to an incumbent firm. In order to compete with this new competitor, assume this firm would have to reduce the price of its product substantially, leading to a loss situation. In this case, the ability to abandon this market will be valuable, as such an option may avoid potential further losses. To appreciate this and other types of options organizations traditionally deal with, a typology of real option types is presented in Figure 2 (which has been adopted from Copeland & Keenan, 1998).

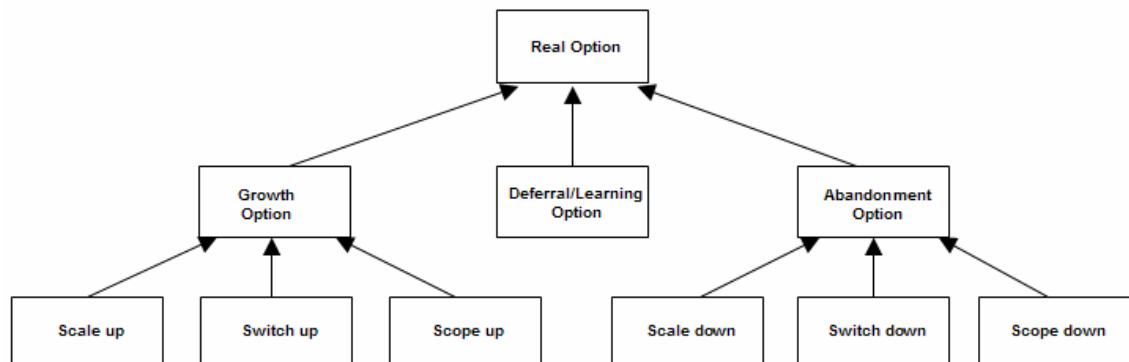


Figure 2: Real option types (from Copeland & Keenan, 1998).

- **Managers would like to know whether the real options approach is an appropriate investment valuation technique.**

It should be acknowledged that the real options approach is just one of a number of methods that organizations routinely use to value investments. It therefore stands that not all organizations will choose to adopt the real option approach, and therefore the pattern proposed herein⁶. In a recent review of capital budgeting practices, Ryan & Ryan (2002) found that out of 13 methods to value investments, the real options approach was actually used the least often by larger organizations. This relative lack of adoption of the real options approach for investment valuation is perhaps not surprising, given that this approach is routinely criticized for being potentially too complex for some managers to use and understand (see, e.g., Luehrman, 1998), and also presents practical difficulties in terms of implementation, such as estimating the impact of uncertainties that may affect project outcomes. The prevalence of alternative investment valuation methods is also not surprising, as application of the real options approach should be restricted to only valuing investments with the following properties:

- there is uncertainty regarding future rewards,
 - this uncertainty will be resolved over time as new information arrives,
 - management has the flexibility (leeway) to wait and take action on this new information,
 - the investment is totally or partially irreversible (i.e., sunk costs), and
 - the investment has asymmetric payoffs. (Dixit & Pindyck, 1994).
- **When selecting between potential investment opportunities, or when deciding strategic direction, managers would like to know the value of any real options that have been identified.**

How to value options is a question undergoing intensive research. Accordingly, there is a wealth of material on this subject. Notwithstanding, the real option pattern will not address directly how to value real options.

- **Many projects, and therefore options, have interdependencies. Consequently, managers would like to be aware of these interdependencies, and be able to manage and view options from different aspects: for example, as investment portfolios (groups), option types, projects, as well as according to investment stage (investment path-dependencies).**

The possibility of interdependencies across projects has motivated some authors to recommend that the system of assets, rather than the individual investment decision, be the critical unit of analysis and decision for managers (Miller & O'Leary, 2003; Trigeorgis, 1995), and that strategic initiatives be viewed as chains of interrelated investment decisions (Smit & Trigeorgis, 2007).

- **Managers would like to develop processes to track, monitor and manage real options.** Sub-forces, in this regard, may include:
 - Managers would like to know when an option expires, or has the potential to be exercised.

⁶ In addition, many organizations that actually use real options for investment valuation may also use other methods of investment valuation, as the use of multiple investment valuation methods is common (Ryan & Ryan, 2002).

