Real Options & Examples in the Chemical Industry

By Robert Endres and Jarvis Cheung

Summary

A 'real option' is an option associated with a real asset, as opposed to a financial security. Real options in the chemical industry take the form of either investment or operating flexibility to choose between alternatives after uncertainty in the future is resolved.

Investment flexibility results from an investment's interdependence with future and follow-on investment. Operating flexibility arises from the flexible operation of physical assets or contracts and enables management to revise operating decisions at future times

Real options bear similarities to financial options. Both confer rights, but not the obligations of exercise. Both can help companies limit their downside risk while also gaining access to future upside opportunities. And the value of both types pf options increases with uncertainty. There are differences as well. Real options bridge the incompleteness gap existing in the market for financial options, and provide cover against uncertainties resolved over relatively longer time periods.

The real option perspective has significant implications for the development and implementation of strategy and risk management. It encourages management to confront fundamental sources of uncertainty proactively, rather than merely attempting to buffer against or avoid uncertainty. It encourages managers to create value and reduce risk by making strategic investments that confer claims on potentially lucrative opportunities, while actively monitoring various sources of uncertainty, and changing resource allocations appropriately in real time.

Chemical companies seeking to manage risk through real options and associated investment may increase their odds of success by attending to two basis challenges. First, they need to recognize when and how options are embedded in strategic investments, and acquire the skills to value and negotiate real options. Second, they must be sensitive to specifics of transaction design and execution. Examples here include limiting the carrying costs associated with real options, defining relevant market cues to be monitored and ensuring that the claim on the upside is secure.

What is a 'real option'?

Investment and operating flexibilities associated with assets or projects are called "real options".

Investment Flexibility: Investment flexibility results from an investment's interdependence with future and follow-on investment.

Growth	Early investment is a prerequisite or a link in a chain of interrelated projects, opening up future growth opportunities.
Time to build	Staging investment in a series of outlays is an option to continue/default if new information is favorable/ unfavorable respectively
Expand Scale	If market conditions turn out more favorable than expected, management can accelerate the rate or expand the size of investment by incurring a follow-on investment.
Reduce Scale	If market conditions turn out weaker than originally expected, management can reduce the scale of planned operations, thereby saving part of the investment outlays.
Abandonment	If market conditions decline severely, management can abandon current operations permanently and realize the resale value of assets in secondhand markets or re-deploy the assets to an alternative use.
Deferral	Management has an option (holds a right) to invest in a project up until an expiration date T. It can wait to see if output prices justify the investment.

Operating Flexibility: Operating flexibility arises from the flexible operation of physical assets or contracts and enables management to revise operating decisions at future times.

Operating scale	A firm can expand the scale of production if market conditions are more favorable than expected. And if conditions are less favorable, the firm can reduce scale of production; in extreme cases production can be halted and restarted.
Production flexibility	If prices or demand change, management can change the output mix of a facility with product flexibility or the same outputs can be produced using the different types of inputs to maximize profits.
Storage	Storage allows a firm to inject or withdraw product into storage at ant time. It allows a firm to take advantage of time spreads that exist across different points of the forward curve.
Volume off-take "swing"	Contracts that specify a minimum monthly or quarterly quantity required at contract pricing and a maximum allowed off-take allow a company to choose the best of contract or spot pricing for the flexible portion of the commitment.
Global network	Production operations in geographically dispersed countries confer the option to switch production activities across borders in response to changes in currency markets, factor markets or product markets.

Real options represent value that is contingent on earlier investments and offer management flexibility they may exercise at its discretion over time, as uncertainty is resolved.

For example:

- Investment in a 1st generation technology may lead to a new generation of commercial processes or new products. In isolation the initial investment may appear unattractive, but it may be the first in a series of other interrelated investments that when taken as whole, have attractive economics.

- Marginal, incremental plant capacity represents a right, but not an obligation to acquire current period's cash revenues by paying the variable costs of operating as the exercise price. The operator can produce when the economics justify it.

- A flexible production process offers period-to-period choice to produce in the most economic mode as the relative prices of inputs and outputs become known.

