Chapter 9
Convertible Contracts

9.1 Introduction

On projects, as work is completed and new information comes to hand, the scope becomes better defined. Equivalently, uncertainty in the scope decreases. It would seem reasonable then that the contractual arrangements on a project should also progress in line with this decreased uncertainty, rather than staying constant from project start to project end. Information asymmetry, whereby the project contractor is better informed of the work than the project owner, and contractor self-interest leading to possible opportunistic behaviour, also suggest the need to tailor contractual terms to a project's situation in order that the owner's interests and the contractor's interests better align. It could also be anticipated that tailoring a contract to a project would be more cost-effective than having a rigid structure applicable throughout the project duration. Such tailoring also enables an adjustment of project risk, and may possibly assist in the reduction of disputes. In line with these potential advantages, the chapter explores the role and viability of changing contract terms, as a project progresses, and offers an original analysis in this respect.

For definiteness, the chapter concentrates on construction projects and contracts with conversion between payment types, but the chapter's approach generally applies to all contracts and all terms within contracts. General discussion that is broader than construction and payment types, that is, covering contracts and terms generally, is given in a supplemental form. The broader usage of the word 'terms' incorporates payment types as a particular example.

Contract payment types may be classified as either fixed price contracts (including lump sum, schedule of rates or unit price, and guaranteed maximum price—GMP) or as prime cost contracts (including all the cost reimbursable varieties). Each payment type gives a different risk for the owner and the contractor, and each has different applicability dependent on the degree of information known about the project work.

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Having the ability (flexibility) to discretionarily change (convert, switch) contract payment types can be interpreted as an option, and its value can be established using the book's approach. The holder of the option to convert is given the right, but not the obligation, to change payment types. It could be anticipated that such a right would have a cost or a premium (possibly, but not necessarily up front), and so it is necessary to value the option in order to establish what is a reasonable cost to pay for the right. The definite conversion, that is, one that is contractually devised to happen with certainty as opposed to a discretionary conversion, can be shown to have a lower value, and in some cases a negative value. Conversion might be anticipated to occur at the transition point between defined project stages [3], because of the different knowledge, skills and resources that are required for these stages. But, conversion need not be restricted to this timing.

The option value is established here by looking at the project net cost resulting from the change, and in particular the expected value and variance of the net cost, and then discounting these to present worth values. The net cost is the difference between the cost of continuing under the existing payment type and the cost that will occur under the new payment type. The option value follows from knowing the present worth distribution fitted to these discounted values. This, in conjunction with any cost or premium (possibly, but not necessarily up front), establishes whether flexibility embedded within a contract is worthwhile or not from a commercial viewpoint. Legal issues could involve the termination of the first contract, formation of the second contract, novation, and a variation; these are discussed below. The chapter does not discuss potential agency issues [1, 5–7].

The structure of the chapter is as follows. Both commercial and legal implications are covered. Firstly, the background to convertible contracts is outlined. The characteristics of convertible contracts are then examined, along with how the flexibility associated with convertibility is valued. Finally, associated legal matters are discussed, followed by a case example on building refurbishment, a summary of the approach from the point of view of the contracting parties, and implementation issues. Reference terminology is to owner and contractor in the following as the contracting parties, though the material is applicable for contractual dealings between any two parties.

The chapter provides an original approach to valuing convertible contracts. Current literature does not deal directly with the matter addressed. The chapter, for definiteness, concentrates on construction contracts with conversion between payment types, but the chapter's approach applies to all contracts and all terms within contracts. The chapter will be of interest to researchers and practitioners concerned with optimizing project outcomes through contract design. The theory and results are independent of any particular conditions of contract. Rather, mention is only made to contract terms which generally apply across all conditions of contract; any conditions of contract can be modified to include a conversion capability. The chapter does not discuss the strengths and weaknesses of different payment types or different conditions of contract [2].

9.2 Background

The chapter draws its background from contract payment types, options and convertible contracts. Contract payment types, their place of usage and associated risk issues are established knowledge and are not therefore repeated here (see, for example, [2]).

The concept of having a 'convertible' entity is not new. For example, it has existed for some time in the finance industry in bonds, securities and venture capital transactions, and in insurance policies and adjustable rate mortgages, allowing for changes in contractual terms such as the length of insurance or the type of interest rate applicable.

