Valuing Technology, Setting up Strategy: Real Option and SMEs

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Abstract: Many businesses are actively managing their strategy to improve corporate activities and portfolios performance but the practice is sadly uncommon in the case of Small and Medium-sized Enterprises (SMEs). The need of strategic practices is very crucial to survive; yet with limited resources and expertise, SMEs are at loose end. The condition is worsened by current strategic practice that fails to incorporate uncertainty and flexibility. With the application of Real Option Valuation (ROV) among large firms, this paper suggests an enhancement to SME's current strategic planning. ROV applied with Option Metrics Space (OMS), allows managers to obtain quantitative and qualitative information on two main investment dilemmas, to invest or not to invest and when and at the same time match the decision to their limited resources and capacity. Seen as a better approach, incorporation of ROV into strategic planning values proposed project as a multi-stage operation, dynamically assessed over time rather than broken into several pieces. As a result, SMEs are able to decide on investments that are worth undertaken through an improved strategic planning practice.

Key words: Technology management, investment analysis, real option valuation, strategic management, planning practice

INTRODUCTION

Strategic management is viewed as a process which actively developing and managing corporate portfolios. In the past decades the development has resulted in two fundamentals-ironically contradict each other (Spencer and Brander, 1992; Ghemawat and Sol, 1998). The first view, originating from Resource-Based (RBV), emphasizes that firm should invest in resources that create more advantages, efficiency and competencies (Teece, 1984; Wernerfelt, 1984). The second, viewed from the point of organizations economics and game theory-resulted in understanding that strategic flexibility is valuable in assessing constantly changing business environment to obtain better opportunity, payoffs and shareholder wealth (Smit and Trigeorgis, 2006). However sometimes the organization economist's view that is not worth due to several tradeoffs between competencies and strategic value in competitive setting (Schelling, 1980; Shapiro, 1989). Therefore an "alignment" is needed to ensure optimum decision to react to business environment with limited capacity (Myers, 1984).

Strategic management emphasizes more on RBV and attaches it to Discounted Cash Flow (DCF)-based analysis to decide on the best investment. DCF analysis is a method of investment valuation using the concepts of the time value of money. All future cash flows are estimated and discounted by using a discount rate or cost of capital to derive at Present Values (PVs). The sum of all future in and out cash flows, lead to Net Present Value (NPV) which is taken as the value or price of the cash flows in question. Yet, DCF is rigid and fixed comprares to organization economists' principles because it aims to obtain strategic value in competitive setting. That is why DCF fails to incorporate uncertainties and unable to connect between the two views.

The issue above has flashed an obvious gap between financial and strategic management as highlighted by Myers (1984). Current practice of capital budgeting process dominated by DCF does not match to strategic approach. In order to solve the problem, real option is suggested to be the links between financial and strategic management thus being applied by many large firms with complex activities.

The approach above has hinted new practice for SMEs in order to achieve optimal performance, growth and survival within limited capacity and resources. Despite of endless findings on the positive relationship

between strategic planning and firm's performance, only small number of SMEs practice strategic planning (Wheelen and Hunger, 2012). SMEs who practice strategic planning usually have higher probability to success and able to prevent failures (i.e., involuntarily wound up) (Perry, 2001).

In the opposite, SMEs whom do not practice strategic planning, usually their planning "system" is more towards short term goals rather than long term (Stonehouse and Pemberton, 2002; Mazzarol, 2004). SMEs managers are usually reactive rather than proactive. As a result, most SMEs' strategic planning are frequently ad hoc and intuitive without careful analysis, thus providing less measured or analysed performance (French *et al.*, 2004). The situation flags a critical need for SMEs to develop better practices (Ates *et al.*, 2013). Therefore, with the emergence of real option, SMEs should be able to exploit the methodology for survival and growth, just like large firms.

Real option Valuation is originated from option theory. Through ROV, it improves investment decision of Net Present Value (NPV) which is based on Discounted Cash Flow (DCF) with fixed discount rate. The embedment allows treatment of high uncertainty and flexibility, providing the optimum resource allocation to reach strategic mission along time. Originally, this is seen as a sophisticated method plus the fact that the application is noticeable only among large corporations with complex activities. With such reputation, SMEs are drawn back from the adoption. This study aims to illustrate an improved investment decision method for strategic planning which is feasible for SMEs. Therefore, it is important for SMEs to understand:

- Why it is important for SMEs to practice strategic planning?
- How firms (especially SMEs) can formulate flexible strategies in order to react to changes in environment?
- What is the best financial approach available to be applied for the above purpose?
- How to determine the best time to execute flexible strategies formulated?