Comparing Financial and Real Options

There is a close analogy between real options and financial option. Like financial options, real options confer the right but not the obligation to take some action in the future. Both can help companies limit their downside risk while also gaining access to future upside opportunities. And the value of both types of options increases with uncertainty.

Having said this, there are differences between financial and real options.

Financial Options	Real Options
Requires only an initial investment, with no ongoing investment.	Often require ongoing investment in managerial time and attention
Provide a proprietary claim on the asset at exercise	May provide only a non-proprietary or shared claim at exercise
Has an exercise price that is fixed	Exercise price may vary over time
Value that is identical for all potential owners of the option	Value is unique for each potential owner (due to learning, capability, synergies)
Value that is identical for all potential owners of the option	Often require "sticky" investments that may be difficult to unwind

The Failure of Traditional Valuation in the Presence of Flexibility

Traditional NPV approaches have inherent limitations when it comes to valuing investments or projects with investment and operating flexibility. They ignore or cannot properly capture management's flexibility to revise its original operating strategy if and when, as uncertainty is resolved, future events turn out differently from what management expected at the outset. To show the failure of traditional valuation techniques, we look at a simple (albeit admittedly contrived) example.

Suppose a company is considering investing $55 MM (all equity) in a project today whose expected value one year from now will be either $90 MM or $30 MM with equal probability.

State	E(V) @ T1	Probability
Good conditions	$90 MM	q = 0.5
Bad Conditions	$30 MM	(1-q) = 0.5

Assume that investors require a 20% rate of return on investments with like- risks, and the risk-free rate is 8%. Using traditional discounted cash flow techniques (DCF), the net present value of the project is: NPV = (0.5 x 90 + 0.5 x 30)/1.2 – 55 = -$5 MM

Now, suppose the company can secure a guarantee from the government (who wishes to support the project). Should bad conditions occur, the government will buy out the entire project for $90MM. Note that the guarantee is essentially an “abandonment” option owned by the company. It gives the company the right to sell the project to the government and receive the guaranteed amount of $180MM.

The guarantee's payout in the two states are:

State	Outcome
Good conditions	0
Bad Conditions	$60 MM

Under traditional valuation, the value of the project with the guarantee would be

NPV of project with guarantee = (0.5 x 90 + 0.5 x (30 + 60))/1.2 -55 = $20 MM

And the value of the abandonment option provided by the guarantee would be:

Value of guarantee = NPV of project with guarantee – NPV of project without guarantee = $20 - (- $5) = $25 MM

But the value of the project with the guarantee and value implied for the guarantee are clearly wrong since the flexibility to abandon the project for a guaranteed price of $90MM alters the project's risk and discount rate.

With the government guarantee, the project pays out $90MM in both states. Hence, the project is risk-less, and the correct discount rate that should be applied to it is 8%.

Hence, the value of the project with the guarantee is:

NPV of project with guarantee = (0.5 x 90 + 0.5 x (30 + 60))/1.08 – 55 = $28.33 MM

And the correct value of the guarantee (the abandonment option) is:

Value of guarantee = NPV of project with guarantee – NPV of project without guarantee
= $28.33 – (- $5) = $33.33 MM

So- traditional DCF analysis understates the value of the project with the guarantee as well as the guarantee. This is readily seen for the case where the guarantee hedged all the project risk, (and hence where the correct discount factor to apply is easily seen to be the risk-free rate). But it's also true in the more general case. We will show later that even in cases where the guarantee hedges only a portion of the risk (pays something less than $120 MM in the bad state), the project's value would still be understated with the application of traditional valuation techniques.

The bottom line - traditional valuation fails to properly value projects with options attached to the underlying asset[1].

The Need for an Expanded Valuation Framework

The failure of traditional valuation of assets in the presence of optionality suggests the need for an expanded NPV framework that captures two sources of value: 1) the traditional 'static' NPV (assuming no flexibility) and 2) a premium for any attached flexibility. Total value is quantified as the sum of static NPV and an option premium reflecting the value of managerial flexibility.

Expanded NPV = Static NPV + Option Premium from Flexibility[2].