However, the introduction of the concept to contracts on projects is still in the development stage, with little work published to date. Despite this, there is a belief that convertible contracts offer advantages when compared to more traditional ways of contracting. Contract conversion has been used in practice, but without any formal analysis or an attempt to value it or frame it within an options analysis.

Incorporating options into contracts gives an owner an opportunity to mitigate its costs. The owner is able to hedge against cost escalation, obtain potential gains, and prevent post-contract-formation opportunism. A convertible contract prevents the contractor from behaving inefficiently and from taking unfair advantage of any such opportunism.

In a construction context, the convertible contract idea has a cousin in Early Contractor Involvement (ECI) project delivery. In ECI, the contractor for the first stage (involving full or part design, and possibly other activities such as project risk mitigation) may be selected through a non-price competitive process, making the relationship between the contractor and the owner important, as it is in all prime cost contracts. Whilst there is a form of ECI that uses one contractor for the design stage and then seeks tenders from others to undertake the construction, in convertible contracts there is only one contractor involved.

9.3 Convertible Construction Contracts

The term 'convertible contract' is used as an umbrella term to describe a flexible form of contract. It allows an owner and a contractor to agree on one set of terms initially and later agree different terms depending on the circumstances at the time, or upon reaching defined events. Once the terms have changed, they are regarded as having been 'converted'. In the context of construction contracts, these terms may relate to a range of things, including payment type, conditions of work, the programming/scheduling of work, or the project scope. The contract is tailored to the specific conditions applicable to the project at the time of the conversion. Accordingly, the use of a convertible contract should be advantageous.

It is unlikely that all the terms of a contract are subject to change. Those terms that are flexible would be agreed upon by the contracting parties and clearly stated in the contract as terms which may be later converted. The extent to which these terms

may be converted would also be explicitly stated, and are essentially contingent upon the agreement between the owner and the contractor. Alternatively, contracting parties may choose to agree on the extent of conversion upon initial engagement, without the need for later amendments or the introduction of new terms. At the time of conversion, price negotiation between the parties may be necessary. This chapter centres on converting payment types.

Incorporating the flexibility to change contract payment types can be seen as an option, and its valuation follows the options analysis of this book. To be considered worthwhile for the owner to incorporate an option into a contract, the value of the option (to the owner) needs to exceed any cost for incorporating the option. To be acceptable to the contractor, the contractor also needs to gain from converting or switching contract payment types.

Generally, it would be envisaged that payment switching would take place from a prime cost payment type to a fixed price payment type; that is, the project commences under a prime cost payment type and later converts to a fixed price payment type. This is so, because at the start of a project the scope may be ill-defined and hence suitable for a prime cost type payment, but as the project progresses and its scope becomes better defined, a fixed price type payment would be more appropriate. Within the two payment types, any of the varieties could be considered. The switch occurs at the point where the remaining scope can be reasonably accurately defined and priced, and only if the switch is worthwhile (to the option holder) at the time. The decrease in scope uncertainty, together with the switch of payment types, lead to different risks to each party.

The following discussion refers to giving the option right to the owner. Since the benefit lies with the owner, inclusion of a conversion clause in the contract is contingent on agreement with the contractor, and providing the contractor with appropriate compensation, or the contractor gaining in some way. However, if the contractor perceives working under a fixed price arrangement better than under a prime cost arrangement (in which case, both the owner and contractor stand to gain), this payment might be small. The payment might be viewed as an incentive to agree to a convertible contract. In addition, the contractor is afforded the opportunity to demonstrate goodwill to the owner and to build on its reputation and future relationship. It would also be possible to give the option exercising right to the contractor, or to be by joint agreement of the parties at the time of exercising. However, giving the owner the right would appear to provide the owner with the best project outcome, including the elimination of agency issues with the contractor; hence it is this situation which this chapter considers.

9.4 Method of Analysis

Discussion in the following refers to one switch or conversion in the lifetime of the project; for multiple switches, the situation repeats.

Common to all convertible contracts are:

- An exercise or switching time, T, chosen on the basis of having enough project information to estimate a fixed price finishing cost with reasonable accuracy. The time T would be contractually defined, either approximately or exactly, based on prior knowledge of the project and its timeframe, and known to both parties. The owner can exercise the right to switch at time T.
- There are both costs and benefits flowing to both the owner and contractor at and following time T. These costs and benefits will be different to those had no switch taken place.
- There is a cost to the owner for having the option right. This might be manifested in a payment or benefit to the contractor at any time in the project.