All this questions are to be answered in the following sections.

Literature review: Strategic management determines the mission, vision, goals, objectives, values, roles and responsibilities of an organization to be attained in the future. Strategic planning in strategic management involves utilization of resources in order to enhance the organizations performance in their external environments

(Vaara and Whittington, 2012). Strategic planning concentrates on setting financial and non-financial goals with specific allocation of necessary resources (Mitchelmore and Rowley, 2013). Bind with RBV it aims to obtain competitive advantage and efficiency (Nandakumar *et al.*, 2011). There are many literatures available which support the importance of strategic planning in ensuring positive business performance, for example, Delmar *et al.* (2013) and Ates *et al.* (2013). Firms whom employ strategic planning as part of its strategic management activities usually have higher sales growth, higher return on assets, higher profit margins and higher employee growth (Mitchelmore and Rowley, 2013). The engagement of strategic planning opens up to better results on innovation, newly patented products and management technologies (Laforet, 2013).

Other than that there are no clear reasons why SMEs oppose to strategic planning (Nandakumar *et al.*, 2011), studies are carried out to understand this phenomenon. Some of the findings state that SMEs reject strategic planning because the managers are lack of specialised expertise and possess limited knowledge of the planning processes eventough it is proven beneficial (Wolf and Floyd, 2013). The rejection is even stronger for SMEs with complex activities as they are unsure of how to deal with high degree of uncertainty (Mitchelmore and Rowley, 2013).

With the environment continuously changing the approach of DCF fails to take into account certain aspects of uncertainty, particularly to link to flexibility. Firms are assumed to follow previous formulated strategy regardless of any changes in the environment which means no hint of flexibility is considered. Planning becomes rigid. Yet, strategists claim that planning should react to the current state of environment. Eventually, obtaining competitive advantage and sustaining it is difficult if firms want to stay in the business and achieve its mission as being determined at the beginning of the process. The reason-the basis of capital budgeting employed apparently does not match with strategy formulation. Failure connecting between financial and strategic views becomes more apparent.

On the other hand, ROV is a new valuation method that mitigates the missing links between financial and strategic management. However, this paper is not going to discuss the technicality in details. Quantitative and technical explanation on real option and ROV may be referred to Smit and Trigeorgis (2006)'s Strategic Investment. ROV is used for valuing complex investment projects. The most important aspects being considered in this valuation methodology are incorporation of uncertainty and flexibility into valuation of project investment. With many advances in ROV, several

different options have been valued to suit various business characteristics and environments. Besides the option to defer an investment, there are options to alter production scale, to stage investments, to abandon business activity, to default during construction as well as growth option, just to quote some relevant cases (Trigeorgis, 1993). The role of ROV in decision-making has grown and also been debated many scholars. Driouchi and Bennett (2012) for example highlights ROV contribution in decision-making as being found in studies by Leurhman (1998a, b), McGrath and Nekar (2004).

Different economic fields have also benefited from ROV methodology. Among the contributors are Cortazar, *et al.* (1998) and Trigeorgis (1990) whom analyse natural resource investments; Kellogg and Charnes (2000) value a biotechnology company, Schwartz and Moon (2000) price an internet company, Grenadier and Weiss (1997) value investments in technological innovations, McGrath and Nerkar (2004), Willigers and Hansen (2008) cope with R&D in pharmaceutical industry including Muharam (2011) assesses SMEs in steel industry.

Therefore, it is important to practice a new approach that is capable to overcome the deficiency of DCF in investment analysis. At the same time the approach should not be too complicated to deter SME's managers to adopt it. It is suggested that DCF is enhanced with ROV and be appliaed alongside with strategic management tool.

MATERIALS AND METHODS

The research conducted in this study follows a stylized fact case study approach as exploratory research following Cooper and Slagmulder (2004). The approach is similar to other studies in the field of real options such as Dixit and Pindyck (1994) and Trigeorgis (1996) in the case of natural resource activities. This approach requires of the construction of a base case with various sources of information representative in a worldwide scenario.