In the absence of flexibility, the expanded NPV result is identical to that of static NPV or that derived using traditional DCF analysis.

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[1] Conventionally applied DCF techniques were originally developed to value passive investments in stocks and bonds. The techniques were predicated on the assumption of passive management, and allowed no flexibility to take action, as uncertainty was resolved with the passage of time.

[2] Notice that the use of expanded NPV framework does not result in throwing away static NPV techniques. Static NPV is a necessary input to the expanded NPV approach.

Option Valuation

Option valuation techniques can enable management to properly quantify the added value of a project's operating and strategic flexibility. Various models can be used to value real options, including stochastic dynamic programming, numerical methods, Monte-Carlo simulation and analytic models. One approach to valuing options- called risk neutral valuation- derives equilibrium prices that options would command in complete and competitive capital markets. It focuses on what option cash flows would be worth if the options were freely traded in the marketplace.

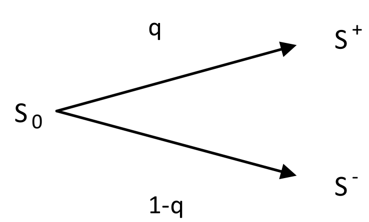
Let's look at the assumptions and rationale for risk neutral valuation of options- first for financial options and then consider the application to real options. For ease of analysis purposes, we use a simple binomial (two-state) state model.

Risk Neutral Valuation of Financial Options

Suppose a freely traded financial security exists, denoted by S. Its value today is S_0. The price will move over the next period either up to S^+ with probability q and down to S^- with probability (1-q). This completely describes its future possible price outcomes over the next period.

Financial Security

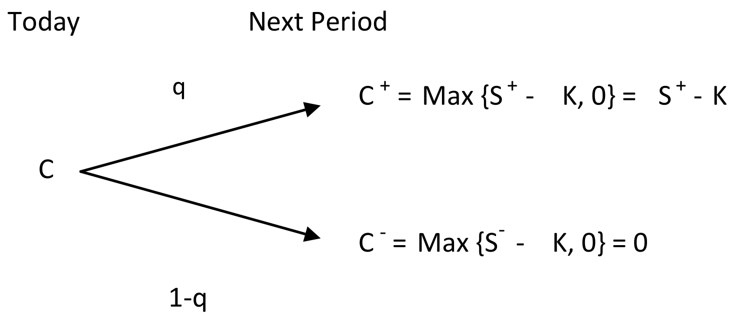
Today Next Period



A contingent claim (a call option), on the security exists, exercisable at S=K, whose payoffs are:

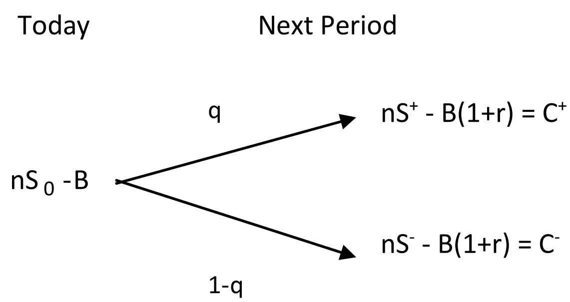
$C^+ = S^+ – K$ with probability q and $C^- = 0$ with probability (1-q)

Call Option



We postulate that money can be borrowed at the risk-free rate and the option's payoff can be totally replicated in each state with a portfolio of n shares of the financial security, financed with borrowing B. The payoffs in each state are:

Replicating Portfolio



The replicating portfolio can be used to hedge the exposure of the call option to potential changes in the underlying security's price.

1. $nS^+ - B(1+r) = C^+$
2. $nS^- - B(1+r) = C^-$

Since the payoffs of the replicating portfolio and the call option are equal in all future states, their initial values must be equal.