- Managers would like to be alerted in a timely fashion to new information that may cause initial assumptions about option valuation or estimates of uncertainty to be need of revision.
- Managers would like to ensure that adequate information and important information has been collected to support sound capital budgeting decisions.
- Managers would like to differentiate between routine and non-routine requests for capital resources.
- **The ability of managers to identify, track, and monitor real options may be partially dependent upon the ability to integrate and coordinate a number of interlinked information systems, such as an organization’s foresight, forecasting, and intelligence processes** (see, Neugarten, 2006).

Solution

Strategic planning and capital budgeting are very information intensive processes. As Maccarrone (1996: 48) puts it: “*the role of information systems is very critical: as a matter of fact, the development of an investment proposal is a very long and complex activity, requiring a huge amount of data.*” Moreover, information systems can be implemented to support a number of aspects of the capital budgeting process, such as providing decision support for the investment analysis, or using software agents to monitor changes within the business environment that may effect options (see, e.g., Collan & Liu, 2003). However, the focus of this pattern is specifically on the modeling and recording of identified options. This pattern will also be of relevance to the design of systems used to monitor and keep track of options.

To address the key problem of focus within this pattern (i.e., how we represent real options within a REA-based enterprise model), we will first reflect upon the ontological composition of real options. Second, we will extend this analysis by comparing our findings with the ontological primitives of the extended REA ontology. Finally, we will suggest an approach to reconcile real options theory with the extended REA model.

In looking at the ontological composition of real options, McGrath, Ferrier, & Mendelow (2004) warn that one fundamental problem within real options research is that there is little consistency regarding what is actually meant by the term *real option*. Notwithstanding, these authors assert that one common idea is that a real option involves a limited commitment that creates future decision rights⁷. More specifically, we therefore describe a real option as a representation⁸ of a set of future exercisable decision rights over some underlying asset(s) that is valued by a decision maker. Accordingly, a real option represents a set of *potential* (contingent) actions (and therefore potential states of affairs) affecting the state of some underlying asset (or potential asset). At the core of any option value is the flexibility it entitles the holder. In this respect, one would usually expect a general monotonic relationship between the number of available actions and the degree of flexibility a decision maker enjoys⁹. Decision rights also possess properties and states. For example, an important property of a decision right is the identity of the entity that possesses the authority (responsibility) to enact the decision. Sometimes this right will be held exclusively, or sometimes shared with other entities (e.g., proprietary options vs. collaborative ventures). Decision rights also have a beginning and an end. The end of the life of a decision right may come with the exercising of the option, which generally will mean that the right and other assets are exchanged (converted) into real assets

⁷ Although McGrath, Ferrier, & Mendelow (2004) stress *future* decision rights, an implication of accounting for real options is that such rights are recognized contemporarily.

⁸ Accordingly, real options are intangible things.

⁹ See Hilton (1981) for a discussion of this relationship.

(i.e., *potential* actions become *actual* actions). Furthermore, the exercising of decision rights may be guided by (subject to) a set of constraints. For example, there may be temporal, ordering, as well as inclusive and exclusive disjunction constraints (e.g., some decision rights may be exercised, irrespective of the state of other decision rights, or such exercising may be constrained by the state of other options). In addition, a decision right will not be valuable unless the owner of those rights (or agent charged with exercising the right) has the capacity and right to enact a decision associated with a decision right (e.g., a decision maker cannot claim a decision right owned by another decision maker, unless there exists an agreement delegating decision rights, and they also possess an enforceable legal authority to enact a decision). Enacting a decision right turns a potential action into an actual one, which may have consequences: such as changing the state of the underlying asset, ending the life of the associated decision right, creating new decision rights, or generating a set of commitments.

A central notion in the above ontological analysis of real options is that a right to take a *potential* action (flowing from exercising a decision right) will be of interest to decision makers, and therefore is deserving of recognition within an enterprise ontology. Notwithstanding this argument, while the extended REA model recognizes future economic events and exchanges (e.g., through the constructs of contract, commitment, and agreement), there is no explicit recognition of ‘potential’ economic exchanges or events. Here, we specifically define a ‘potential’ event as one that is possible (e.g., it may be planned), but not yet committed to (it may therefore remain discretionary), and therefore its actualization is uncertain.