The only suitable way of analysing an option of the form considered here is by using the book's approach; traditional financial option analogies are regarded as being inapplicable. Only costs relating to exercising the option are considered, that is, costs at or after the time of exercising (T). The costs for the second payment type are subtracted from the costs for the first payment type (assuming that it continues in the absence of switching). All costs are probabilistic, and are discounted to give the probabilistic present worth. The option value then follows on knowing the present worth distribution.

Cost estimates, whether approximate, preliminary or detailed, are assembled in the usual way. Cost estimates and their variability could be obtained from historical data, or built up from components, including direct costs (directly related to work items), indirect costs (time-varying and one-off—not identified directly with work items), business overheads and profit. Contingencies are incorporated into the estimate variability in the component costs, and would not be a separate component as in a deterministic estimate. In terms of the component approach, the uncertainty in each component can be established in a number of ways, for example as presented in Chap. 2. Correlations between the cost components are also needed, and these might best be estimated based on knowledge of the particular components and their paired relationships, rather than through any involved mathematical analysis. For example, the greater the volume of work (direct cost), the greater the time-varying cost (indirect cost), while one-off costs such as site disengagement may not be affected; profit and business overheads might be added as a percentage, the quantum of which might vary with market conditions and competition. If the total estimate is being built up, say, through monthly costs, then some thought will also need to be given to the correlation between monthly cost components—generally high correlation could be anticipated between similar cost components close in time, but reducing with time apart and as the nature of the work alters. For the intent and accuracy of the analysis, it would not be necessary to look at sub-component cost estimate correlation. It would also only be necessary to broadly categorize the degree of correlation, for example as high, medium, low or no correlation.

Cash flows are looked at from the viewpoint of the option holder, such that something favourable to the holder is taken as positive and something unfavourable to the holder is taken as negative. This leads to looking at the difference between the future

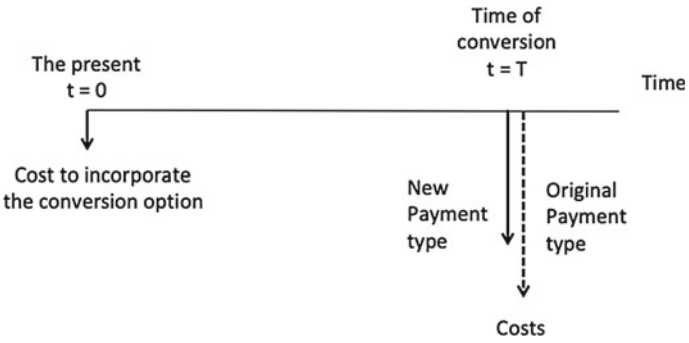

Fig. 9.1 Cash flows for comparative analysis

cost if the original contract type is continued at and beyond T and the future cost if the new contract type is adopted at and beyond T.

For costs at and beyond T, let Y_{T1} be the (total) original payment type cost estimate assuming that the original payment type continues (that is, in the absence of switching), and Y_{T2} the (total) new payment type (replacing the original payment type, with switching occurring) cost estimate (Fig. 9.1, where costs at and beyond T have been discounted to T). Close to perfect correlation may apply between these two cost estimates. At T,

$$X_T = Y_{T1} - Y_{T2}$$

The expressions in Appendices 2.11.1, 2.11.2 and 2.11.3 follow.

The value of having the flexibility to convert can then be established using Eq. (1.1), namely, convertibility value = ΦM. The payment type is only switched at time T if it is worthwhile to do so.

This convertibility value might be shared between owner and contractor by negotiation. Based on the origin of Eq. (1.1), a definite conversion (leading to E[PW]) has a lower value than the convertibility value, because of the negative part of the PW distribution, and can even take negative values.

It follows from Appendices 2.11.2 and 2.11.3 that the greater the uncertainty in the cost of the project, the greater the value of this flexibility. Hence, the value of this flexibility (the value of convertibility) decreases as the project scope becomes better defined, and as estimates are being made for activities less distant into the future, that is, as the project progresses. The cost uncertainty derives from a shortfall in scope definition, and trying to foresee the future and predict future events. There are multiple sources of uncertainty in construction, for example, latent conditions, adverse weather and potential inaccuracies in any forecasted costs. However, it is because of this uncertainty that the flexibility has a value; with determinism (that is, the remaining project cost is known with certainty), the flexibility has no value.