Analyses: The strategic planning approach in this study follows Miller and Waller (2003) which integrating scenario planning and ROV. The integration is applied to keep the best of both tools by complementing each other as shows in Fig. 1. Through this process, SWOT analysis is used to examine business environment before being combined with ROV to illustrate feasible practice for SMEs' strategic planning.

Research setting: The project chosen for the evaluation is an investment in first stage steel processing, a mini-mill iron smelting project. There is a new proposal of building
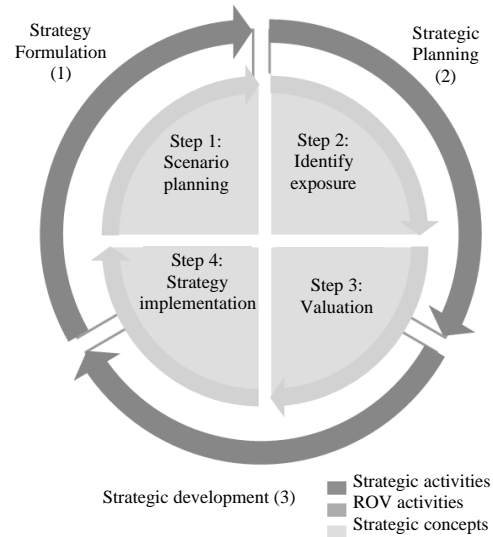

Fig. 1: Activities conducted according to strategic management concepts

up an iron smelting plan based on new process innovation, mini-mill iron smelting. The investment requires €10 million, €6 million in t0 and €4 in t1. By investing this amount the firm will have a mini-mill plant with capacity of producing 182000 tons per year. However, due to Kyoto protocol the plant is allowed to produce only up to 75% of its capacity in order to maintain emission and effluent at minimum level.

The investment has an expected useful life of 10 year. About 2 year are dedicated for construction and the rest 8 year are operational. Volatility is forecasted to be $\sigma = 30\%$. Two discount rates are employed which are 5% of risk-free rates and 12 % of adjusted-risk rate. Holding to this information, discounted investment cost is I is €9.81 million while discounted net cash flows, V is €9.25 million resulting in NPV of €-0.56 million (negative NPV).

The pre-analyses conducted in assessing possible risks have resulted in embedment of 4 individual options into the case. Instead of investing €9.81 million and getting return of NPV €-0.56 million (negative NPV) the investment is now embedded with option to defer, option to cancel during construction, option to expand and option to abandon.

After assessing the risk, opportunity and performing financial analysis the current concern now is to connect all the information and analysis for strategy formulation. This is a big concern according to Popli and Rao (2009). From their study it is found that SMEs in steel sector would not be able to compete due to weaknesses such as obsolete technology, high cost of production, poor

quality of goods, lack of capital, weak infrastructural facilities, plethora of labour legislation, lack of cohesion among SME units, ineffective associations, lack of up-to-date information, lack of international exposure to their products and lack of standards conforming to international standards. Therefore, with the approach of real option, risk assessment and financial analysis are capable to be connected as an input to formulate business strategy. Hence, it would be able to overcome the above managerial weaknesses of SMEs.

Analyses

SWOT analysis: The steel industry is facing a competitive demand from year to year. Between 1960s to late 1980's the industry was dominated by OECD (Organization for Economic Corporation and Development) countries. However, with the new emergence of developing countries like China, India and South Korea, the domination tilts slowly to Asia. The growth is also encouraged by technology development that allows cost minimization, together with production maximization and quality improvement.

Summarizing the reports provided by Sato (2000, 2009) and Popli and Rao (2009), steel industry is approaching its mature state with steady increment in demand. Products are generally similar with slight differences in quality. General products are priced according to trade market. Some producers are able to add special features to the product according to customer's specification, for example in the final composition of minerals and size.

In order to survive in this particular condition, Porter (1980) suggests two strategies to be adopted in order to create value and competitive advantage. First, cost advantage strategy which allows products to be priced lower than competitors. Cost reduction is obtained by having economy of scales. This is a good approach if product is more commodity-like, difficult to differentiate and demand is highly elastic. The second strategy is differentiation which allows product to be sold at premium. This strategy works if there is strong relationship among suppliers-firm-customer where demand is low elastic to price, sources of advantage have been exploited by competitors and nature of product allows customers to perceive extra value.