In contrast to the extended REA model, several recently proposed business ontologies have acknowledged within their frameworks the importance of ‘potential’ economic exchanges or events, in addition to certain ones (e.g., past or contractual events). Essentially, the recognition of ‘potential’ events constitutes an extension of the interest reflected in the extended REA model aimed at recognizing the “could be” dimension of enterprise events. One example of such an ontology is *The Enterprise Ontology*, which was proposed by Uschold *et al.* (1998). This ontology, for example, includes constructs for: *potential sale* (to represent future potential sales, vis-à-vis completed sales) and *potential customer* (defined as any legal entity who may become an actual customer, vis-à-vis actual customers). In addition, one of the central constructs within this ontology is *activity*, whose definition includes an *activity* that may have happened in the past, may be happening in the present, or can hypothetical happen sometime in the future. A second example of an ontology that recognizes ‘potential’ events is the *Business Motivation Model* (BMM). In essence, BMM is a metamodel of the concepts essential for business governance, and focuses on modeling management intentionality, and supports the developing, communication and managing of business plans in an organized manner (Yu, Strohmaier & Deng, 2006). Central elements of BMM include *Means, Ends, Influencer, Potential Impact* and *Assessments*. More specialized constructs include: *Visions, Desired Results, Goals, Objectives, Missions, Course of Actions*, and *Internal* or *External Influencers*. Clearly, several of these constructs, such as *Potential Impact*, explicitly recognize ‘potential’ events. Overall, the motivation to recognize ‘potential’ events within ontologies may, in part, be motivated by an increasing pace of change within the broader business environment, which is making strategic decision making and resource allocation more challenging for businesses. It is therefore not surprising that a number of ontologies have also been recently proposed that are aimed more specifically at supporting the strategic planning function¹⁰. For example, Jussupova-Mariethoz & Probst (2007) recently proposed an ontology for enterprise

¹⁰ In this regard, we endorse the sentiments of Nelson & Nelson (2003), who recently made a call for the development of strategic ontologies that can serve as foundations for strategic patterns.

performance and competences monitoring; while Tham & Kim (2002) proposed an ontology for strategic intelligence.

Perhaps the closest construct in the extended REA ontology to the idea of a ‘potential event’ is that of a *commitment*. Ijiri (1975: 130) defines a commitment as an “*agreement to execute an economic event in a well-defined future that will result in either an increase of resources or a decrease of resources.*” Reading this definition strictly, although this construct explicitly recognizes future events, it implies that the associated economic events have been planned, and in addition, there is in existence a commitment (intent) for these events to become actualized. In other words, an economic commitment is a *promise* to execute an economic event at some point in the future (Hruby, Kiehn & Scheller, 2006: 93; ISO/IEC 15944-4). In contrast, our definition of potential events relaxes the latter assumption, as there may not necessarily be in existence a commitment (intent) for these events to become actualized. According to real options theory, any final intent will be determined over time, as uncertainty is resolved through the receipt of new information.

Also of interest here is the central role of the concept of *rights* within the extended REA ontology. While the original incarnation of REA (McCarthy, 1982) refers to ‘monetary’ flows, rights are now viewed as being the source of value for economic exchanges – i.e., inflows and outflows are flows of rights. Accordingly, there is an implied view that resources constitute bundles of rights. While many rights may constitute ownership-type rights (i.e., property rights), the idea of rights within the extended REA ontology is very broad. For example, ISO/IEC 15944-4, which heavily draws upon REA, includes examples of rights such as the right of way, and privacy rights. However, we failed to find any explicit recognition of *decision rights*, present or future ones, as being valid examples of rights within the REA framework. Such an omission, either by intent or disregard, serves to highlight the following questions:

- What type of exchanges involve exchanges of decision rights?

Which leads to other questions, such as:

- If real options constitute resources in an REA sense, how are real options created in the first place?
- How transferable (liquid) are decision rights that may be associated with real options?