The time at which the option is to be exercised might be pre-determined in the contract or may be variable. The analysis is similar for both cases. If a variable time,

then the best time to exercise the option could be established by enumeration—doing the same option calculation for different T values and selecting the best outcome. The option is only exercised if, at the time, it is worthwhile to do so. That is, it is only exercised if there is a return to the owner by changing contract payment types. For example, if guaranteed maximum cost (GMC) is being used to start the project off, and the total project cost, if switching occurs, would exceed the maximum cost guaranteed by the contractor, the option may not be exercised, because staying with GMC and not switching may yield the lowest project cost.

9.5 Case Example

The following case example relates to the upgrading of a residential building through part demolition of the building (primarily the roof structure) and the addition, among other things, of an additional storey [4].

The building demolition stage introduces many uncertainties as to the existing building condition, while the subsequent construction stage (new building work) is relatively routine building construction. Accordingly, a cost reimbursable contract is appropriate for the demolition phase, and a lump sum contract is appropriate for the new building work.

The switch between payment types (namely, cost reimbursable to lump sum) occurs following the end of the demolition stage, equivalently the start of the construction stage. The time at which the switch occurs, that is, the time of option exercising T, is the time planned for the end of the demolition phase. Here, the planned switch time $T = 1$ year.

Cost estimates are assembled from all component costs. This is a well-established practice and so is not given here. Rather, the calculations are worked here in terms of total estimated costs. Only those costs at or beyond the time of exercising, T, are relevant in the calculations, not the total project cost.

For the new building work, the (total) estimates are:

- Under a cost reimbursable contract—\$680k most likely estimate, with optimistic and pessimistic estimates of ±25%. Using the PERT expressions relating optimistic, most likely and pessimistic estimates to expected value and variance (Chap. 2), this gives $E[Y_{T1}] = \$680.0\text{k}$ and $Var[Y_{T1}] = (\$56.7\text{k})^2$, where Y_{T1} refers to cost reimbursable values.
- Under a lump sum contract—\$650k most likely estimate, with optimistic and pessimistic estimates of ± 15%. Using the PERT expressions relating optimistic, most likely and pessimistic estimates to expected value and variance (Chap. 2), this gives $E[Y_{T2}] = \$650.0\text{k}$ and $Var[Y_{T2}] = (\$32.5\text{k})^2$, where Y_{T2} refers to lump sum values.

Since values for Y_{T1} and Y_{T2} are based on similar estimating principles, it is reasonable to assume that Y_{T1} and Y_{T2} are close to being perfectly correlated. That

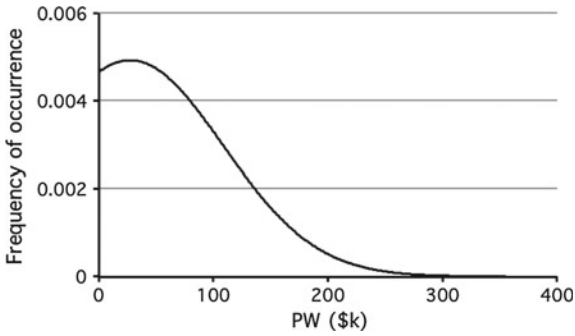

Fig. 9.2 Example—part probability distribution for PW (PW upside)

is, as estimates for Y_{T1} increase (decrease) so too should estimates of Y_{T2} increase (decrease).

For an assumed 10% per annum interest rate, the expected value and variance of the present worth can now be calculated by discounting the difference between Y_{T1} and Y_{T2} to the present (Appendix 2.11.2), E[PW] = \$27.3k and Var[PW] = $(\$81.1k)^2$.

To demonstrate the next calculation, though this is not necessary in practice, the probability distribution for PW can be drawn. Assuming a normal distribution fitted to the values of E[PW] and Var[PW], gives Fig. 9.2. Figure 9.2 shows the 'PW upside'.

Equation (1.1) requires two values, namely Φ and M. Here, $\Phi = 0.618$ and $M = 73.0$. Then, from Eq. (1.1) the convertibility value $= 0.618 \times 73.0 = \$45.1k$. This is approximately 7% of the contract sum (for the new building work).

Comparison. Incorporating a definite switch in payment types within the contract (compared with the option to switch as just calculated), leads to a lower value (namely E[PW] = \$27.3k or 4% of the contract sum).

The switch may or may not occur depending on the circumstances at time T. The switch only occurs if it is in the owner's interests to do so at T.