As most SMEs are having the problem of being cost and quality competitive, the first step suggested is to invest in new innovation which allows lower cost of production and quality maintenance. The investment in a new technology of mini-mill smelting plant allows SMEs to overcome the obstacle of high cost of production. Adhere with good supervision and standard practices, it enables to improve product quality according to international standards which opens up opportunity to market the product globally. "SWOT-wisely", this investment will simultaneously overcome SME's weaknesses in lack of innovation and technology and use to exploit the opportunity in surging demand of steel. Apart from that it also creates competitive advantage and deals with threats from competitors.

Identification and creation of options: Investing in new mini-mill smelting plant gives managers several options to be considered. The base case opens up to a wide array of scenarios, i.e., of flexibility. Opposing to the traditional approach of DCF without optionality, ROV approach moves from the one-path sequence to an investment proposal with various options of flexibility. The one-path sequence is the base case while other complementary options of the investment opportunities that are embedded into the ENPV.

The complementary options lead to a multi-direction path, presenting possible future decisions available to react to changes in business environment. Based on the case, the investment project may be taken immediately or deferred to the next year of t1, creating an option to defer. Besides that the project has the opportunity to be cancelled during construction which if it is exercised, the project has no opportunity to enjoy future expansion.

The purpose of having this financial flexibility option is mainly to create either a solution for the firm in case there are financing difficulties or a way out when investment is no longer competitive in the future or as such. By doing this, firms have the possibility of retreating from the pre-determined path to carry on the investment when it is no longer profitable to be continued. The options suitable for this scenario are: i) the option to cancel and) the option to defer and cancel.

Firms may have the possibility of enjoying higher return in the future and benefit from prosperous business environment which causes higher demand and market growth. In case that such a scenario happens, the project is expandable in year t4 and able to operate at its full capacity. There are two paths that lead to expansion. The first option is to invest now and expand later. The second option is the option to defer investment before expanding it when market growth becomes more evident.

In case that market and demand turn bad, it is possible to abandon the project so that further losses are avoided and salvage value can be claimed. There are four paths that open up the possibility where the option to abandon can be exercised. The path that lead to abandonment are individual option of abandon; expand and abandon; defer and abandon plus defer, expand and abandon. The whole scenarios are presented as Fig. 2 for better illustration.

ROV: Besides calculating project's return in form of Enlarged Net Present Value (ENPV), ROV is able
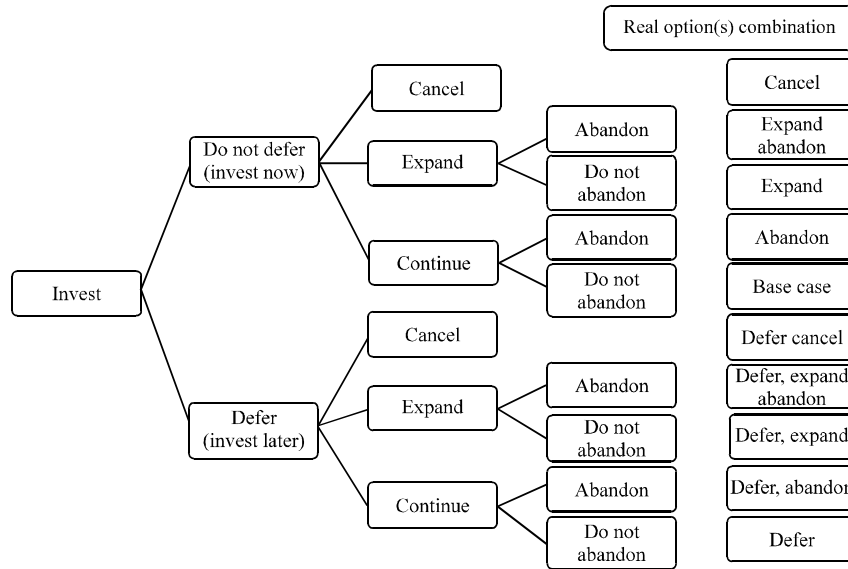
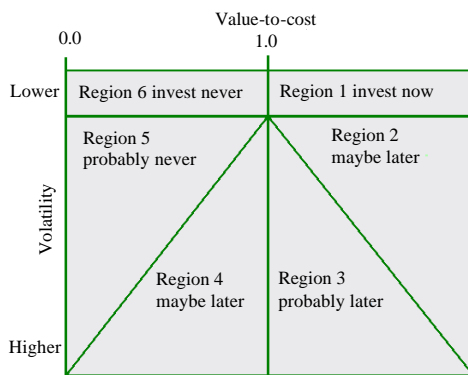Fig. 2: combination of options for the investment according to the proposed sequences

