A real options approach to implementing corporate social responsibility policies at different stages of the mining process

Michael Hitch, Ashwin Kumar Ravichandran and Vedvyas Mishra

Michael Hitch is based at the University of British Columbia, Norman B. Keevil Institute of Mining Engineering, Vancouver, Canada. Ashwin Kumar Ravichandran and Vedvyas Mishra are both based at the Indian Institute of Technology, Kharagpur, India.

Abstract

Purpose – *The purpose of this paper is to introduce the concept of ''optionality'' of corporate social responsibility programs in the mining sector. It is postulated that the degree of commitment and implementation varies with the different stages of the mine life cycle.*

Design/methodology/approach – *The methodology/approach applied in this paper follows that of complex systems theory. The authors recognize that elements of CSR do not function/occur in isolation but rather operate in a complex and dynamic system.*

Findings – *The findings presented in the paper indicate that there is a not a single ''silver bullet'' approach to CSR but rather one that ebbs and flows with not only the technical stage of development of a mine but also those extra- economic modifiers that influence a mine's performance and survivability in a competitive global market.*

Research limitations/implications – *The limitations of this particular paper/research is the inability to get a complete set of cost data from any single mining operation. This is due to the highly confidential and proprietary nature of this data, hence a hypothetical/theoretical case is presented.*

Practical implications – *The practical implications of this research include recognizing the different stages of the mine life cycle cause different applications of CSR policy development and implementation. The authors present a view of a flexible and reflective CSR application.*

Originality/value – *This is the first and novel attempt to consider the actual value and commercial implication of CSR using the methods of real options within the broader theoretical framework of complex systems.*

Keywords *Corporate social responsibility, Sustainable Development, Management strategy, Cost drivers, Mining industry*

Paper type *Conceptual paper*

1. Introduction

Corporate social responsibility (CSR) has been enshrined as one of the most crucial aspects for justifying the sustainable growth of humankind from the aspect of firm growth. In terms of mining, we can closely associate CSR with the strategic decisions that need to made, from the exploration stage to closure, which are associated with uncertainty and risk.

We need to refrain from perceiving CSR as an idea and rather aim to incorporate it into our present schedule. The program should be viewed as a long-run investment. Economic-based considerations have lost importance, and now every firm assesses alternative ideas for sustainable development. This opens up the aspects of environmental, social and legislative responsibilities towards a healthier tomorrow and places proper appreciation on safety concerns (Amit and Wernerfelt, 1990). Every firm glorifies the image of CSR as a practically implemented action towards sustainability. This helps firms maintain relations not only with stakeholders and potential investors but also with the community as a whole.

The relevance of CSR policies in mining industries has always intended to create overall development. However, this is a molded picture. We have been oblivious to the social and ecological premises of growth. Cost/benefit analyses have assumed utter importance, with human development ascertaining minimal value (Jenkins, 2004). The social and ecological legitimacy of projects has never been taken into consideration. However, firms are now beginning to generate proper plans not only to augment ecological concerns but also to justify social needs (Cowell *et al.*, 1999).

For every firm to progress, the satisfaction level of its human resources should play a crucial role. Public opinion about the extraction industries and their precarious effects on the ecological environment has led to negative assumptions among the masses (Rae and Rouse, 2001). This notion still predominates, while economic considerations are a side issue. With growing concerns about ecological misbalance and human resource exploitation, various pressure groups have come up. Mining firms are easy targets for such groups, since there are various areas where these norms might be violated (Walker and Howard, 2002). In addition, on-site accidents also give such groups an opportunity to question the safety concerns. Thus, in order to pacify pressure groups, mining firms need to be proactive in the sector of CSR.

The focus of the financial sector on the social perspective and on risk management has also alienated them from simply profit generation. Thus, materializing concerns have taken a back seat. In order to satisfy the financial sector firms invest in CSR with the objective of social advancement as a means of human growth. Wood (1991) refers to CSR as ''a broad concern with the impact of business behavior on society'' with prior focus on outcomes to ''a business organization's configuration of principles of social responsibility, processes of social responsiveness, and policies, programs, and observable outcomes as they relate to the firm's societal relationship'' (p. 693). This section introduces the issues highlighting the benefits of sustainability. In the next section, we discuss the shortcomings of the CSR policies and its effect on real life situations.