The financial analysis has a number of input variables, the most central of which are the uncertainty in the cost estimates and the interest rate. Increasing the uncertainty in the cost estimates increases the convertibility value. However, the conclusions remain essentially the same with different interest rates, primarily because any cost estimates for each payment type are being discounted similarly.

The value associated with an option to switch will decrease with time as the uncertainty in the cost estimates reduces and the scope becomes better defined. The option to switch provides a hedge against risk associated with cost uncertainty, and its value decreases as the risk decreases.

9.6 Summary Approach

The approach to be adopted in establishing the financial viability of incorporating convertibility in a contract is as follows:

1. The time, T, at which conversion may take place is estimated.
2. The costs for both (original and new) payment types for the project at and beyond T are estimated. These may be in the form of optimistic, most likely and pessimistic values, from which expected values and variances of costs can be calculated. Cost correlations, if developing the estimates from components, are also estimated.
3. These costs are discounted to the present day and the differences between the two sets of costs lead to an expected value and variance of PW (Appendix 2.11.2). Based on this, a distribution can be fitted to PW.
4. Equation (1.1) is used to calculate the convertibility value.
5. Negotiation may then proceed between the owner and the contractor as to how this value (less any cost or premium necessary in order to establish the option) might be distributed between the parties.

Optimal (in the sense of greatest reward) timing of the conversion would clearly be of interest to the parties in order that they gain as much as possible. This can be established though enumeration. That is, different exercising times are considered in Step 1 above, and the option value for each calculated, with the best of all calculated values noted. However, project considerations, for example related to the type of work or resourcing and not monetary value alone, may dictate the 'best' time to switch.

Where a project is composed of different work items, each covered by a different payment type, it is possible that any of these work item payments could be separately subject to being changed during the project.

9.7 Legal Matters

A contract is a legally enforceable agreement, and hence some thought needs to be given to legal matters.

The contractual power to change would be conferred by a 'conversion clause'. Such a clause would allow the owner the right, but not the obligation, to change the type of contractor remuneration as detailed within the clause, after work had begun. The exercising of the option would not be brought about as a surprise or with any punitive or threatening purpose. The ability to switch along with mention of the timing would be contractually agreed.

The following discussion is within a common law framework, and focuses on particular points which are applicable to convertible contracts.

(i) An options clause. An appropriate clause would allow the owner an option to switch from a defined prime cost remuneration type to a defined fixed price remuneration type. The clause should also stipulate something about how the fixed price is to be obtained, and the time(s) at which the option may be exercised.

(ii) Novation or variation. There are two possible ways or scenarios in which the switch between contractor remuneration types might be looked at legally. Firstly, where exercising the option amounts to a fundamental alteration to the terms of the first contract such that a new contract is required to be formed; and secondly, where exercising the option amounts to a mere variation to the terms of the first contract such that no new contract is required, but rather a variation of the first contract is required to be enforced.

In the first scenario, a novation results, because the first contract is required to be formally terminated and discharged and the second contract is required to be properly formed to replace it. The parties expressly agree to a specific way in which the first contract will be terminated, namely by exercising the option in a defined way. The result of this is, in essence, two separate contracts each with their respective terms, obligations and rights. Since only changes to the contractor's remuneration type are involved, it is anticipated that all other terms from the first contract will be mirrored in the second contract. Being commercial dealings, the elements of a contract—agreement, consideration, legal intention, capacity, …, would be apparent in the second contract as in the first contract. The option cost to the owner might also play a role in being regarded as consideration in the discharge of the first contract and/or the formation of the second contract. Another possibility is that two contracts exist from the start of the project, with only one being applicable at any time during the project.

In the second scenario, the first contract would require drafting in such a way as to convey the change in contractor remuneration as a minor adjustment to the terms of the first contract and as a subsequent agreement. Here, reference is to a variation of a contract (as distinct from variation of the work), which generally involves adding, omitting or altering of contractual terms. This requires that the parties agree that exercising the option only changes the terms of the first contract. No new contract is required to be formed, but rather a subsequent agreement is created. The consideration for this subsequent agreement could be the option cost, or the change in or forgoing obligations (for example, payments and work) for both parties. Since no new contract is being formed, it is anticipated that all terms, other than the change to the contractor's remuneration, would continue to apply once exercising has taken place.

Both scenarios—novation and variation—are equally valid at law. It is thus possible to structure a contractual arrangement to suit how the parties choose to be engaged. However, the variation approach may offer a more seamless transition between remuneration types.