Fig. 3: Dimensions and Segmentation of option value space (Luerhman, 1998b)

Table 1: NPVq and cumulative risk for the Portfolio.

Variables	V	K	NPVq	σ (%)	t-values	σ √t
D	9.250	10.50	0.88	30	2	0.42
C*	9.250	4.790	0.52	30	2	0.42
E	5.210	2.470	2.11	30	4	0.60
A*	4.435	5.000	1.13	30	2	0.42
D and C*	9.800	4.500	0.46	30	2	0.42
D and E	3.920	2.400	1.63	30	5	0.67
D and A*	3.820	5.250	1.37	30	3	0.52
E and A*	5.124	5.000	0.98	30	4	0.60
D. E and A*	4.451	6.825	1.53	30	5	0.67

D = Deferral; E = Expansion; C = Cancellation; A = Abandonment

The NPVq and respective cumulative risk for the proposed investment with each set of complementary options are shown in Table 1. For these combinations of options, the rule Max (V-K, 0) is change to Max (K-V, 0) due to its nature that resembles put option.

to translate NPV to NPVq. NPVq which presents the value-to-cost ratio is used to express the relationship between V and K, signifying current profitability. Proposed investment is favourable when NPVq value is >1 (NPVq >1). Meanwhile, cumulative volatility, $\sigma\sqrt{t}$ is defined as the variance per period of asset returns cumulated over the time to option expiration to signify the cumulative risk observed for the proposed investment. The NPVq and cumulative risk for the initial investment without any options embed are:

$$NPVq = 9.250/9.810 \text{ million} = 0.94$$

$$\sigma\sqrt{t} = 0.3 \times \sqrt{1} = 0.3$$

Exercise timing of options (The Option-Value Space, OVS): After NPVq and associated cumulative risk are obtained the values are plotted in an Option Value Space (OVS) following Luehrman (1998a, b). This option space has two dimensions; Value-to-cost ratio and cumulative risk. The questions of whether to invest now or not will be answered by looking at the position of the investment against the value-to-cost dimension. Any investment which passed the 1.0 line is accepted to be undertaken. This parts the space into 2 divisions, with the right column places the favourable investment (Fig. 3).

Later, cumulative risk will further divide the panel from 2 Segments into 6. Investments are going to be categorized as "invest now" (Region 1) to "invest never" (Region 6) and going through "maybe now" (Region 2)
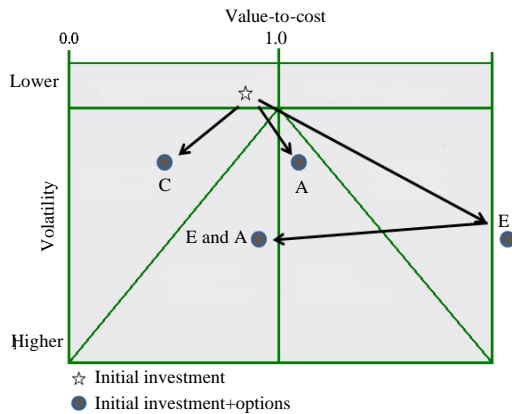
Fig. 4: Position of initial investment and investment with options embedded

and "probably later" (Region 3) to "maybe later" (Region 4) and "probably never" (Region 5). By doing this, contingent strategies against sets of uncertainty are monitored thus allowed strategic options to be exercised when needed (Fig. 3). As a result, values obtained from Fig. 4 F are plotted on the OVS are as follows (Fig. 4).