While we do not intend to fully discuss these issues here, it is of interest to assert that some real options (and therefore decision rights) can be more easily identified than others. In fact, one challenge that organizations face is to identify what real options they may have that may remain undiscovered. Furthermore, while accounting systems were originally designed to recognize the state of an entity’s physical assets, their ability to recognize and track the state of intangible assets is still an area of intense research within the Accounting discipline. Perhaps a good example of an underlying asset that clearly possesses decision rights is a patent¹¹. Another example is a commercial lease held by an oil company granting the company legally-enforceable decision rights over the exploration or development of a potential oil field. In contrast, an organization may choose to make an investment in an emerging technology without a full understanding of what benefits it may produce; but the organization may see such an investment as a way of creating a first-mover advantage (option to expand) if the market for related technology products expands. In summary, notwithstanding the extent that decision rights are ‘valued’ in an economic sense, it would seem plausible that their transfer between

¹¹ A patent is a set of exclusive rights granted by a state to a patentee (the inventor or assignee) for a fixed period of time in exchange for the regulated, public disclosure of certain details of a device, method, process or composition of matter (substance) (known as an invention) which is new, inventive, and useful or industrially applicable (Wikipedia, 2007).

economic agents would be befitting an exemplar right within the intent of the extended REA ontology.

To reconcile the extended REA ontology with real options theory, we believe it is necessary to introduce a variation on the REA *commitment* construct, which we shall refer to as a *contingent commitment*¹². Specifically, we adapt Ijiri's (1975) definition of a commitment to define a *contingent commitment* as an “*agreement whose actualization is dependent upon the exercising of a collection of valuable decision rights that provide a decision maker with an option, not obligation, to execute an economic event in a well-defined future that will result in either an increase of resources or a decrease of resources.*” Within this context, actualization is the execution of economic events that fulfill commitments (ISO/IEC 15944-4: Rule 39), thereby incrementing a *real* commitment. In this way, an option instance can be seen as the reification of a typed collection of decision rights associated with an underlying resource (asset). The term *contingent* was deemed an appropriate descriptor, as its definition includes a reference to being: “dependent for existence, occurrence, character, etc., on something not yet certain; conditional; liable to happen or not; uncertain; possible.” Moreover, we specifically chose to continue the use of Ijiri's (1975) phrase “*in a well-defined future*” to restrict the definition of a contingent commitment to well-identified events, thus expressly excluding events that are either improbable, random, or unexpected. This view of commitments distinguishes between *real* and *contingent* commitments, and recognizes that some commitments may involve a type of agreement whose outcomes are not necessarily fixed/settled, but can change depending on future decisions to be taken. In essence, over time, as contingent commitments unfold, real commitments may be created, and as a consequence, real events, rather than potential ones, may eventuate.

As a *contract* can be viewed as a set (group, bundle, logical container) of commitments¹³ that are made within a legal jurisdiction¹⁴, it is therefore natural to ask whether comparable fiat boundary conditions exist for real options. While a contract, which imposes a set of obligations, appears to contrast with the *free will* principle reflected in real options thinking, we suggest that a specific underlying asset may be the focus of a collection of real options. Abstractly, we can refer to this collection as a *project*. At the next level of grouping abstraction, a set of project may constitute a strategy or a portfolio (Smit & Trigeorgis, 2006).

Design of the Real Option Pattern

Figure 3 presents a high-level fragment of a REA-based model for real options, which features the proposed *contingent commitment* entity. We assume that all current options have already been correctly identified and materialized – i.e., the diagram does not feature the necessary exchange processes that may be required to originate options¹⁵. Rather, our model acknowledges the possible exercising of the rights associated with real options – i.e., exchanging decision rights for the actions (events) that those rights entitle the holder to enact (exercise).

¹² The idea of contingency actions has sometimes been used in describing the making of strategic investments based on real options analysis (see, e.g., Clemons & Gu, 2003).

¹³ Of course, contracts are not mere boundaries around collections of commitments, as they also possess their own emergent properties (see, Wand, Storey & Weber, 2000, for a discussion of composite things), such as a contract administration clause detailing a mechanism for dispute resolution.

¹⁴ A commitment can also be of a non-legal nature, and therefore constitute a *part-of* an agreement.

¹⁵ For a REA model acknowledging the creation of intellectual property (which is an example of an underlying resource that will commonly have associated options) through an exchange process, we refer the reader to Hruby, Kiehn & Scheller (2006: 58).