3. $C = nS_0 - B$

Solving the three equations in 3 unknowns n, B, C :

$$n = \frac{C^+ - C^-}{S^+ - S^-}$$

$$B = \frac{S^- C^+ - S^+ C^-}{(S^+ - S^-)(1+r)} = \frac{nS^- - C^-}{(1+r)}$$

$$C = \frac{pC^+ + (1+p)C^-}{(1+r)}$$

Where $p = \frac{(1+r)S_0 - S^-}{(S^+ - S^-)}$

Note that C, the option's price today, does not depend on the actual probabilities q, 1-q. or on investor risk preferences. Two investors who have different risk preferences or ascribe different probabilities to the two states can still agree on a fair price for the option. The probabilities and investor risk preferences are simply irrelevant! The option's price depends only on the strike price, underlying security price today, the risk-free rate, and range of future price movement over the next period (S+ and S-). If that were not true, arbitrage could occur.

- If $C > (p\ C^+ + (1\text{-}p)\ C^-)/(1+r)$, an investor could sell the option for C and buy the replicating portfolio and earn a return greater than the risk-free rate at no risk.

- If $C < (p\ C^+ + (1\text{-}p)\ C^-)/(1+r)$, an investor could buy the option for C and sell the replicating portfolio and earn a return greater than the risk-free rate at no risk.

Interpreting p

The equation for C takes the form of a weighted average of C^+ and C^- (weighted by factors p and (1-p) respectively) divided by a risk-free discount factor.

$$C = \frac{pC^+ + (1+p)C^-}{(1+r)}$$

Let's look again at the equation for p.

$$p = \frac{(1+r)S_0 - S^-}{(S^+ - S^-)}$$

Note that since $S^+ > S^-$, we know that S^+ must be $> (1+r)\ S_0$. Otherwise, no investor would ever invest in the underlying financial security, as its expected return would always be less than the risk-free rate. So p is always less than 1. And p + (1-p) =1.

So the value equation for C is of the form of an expected future outcome, discounted by the risk-free rate- where the outcomes in each state are weighted by p and (1-p). Because p + (1-p) = 1, they can be interpreted as pseudo-probabilities. They are not actual probabilities, but rather are the probabilities that would prevail in a world where investors are indifferent to risk and their use allows for discounting at the risk-free rate[3].

Risk Neutral Valuation of Real Options

Risk neutral valuation can be justifiably applied to real options- even though the underlying assets may not be traded in the marketplace. This is because we are interested in determining what the asset's cash-flows would be worth if they were traded in the market (their contribution to the market value of a publicly traded company)[4].

In risk-neutral valuation of real options, we assume the existence of a freely traded 'twin' security for the underlying asset. The twin security's price correlates perfectly with the underlying asset's value[5]. Hence, a replicating portfolio of debt + shares of the 'twin security' can be used to dynamically hedge the value of options tied to the underlying asset. And hence we can apply risk neutral valuation to derive equilibrium pricing for real options[6].

To illustrate, we will now apply risk neutral valuation to the aforementioned project with a guarantee.

Example of Risk Neutral Valuation of a Real Asset

Recall the project has a gross value in one year that is conditional on the outcome state- good or bad. The payouts in each of two possible states, good conditions or bad conditions are given below, with corresponding probabilities of the state outcomes:

State	E(V) @ T1	Probability
Good conditions	$90 MM	q = 0.5
Bad Conditions	$30 MM	(1-q) = 0.5

[3] The pseudo probabilities p and (1-p) are sometimes call "risk-neutral probabilities". They address the main shortcoming of Decision Tree Analysis (DTA)- which is frequently used to address project/investment flexibility. While it's true that DTA helps structure the investment options and decisions to be made by mapping out all feasible alternative actions contingent on the possible states or outcomes through time, its main shortcoming is the problem of determining the correct discount rate to be applied in working back through the decision tree. Transforming the actual probabilities to risk neutral probabilities avoids the problem. It converts the cash flows to 'certainty equivalent' cash flows, which can then be discounted by the risk-free rate.

[4] Even standard NPV approaches are attempts to determine what an asset or project would be worth if they were traded in the marketplace.

[5] The existence of a traded 'twin security' having the same risk characteristics as the underlying non-traded asset, (i.e. is perfectly correlated with the asset) is sufficient for risk neutral valuation.