RESULTS AND DISCUSSION

Having to link variables in option pricing and plot them against OVS answer two questions in investment strategy. First, the question of investment worthiness is answered by the calculation of NPVq which links the return on the investment, the cost of the investment, the time value of money and the time of expiration of the investment. The initial investment is not attractive at all with negative NPV and NPVq <1 as plotted in Fig. 3.

However, the attractiveness of the investment changes with several options being embedded. Having the options of deferral; cancellation; deferral and cancellation; and expansion and abandonment; ends up in the same negative results where investment is still not profitable. Yet, once the investment is complemented with options to expand; to abandon; to defer and expand; to defer and abandon and to defer, expand and abandon; the investment moves from unattractive to attractive region with positive NPVq. These indicate that the ENPV of the investment with selected options results in positive returns.

Plotting NPVq against cumulative risk answers the second question of when the options should be exercised. Investment embedded with options of expansion; and deferral and expansion; has the possibility to be exercised now as the value-to-cost is >1 and with options located in Region 2 signifies that the options are in-the-money.

The other combinations (abandonment; defferral, abandonment and deferral, expansion and abandonment) are promising but should be put on hold as risk and uncertainty are still high. Consideration about exercising these options should be made once the risk level (i.e., cumulative volatility rate) improves. On the other hand, plotting the metrics on OVS also prevents unattractive investment combinations to be totally ignored. Located in Region 4 with higher volatility and lower value-to-cost investments with options to expand and abandon signal that in worst condition they have the possibility of being considered even though the chances are low. The potential of these options is smaller compared to options located in Region 3. Investment with options to defer to cancel and to defer and cancel; are not worth being exercised at current stage as uncertainty is low and risk level is evident, yet holding these options is beneficial as contingency plan. It is obvious that these options are out-of-money as the position signals more risk than potential. Yet, if business environment turns sour, exercising these options may curb occurrence of further losses.

This is proven by making comparisons between ENPV and NPVq. Higher ENPV does not always signal that it is the best option to be exercised. In our case, it is supported that the best option to be exercised is expansion, located at the preferable Region 2 and bearing the highest ENPV of €2.66 million. The NPVq of this option is also the highest with value of 2.11. However, the second preferable investment is not the one with the second highest ENPV. According to ENPV, the second preferable investment option is to embed the investment with the options to Defer, Expand and Abandon (DE and A) but according to NPVq, one with the option to Defer and Expand (DE) is preferable even though both choices are located at the same region. Investment with options to Defer and Expansion (DE) gives better value-to-cost with NPVq of 1.63 compared to 1.53 if it is embedded with options to Defer, Expand and Abandon (DE and A). In fact, from the analysis made, all options bear different level of preference if firms are concerned about the best time to exercise and the better value-to-cost, except for the first option to embed the investment with expansion. Table 2 compares the ranking of the investment options according to both ENPV and NPVq.

Looking from another perspective following the path diagram in Fig. 1, the initial investment should not be taken at all. If the investment is taken now, embedment of options moves the position of the investment to other segment in the OVS as shows in Fig. 5. According to this figure, the best investment is to be equipped with the option to expand. Investment with option to expand has positive NPV and the option is in-the-money. The location
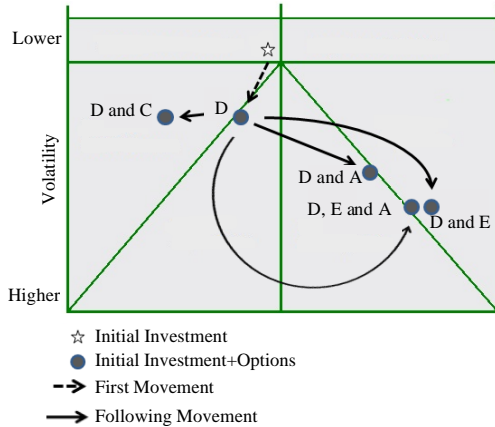
Fig. 5: Positions of the proposed investment if "taken now" with options

Fig. 6: Positions of the proposed investment if "deferred to t1" with options

Table 2: Ranking of the Investment Options according to both ENPV and NPVq

Option	ENPV	Rank	NPVq	Region	Rank
D	0.92	6	0.88	5	7
C	-0.39	9	0.52	5	8
E	2.66	1	2.11	2	1
A	0.61	7	1.13	3	5
DC	-0.33	8	0.46	5	9
DE	1.56	3	1.63	2	2
DA	1.07	5	1.37	3	4
EA	1.25	4	0.98	4	6
DEA	1.81	2	1.53	3	3

of this option signals that the investment might be worth if been exercised now and the project may benefit from early exercise.