Other relevant points for interpreting Figure 3 are:

- Although the exercising of an option will frequently result in a *real* commitment, the replacement of a *contingent* commitment with a *real* commitment is implied in the model (i.e., we have not sought to include both commitment types, in order to keep the model simple).
- Most options will represent bundles of decision rights that are not re-usable (‘renewable’), which may be the case, for example, for labor consumption. In other words, if a project has multiple expansion decision points, multiple distinct expansion option instances should be recognized¹⁶.
- As any single project may consist of a number of investment stages, with option exercise decision points separating each stage, a *contingent commitment* instance will be associated with a particular investment stage (or in other words, each investment stage may be defined by the associated options exercisable at its commencement).
- *Contingent commitment* instances can be grouped into project, portfolio, or compound option groupings¹⁷, and a particular *contingent commitment* group may take on a meta-structure form, such as a binomial tree¹⁸.
- Each contingency commitment instance belongs to a (is a *kind_of*) real option type (see, Figure 2).
- It may be common within some types of commercial arrangements that an option (e.g., an option to scale down) may manifest within specific contract terms or contract clauses. For example, a company may have negotiated with a third-party to rescind an arrangement or contractual obligation to promote a product in the case where predictions about market size turn out to be overly optimistic. For simplicity, we have not attempted to acknowledge such representations within our model.

For an information system designed to support the management and monitoring of real options, or to support strategic decision making, it is clearly preferable to recognize all possible *contingent commitment* groups, as well as all option types, irrespective of whether they can be, or ultimately expected to be, tied to either a set of outflow or inflow economic events. However, it is important to appreciate that there are potentially a number of option types, such as an option to scale-back an investment (i.e., an option to ‘scale down’ operations if conditions are worse than expected), which may not necessarily be directly tied to a specific set of outflow or inflow economic events. While these option types may be valuable, for example, in terms of avoiding potential unfavorable future costs, they may not necessarily require an outflow (above perhaps a nominal one), nor be tied to any specific inflow. Specifically, the source of their value arises from the differences in expected cash flows across different decision paths. van Putten & MacMillan (2004) clarify this distinction by reminding us that total project value (TPV) in the case of investments involving options is the sum of the discounted cash flows (DCF) (the base estimate value of the project) plus the impact of the positive potential uncertainty (i.e. the option value). In this way, the components of a project’s expenditure (outflows) and the cash inflows (inflows) arising from the project over time will be associated with (and an estimate of) the economic exchanges related to the project.

¹⁶ For a typology describing how options can inter-relate, we refer the reader to Benaroch (2001).

¹⁷ Multiple interacting options form compound options, whose value may differ from the sum of values of the individual options they comprise (Benaroch, 2001).

¹⁸ In this pattern, we assume a binomial tree meta-structure for the *contingent commitment group*. However, we acknowledge that other meta-structure forms may sometimes be also suitable. For a discussion of the properties of such investment structures, see Brandão, Dyer & Hahn (2005) and Copeland & Tufano (2004).