[6] The absence of arbitrage opportunities is a prerequisite for equilibrium and hence the equilibrium value of an option on a non-traded asset must be the no-arbitrage value of the option on its twin security.

The static value of the project (absent any optionality) is:

V_0 = (0.5 x 90 + 0.5 x 30)/1.2 = $50 MM

The government is offering a guarantee that completely hedges the company's payout in the bad state at $90MM. The payouts on the guarantee in the two states are:

State	Outcome
Good conditions	0
Bad Conditions	$60 MM

How much is the guarantee worth?

Using risk neutral valuation we have:

$$C = \frac{pC^{+} + (1+p)C^{-}}{(1+r)} = \frac{p\ x\ 60 + (1+p)\ x\ 0}{(1+r)}$$

$$p = \frac{(1+r)V_0 - V^{-}}{(V^{+} - V^{-})} = \frac{(1+0.08)50 - 30}{(90-30)} = 0.4$$

Hence, at r = 8%:

$$C = \frac{0.4x0 + 0.6x60}{(1+0.08)} = \$33.33\ MM$$

Note that this is the same value we derived for the guarantee previously.

These same risk neutral probabilities can also be used to compute the NPV of the project without the guarantee:

NPV project without guarantee = (0.4 x 90 + 0.6 x 30)/1.08 – 55 = $-5 MM

We can now use these risk neutral probabilities to value any option tied to the value of the project. For example, let's consider the value of a guarantee that does not completely eliminate the risk of the project. Suppose the government guaranteed that a total amount of $50MM would be paid out in the bad state. The guarantee's payout would then be:

State	Outcome
Good conditions	0

Bad Conditions $20 MM (50-30)

And the value of the guarantee, as computed from the risk neutral method of calculation would be given by:

Value of guarantee = [p x 0 + (1-p) x 20]/1.08 = [0.4 x 0 + 0.6 x 20]/1.08 = $11.1MM

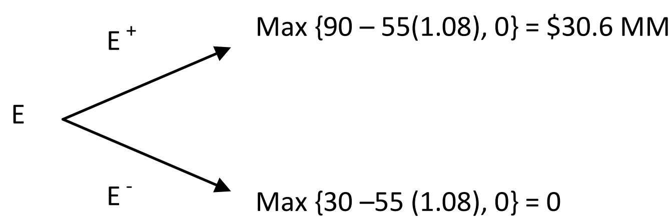
OK, let's apply the risk neutral valuation approach to some more believable real options tied to the project. After all, companies don't generally have the benefit of government guarantees on its investment projects.

Option to Defer Investment

Suppose the company owned an exclusive right to defer the $55 MM investment for a period of one year, when the conditions (good or bad) become known. Management will invest only if good conditions prevail. (We assume that under the choice to defer, the required investment will grow at the risk-free rate, so the $55MM investment required today would be deposited in an interest-bearing account earning 8% for one year.)

What are the present values of the option to defer the investment and the project with the option to defer the investment?

The contingent payouts are:



The NPV, in risk neutral form, is given by:

$$NPV = [p \times E^{+} + (1-p) \times E^{-}] / (1 + r)$$

The correct risk neutral probabilities are 0.4 and 0.6 respectively. We weight the payouts in each state by these pseudo probabilities and discount by the risk-free rate to value the project with the option to defer the investment:

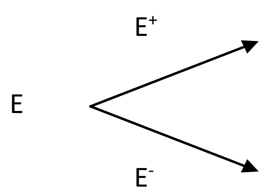
NPV = [0.4 x 30.6 + 0.6 x 0] / 1.08 = $11.33 MM

The net present value of the option to defer investment is then given by:

NVP of option to defer = NPV project with option to defer – NPV project without option to defer
= 11.33 – (- 5) = $16.33 MM

Option to Expand Investment

Suppose after an initial investment of $55MM, management has the option to make a follow-on investment of $40MM in one year and double the value of the project in the associated outcome state. The contingent cash-flow payouts for the project would be:



Max {90, 180 - 40} = $140 MM

Max {30, 60- 40} = $30 MM

Project NPV = - 55 + [0.4 x 140 + 0.6 x 30] / 1.08 = $13.52 MM

The net present value of the option to expand is then given by:

NVP of option to expand = NPV project with option to expand – NPV project without option to expand
= 13.52 – (- 5) = $18.52 MM

Real Options are not Additive

It's important to note that when multiple real options interact, they cannot be simply added together to find total value. The presence of subsequent options can increase the value of the project with earlier options, while exercise of prior real options (expand, contract) may alter the asset itself and hence the value of subsequent options on it. This non-additive property applies to both real and financial options, which complicates the analysis, but also provides the basis for strategies through the interaction between investment, operating and financing decisions.

The Role of Real Options

Real options can limit downside risk and capture positive opportunities. But if this is the role of financial options, why would a company invest in real options to manage risk?

One reason is that the market for financial options is 'incomplete' – meaning some options simply do not exist to hedge certain kinds of uncertainties that matter to a company. For example, retaining competitive advantage in the face of technological uncertainty or the moves of competitors is as important (if not perhaps more) than price or currency uncertainties. Another reason is that financial options provide cover against uncertainties for relatively short time horizons, whereas many uncertainties to which a company is exposed are only resolved over long time periods.

Challenges and Opportunities

Many chemical companies don't understand, nor appreciate the options embedded in their investments or their assets. Others lack the capabilities to value real options.

This is not to say that real options are easy to identify or deal with. They are often hard to identify and usually multiple series of options can get tangled together in complex fashion, e.g. there may be option to wait on investing in a project, with a subsequent option to grow, abandon, and also switch feed-stocks. Valuation of the simplest of real options can be fraught with complexity. Still, a failure to consider these valuable options, at least at a conceptual level, will usually result in sub-optimal decisions that pass up value.

In some cases, the gap between the promise of real option theory and the reality experienced by companies is explained by companies' differing readiness to use real options effectively. In some of our client engagements (and in Shell too) we have heard the client say: "we don't need that… or that's too complex.

Organizational history and complexity are sometimes obstacles standing in the way of realizing the value of real options in risk management. For example, companies that expand internationally, based on a strategy of tailoring foreign subsidiaries to local needs on a market by market basis, may find it difficult to shift production activities as suggested by real options theory. For other companies, information and other costs of coordinating a complex multinational may exceed the benefits of switching options.

Challenges and Opportunities in Realizing the Benefits from Real Options

Corporate readiness	Transaction design and execution
❖ Recognition of embedded options ❖ Valuation and negotiation capabilities ❖ Management and information systems ❖ Global strategy ❖ Organizational configuration	❖ Limiting carrying costs and co-ordination problems ❖ Scanning multiple, complex environmental signals ❖ Making a secure claim on upside opportunities

Implications for Strategy, Risk Management and Capital Budgeting

A real option perspective has significant implications for the development and implementation of strategy and risk management. Real options analysis encourages management to confront fundamental sources of uncertainty proactively, rather than merely attempting to buffer against or avoid uncertainty. Real options analysis encourages managers to create value and reduce risk by making strategic investments that confer claims on potentially lucrative opportunities, actively monitoring various sources of uncertainty, and changing resource allocations appropriately in real time.

Capital budgeting procedures should be extended to recognize and include options present in real projects. And looking at opportunities to invest as collections of options on real assets offers new insight into resource allocation as well.

By viewing investment opportunities from the perspective of options valuation, management is in a better position to recognize that:

- Conventional, static NPV may indeed undervalue projects

- It may be correct to accept projects with negative NPVs if the option premium associated with the value of managerial flexibility exceeds a negative static NPV

- The magnitude of the under valuation, and the extent to which managers should justifiably invest more than that dictated by conventional DCF standards, can be quantified using option valuation techniques.

The options framework indicates that that the value of managerial flexibility is greater in more uncertain, volatile environments. Thus, higher uncertainty is not necessarily damaging to the value of an investment opportunity. While uncertainty indeed does reduce a project's static NPV, it also leads to an increase in the value of a project's option premia, which may outweigh the negative effect.