Investment embedded with option to abandon is next while investment embedded with options to expand and abandon is worth considering. However, to embed the investment with the option to cancel seems unprofitable but worth keeping for immediate contingency. If managers decide to postpone the investment to next year (t1), the investment changes position from "never invest" to "maybe later" which means resources are better for other investments. Hence, the investment plan should be kept on hold. This is the first effect of embedding the deferral option into the initial investment.

Then, complementing the deferred investment with options to expand and options to expand and abandon makes the investment portfolio more attractive. The investment is more profitable if taken at t1 with the embedded options being exercised soon after that. However, the investment with deferral and cancellation options has higher probability of not being exercised compared to investment with deferral and abandonment options. Investment with options to defer and abandon in Region 3 has high value-to-cost but the options are
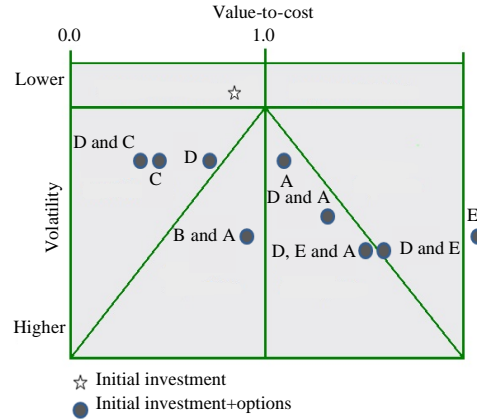
out-of-the-money due to high volatility. However, the position is worth considering once risk level (i.e., volatility rate) improves. The first and following movements of the investment portfolio on the OVS are shows in Fig. 6.

Referring to the metrics as a guideline towards project development over time, SMEs managers are able to formulate strategic moves by integrating the value of waiting measured by ROV. As time passes, project reacts to more certain economic condition and industry environment, both with less volatility. Competitions change and other value creation reactions vanish over time, thus options move into more certain direction. Usually with extra information, option moves upwards and reaches maturity at the top of the options space (Regions 1 and 6), at which point the investment decision must be made or the option expires. A strategy is then depicted in an option space as a sequence of options, reaching a decision whether to undertake an investment or not.

CONCLUSION

Planning based on DCF valuation methods is rigid and unable to capture uncertainties in constantly changing business environments. Given that SMEs are not excluded from the exposures, a special approach is needed to allow them to practice better planning in order to survive with limited capacity. Real option has been potentially seen as a tool that enables to solve the problem. Starting with identification of value drivers, value creation is measured. Uncertainties are dealt with by formulating proactive solutions which provide flexibility. The advantage of ROV in the approach is its ability to assign quantitative value to qualitative intuition of SME's

managers. Valuation is conducted by transforming traditional NPV. Adopting ROV variables and following Luehrman's approach, NPVq is calculated. Then, the values are plotted into a metrics space against cumulative risk so that the option values able to be sketched in the strategic planning path. Referring to the locations of options on the OVS, SME's managers are able to formulate strategic moves. Signals and intuition whether an investment should be taken or not become more objective depending on which side of the metrics the investment option is located at. However as the project maturity level increases, options usually become more certain and better consideration of future options is clearly seen thus helping managers to decide whether an investment is worth to be undertaken.

The advantages of the process explained in this study are several. First, it incorporates both uncertainty and flexibility and measures them which gives more accurate information on project evaluation. Second, using the same variables in the evaluation process, values are reflected in strategic planning in form of the option space metrics. Third, since strategic variables like competitive advantage are important and a project life is continuous, this method allows managers to perform evaluation in a multi-stage option chain development (Smit and Trigeorgis, 2006). Each stage represents options available for the next stage leading to cross time interactions over a long period of time.

Generally, this method is a helpful and comprehensive method that enriches SMEs manager's intuitive thinking by providing quantitative and qualitative information for investment decision-making and strategic planning. The fact that the approach links both corporate finance and strategic management opens up to higher potential in both methodology and application to specific case studies.

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