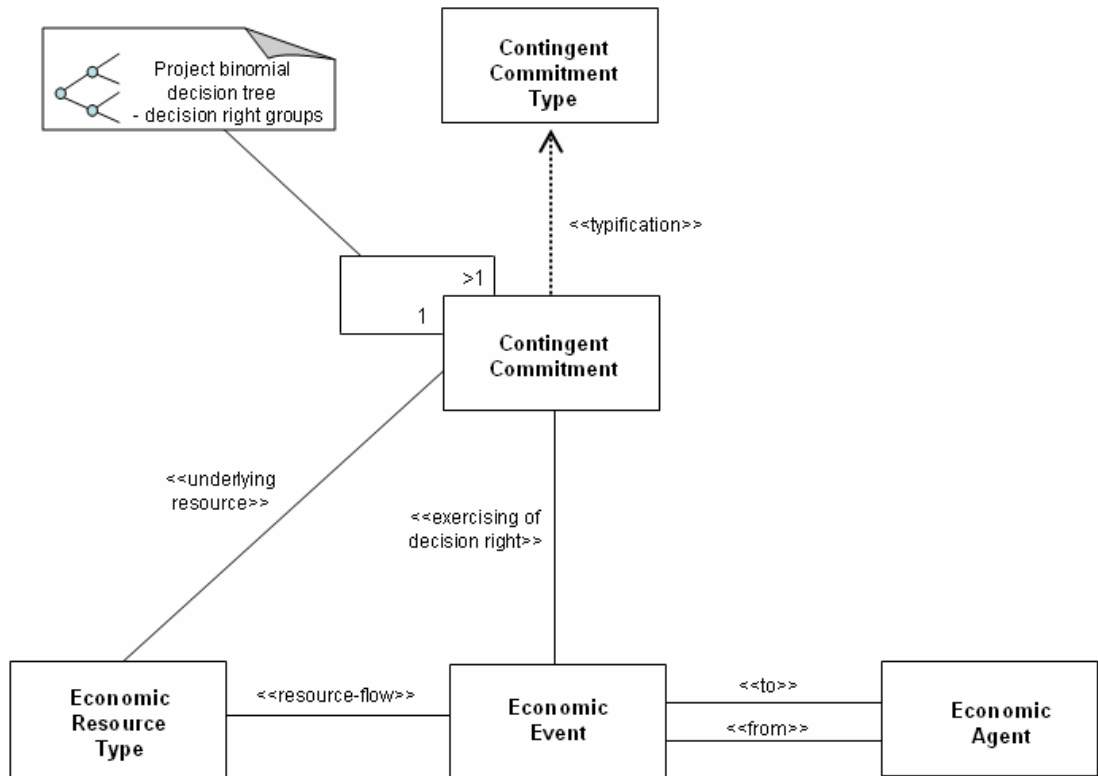


Figure 3: Real option pattern.

Example

Assume an organization wishes to develop a REA-based model of the static objects within an information system that supports the valuation and management of real options. Also assume that the organization has attempted to identify both the cash flows and real options associated with a project which, for this example, we assume relates to the development of a new software product (for identity purposes, we will refer to this software as *Wizsoft*). A simplified representation of this scenario is shown in Figure 4. This decision tree shows several main decision points, and a sample of the real options that management may have identified in such a situation. Again, for simplicity, we will look no further ahead than two investment stages, and our example focuses on three different options that may be relevant in such a scenario: an option to start; an option to defer; an option to grow (e.g., create a new module); and an option to abandon. Again, we stress that we have no interest in this study in addressing the valuation of these options.

Figure 5 illustrates an instantiation of the proposed real option pattern that reflects the *Wizsoft* example (in this case, the example highlights an option to expand). It is important to note that we have not attempted to model all aspects of this type of system. For example, we have omitted economic agents from the model as they are obvious. In the model, the featured option is an option to expand. The decision rights encapsulated within this option are associated with an underlying resource (i.e., the *Wizsoft* software), or more specifically, the resource that will be created on exercising those rights, which in this example, is Stage 2 of the *Wizsoft* software product. The exercising of the option is associated with increment and decrement economic events that recognizes the duality relationship between economic inflow and outflow events associated with the exercising of the option.

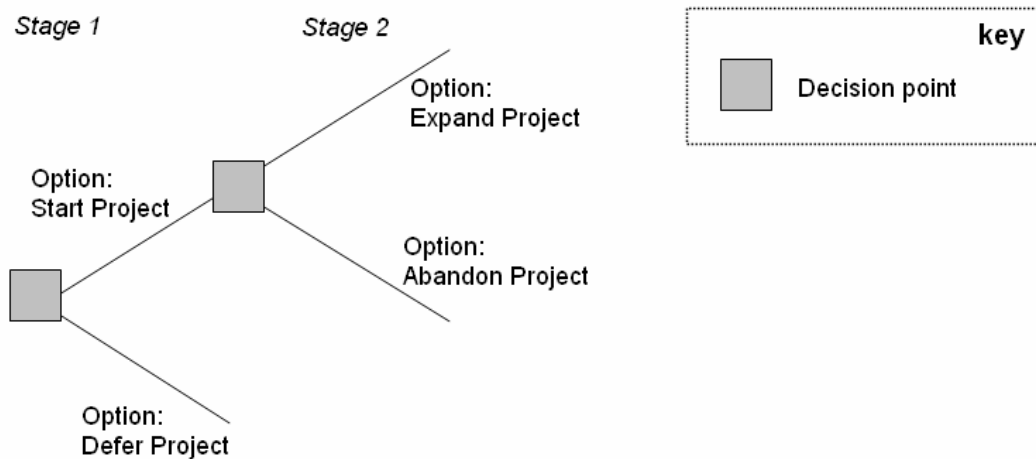


Figure 4: Decision tree for *Wizsoft* project.