Appendix 1

Real Options: Investment Types

Type	Examples	Option Characterization
Growth Early investment is a prerequisite or a link in a chain of interrelated projects, opening up future growth opportunities.	Investment in 1st generation process may lead to a new generation of products.	Early investment is a call option on a future growth opportunity with potential value V_g. The value of the total opportunity is V + Max (V_g, 0).
Time to build Staging investment in a series of outlays is an option to continue/default if new information is favorable/ unfavorable respectively	Staged or follow-on sequential investments	Each stage of project is viewed as a call option on the value of subsequent stages by incurring that stages' cost outlay required to proceed to the next stage.
Expand Scale If market conditions turn out more favorable than expected, management can accelerate the rate or expand the size of investment by incurring a follow-on investment I_e.	De-bottlenecking of plant capacity	The total investment opportunity is viewed as the base-scale project plus a call option to acquire an additional part (e %) of the base-scale project, by paying exercise price I_e, i.e. V + Max (e V- I_e, 0)
Reduce Scale If market conditions turn out weaker than originally expected, management can reduce the scale of planned operations (by r%), thereby saving part of the investment outlays I_r.	New product introductions in uncertain markets	This flexibility to mitigate loss is analogous to a put option on part r% of the base-scale project with value V, with exercise price equal to the potential cost savings I_r, giving payout, Max (I_r – r V, 0).
Abandonment If market conditions decline severely, management can abandon current operations permanently and realize the resale value of assets in secondhand markets or re-	Storage, warehousing and transportation assets; plants with alternative uses	The option can be valued as a put option on the project's current value V, with an exercise price equal to the best alternate use value A, less the costs of

deploy the assets to an alternative use.		abandonment and retrofitting C_a.: V + Max (A- C_a -V, 0)
Deferral Management has an option (holds a right) to invest in a project up until an expiration date T. It can wait T years to see if output prices justify the investment.	A proprietary technology, process or product protected by patents that expire in T years. A lease on valuable land or resources that allows company to defer the development of the resource.	Call option on the gross present value of the completed project's expected operating cash flows, V, with an exercise price equal to the required outlay I_T. Just before expiration of the right, the investment opportunity's value will be Max (V-I_T, 0).

Real Options: Operating Types

Type	Examples	Option Characterization
Operating scale A firm can expand the scale of production if market conditions are more favorable than expected. And if conditions are less favorable, the firm can reduce scale of production; in extreme cases production can be halted and restarted.	Marginal, incremental plant capacity.	Call option to acquire current period's cash revenues R by paying the variable costs of operating C_V as exercise price, i.e. Max (R-C_V, 0)
Production flexibility If prices or demand change, management can change the output mix of the facility (product flexibility) or the same outputs can be produced using the different types of inputs (process flexibility)	A flexi-cracker- offers period to period flexibility to produce in different modes as the relative prices of inputs and outputs fluctuate over time	Call option to acquire next period's gross margin under the ith mode GM_i by paying a switching cost S_{ji} to move from current $mode_j$ to new $mode_i$ e.g. Max (GM_i - S_{ji} - GM_j , 0)
Storage Storage allows a firm to inject or withdraw product into storage at ant time. It allows a firm to take advantage of time spreads	Chemical storage.	Call option on time spread between the forward withdraw price F_w and forward injection price F_i. The exercise price C_M is

that exist on different points of the forward curve.		the variable cost of moving product into and out storage Max (F_w - F_i – C_M, 0)
Volume off-take "swing" Contracts that specify a minimum monthly or quarterly quantity required at contract pricing and a maximum allowed off-take.	Most contracts in the chemicals	Call option on the 'lowest of contract or sport pricing' for the flexible volume portion of the contract, e.g. Max (S-C, C-S)
Global network Production operations in geographically dispersed countries confer the option to switch production activities across borders in response to changes in currency markets, factor markets or product markets.	Production operations in both Europe and Asia. Devaluation of Asian currencies makes production in Europe locations costly on a relative basis, so company shifts production to Asia to achieve a lower cost.	Call option on the real cost advantage offered in a particular country, exercisable at some transportation, switching and other costs differential.

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