9.8 Implementation Issues

With convertible contracts, the main implementation issues, which need addressing, are the following:

- There is a lack of industry familiarity with the concept of convertibility. Generally, human nature is such that something new may initially be distrusted. However, looking beyond any initial reaction, the parties should be able to assess any associated risks and see the benefits.
- The time of conversion would need to be reasonably well bounded and the form of conversion would need to be reasonably clear in the contract, in order not to spring any surprises on the contractor.
- The owner and contractor would need to negotiate the sharing of any gain from having a conversion capability in the contract.
- Negotiated bounds would need to be placed on the lump sum in order to discourage contractors from de-railing the conversion, after having agreed to its inclusion. This might be in the form of an agreed a priori estimate qualified in terms of the associated uncertainty (plus/minus a percentage). Only the form of the fixed price arrangement can be agreed upon; the specific monetary value remains to be negotiated at the time exercising is contemplated. The final agreed lump sum price would be based on a full knowledge of the risks explored in the prime cost stage, but would be by negotiation between the owner and contractor.
- There would need to be mechanisms established for: paying for work started but not yet complete and paid for under the cost reimbursable payment type; recognizing work paid for but not yet complete under the cost reimbursable payment type; and for clearly delineating between the scope covered under the cost reimbursable payment and the scope covered under the lump sum payment. Work not covered by the latter scope would sensibly be paid for on a cost reimbursable basis.

The calculation steps given above lead to a monetary value for having the option to switch within a contract. However, the deeper messages, independent of any numerical calculations, are:

- The value associated with having an option to switch will always be greater than the value associated with a definite switch (one which is contractually stated will occur). This is so, because some switches can lead to a loss; in such cases the option is not exercised, capping any loss at zero. A contractually prescribed definite switch can, in some cases, have a negative value.
- Having the option to switch will always be more attractive than having a contract where switching is not foreseen. Having an option to switch always has a value, even if small in some cases.
- The option value derives from the presence of uncertainty in the cost estimates. The greater the uncertainty in the cost estimates, the greater will this option value be. Conversely, if the there is no uncertainty in the cost estimates, having an option gives no added value. As a project progresses and any uncertainty decreases, the option value decreases.

9.9 Closure

The idea of having flexible contracts is not new, but heretofore a rational analysis has been missing. This chapter gives the analysis as well as an examination of contracts with conversion capabilities. The chapter, for definiteness, concentrated on construction contracts with conversion between payment types, but the chapter's approach applies to all contracts and all terms within contracts. Current literature does not deal directly with the matter addressed in this chapter. Related published work examines conversion in the context of post contract formation opportunism exhibited by contractors, and market underlyings that exhibit price volatility in contradistinction with projects.

The chapter examined the commercial and legal issues surrounding convertible contracts. It is found that both owner and contractor could benefit from such contracts. From the owner's perspective, benefits include hedging against potential financial losses, and increased contractor efficiency. For the contractor, advantages arise from the opportunity to gain from the conversion and to show good faith, thereby increasing its potential for future relationship contracting. The more efficiently the contractor works under a lump sum arrangement compared to a cost reimbursable arrangement, the higher the value of convertibility becomes to the contractor.

Having the right, but not the obligation, to convert the payment type within a contract part way through a project has a value. This flexibility value can be readily calculated. How and when this is shared between the contracting parties would be negotiable between the parties. The direct share to the contractor might be viewed as part of a premium paid by the owner for having flexibility in the contract.

Being a right but not an obligation, the switch may or not be done depending on the circumstances at time T. Clearly, the owner would only switch if it is worthwhile to do so at T.

The summary findings on alternative contractual approaches are:

- The value associated with having an option to switch will always be greater than the value associated with a definite switch (one which is contractually stated will occur).
- Having the option to switch will always be more attractive than having a contract where switching is not foreseen.
- The greater the uncertainty in the cost estimates, the greater will this option value be. As a project progresses and any uncertainty decreases, the option value decreases.

9.10 Extensions

The chapter examined conversion between payment types, but equally the approach is applicable to conversions of other sorts including delivery methods, contract clauses, subcontracts, project expansion and project abandonment.

The chapter examined total project conversion. However, it would also be possible to do part conversions, that is, some subprojects may be converted while other subprojects may not. While the analysis would remain the same as that given in this chapter, research could examine any nuanced implementation issues.

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