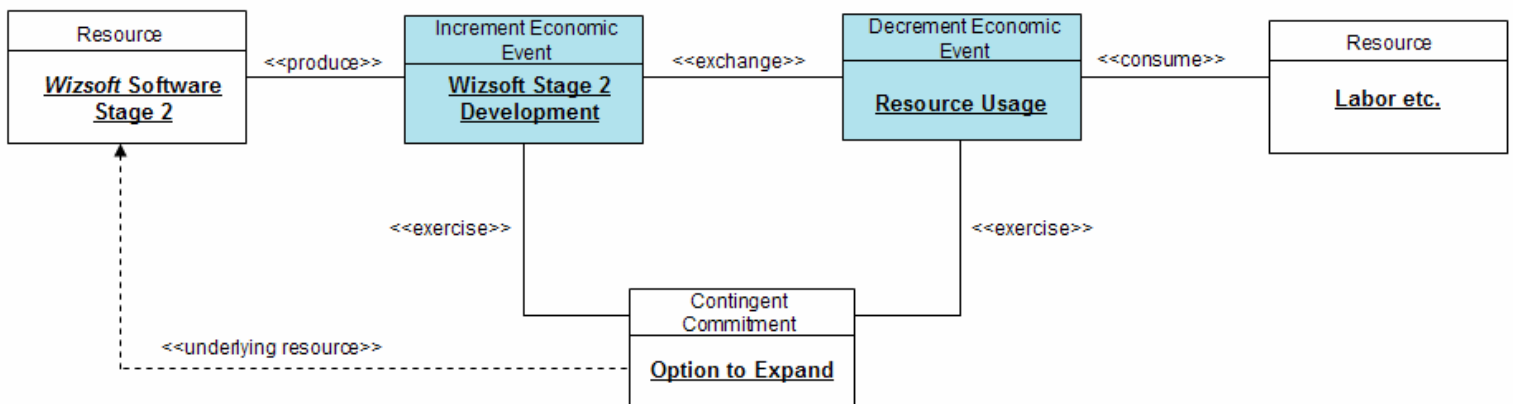


Figure 5: Real option application model for *Wizsoft*.

Resulting Context

The 'big idea' (Win & Calder, 2002) featured within this pattern is to suggest extending the REA ontology to recognize the importance of identifying, recording, and monitoring 'potential events' whose actualization may be partially or wholly decided by organizational decision makers and may be important to the strategic direction of the organization. While numerous 'potential events' may fit this brief, our pattern specially addresses those potential events associated with real options. While we believe we have made a solid case for recognizing 'potential events' within an enterprise ontology, we also recognize that introducing a construct (i.e., *contingent commitment*) that calls for the recognition of economic events beyond those that are prior or certain (e.g., promised, obligated, contracted) may prove to be contentious. Furthermore, the deeper ontological foundations supporting such a proposal may be immature. For example, arguably Sowa's (1999) upper-level ontological categories do not specifically distinguish between the potential and actual / historical locational states of continuants and occurrents within their time-space continuum (see, Sowa, 1999: 71).

In summary, the real options pattern will be relevant to those designers of information systems aiming to support strategic decision processes. However, the pattern presented in this paper is clearly limited in scope and addresses just one small part of the complex information systems and organizational processes that may be in place to support the strategic function within an organization. Limitations on the scope of our pattern is also reflected in that our pattern clearly fails to adequately address and explore a number of *forces* that were introduced earlier. For example, while decision makers would like systems supporting the management of real options to have in place the design of effective valuation practices, this force was clearly beyond the scope of the immediate paper. Moreover, we did not attempt to explore further the possible interrelationships and meta-structural patterns that may exist between and within option groups. Nor have we addressed the complexities associated with integrating such systems into other *feeder* information systems, and the complexity inherent in strategy processes given their organizational idiosyncratic nature.

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