2. Key issues of a CSR policy framework

Every mining firm has a pre-stipulated life, which determines the duration for which the mine affects the local community through sustainable benefits. Sustainability progresses in line with the decisions affecting the concerned community. The firm requires proactive policies and training with respect to mine employment and in the transfer of goods and services. It also needs to ensure that the three prime beneficiaries that govern the ultimate outcome (i.e. the government, the community, and the company) work in parallel. The various impacts of mining on the social structure as well as sustainability issues should hold maximum priority.

CSR covers various economics aspects in terms of mines (Busch and Hoffmann, 2009). From direct employment in operational and constructional stages to indirect employment in tertiary sectors, mines are sources of revenue generation through taxes and foreign exchange earnings; thus, mining helps improve the economy on global scale. Further, the employed workforce can enhance their skill levels and technical abilities, ultimately improving their values on the open labor market. Although a proper format for the distribution of this wealth can be attained through income benefits, these benefits also bring in a lot of migrants, thus unbalancing economic harmony.

When it comes to evaluating environmental well-being, we look at availability prospects of clean air and water, the efficient utilization of the available resources and the adaptation of recycling methods for a better future. One also needs to ensure the proper disposal of waste and attain zero discharge in a short space of time. There is also a dearth of technological advancement in open-ended environmental stewardship. CSR policies should minimize remediation costs through progressive remediation and focus on re-vegetation for the post-mining use of land.

On the social and cultural front, CSR policies should aim to develop the skills of local community members by providing them with employment in all aspects of production. This also calls for a number of migrants, which although destabilizing the economic structure, ensures a far more socially equipped local community, which is also rejuvenated through

small business development via low levels of capital investment. CSR policies should also generate a satiable amount of social capital in order to develop the community as a whole.

With progressive growth, health issues in public firms have attained priority. Such policies should aim to improve occupational and health standards to increase workforce output.

Since direct communication among the three basic stakeholders is crucial, we must assess the legal matters that act as a platform for every justifiable action. Firms must respect the land claims of indigenous peoples and solve them in a passive manner. We must assess and respond to the cumulative effects on national parks and on every biological entity, that affects biodiversity. We must also abide by Environmental legislations and the demands of indigenous peoples.. In order to institutionalize CSR we need to be very broad in our view since the general community is involved.

3. Real Options Analysis (ROA)

An option refers to those investments, resources and capabilities that provide decision makers with ''the ability to select an outcome only if it is favorable'' (McGrath, 1997). Further, options are also a tool of risk management because they limit ''downside'' outcomes (Bookstaber, 1981; Bowman and Hurry, 1993).The word ''option'' is of French origin and means ''the power of choice''. There are two types of options, namely call options and put options. A financial call option provides its owner with the authority to purchase a future stock at the present price (Huchzermeier and Loch, 2001). Therefore, if in the future the price of the stock rises, the owner will not incur the extra cost. By contrast, a financial put option allows the owner to sell the stock in the future at the present fixed price. Therefore, in the put option case if the price of the stock decreases in the future the owner will incur no losses. The use of both the call option and the put option is entirely dependent on the individual. It is not obligatory for any individual to purchase stock if he or she has the options.

Analyzing real options can include assessing all tangible assets such as real estate, technological investments and so on. The real options approach is today very popular in the corporate world because of its viability for strategic management and risk analysis. It also works well with capital budgeting and resource allocation techniques, and it can define whether a particular venture is worth investing in (Trigeorgis, 1993). Real options take into account the fields of undertaking activities and acquiring resources (Sanchez, 1993). The analysis gives the individual a chance to defer the decision on a particular investment until a certain environmental characteristic has revealed itself. Since the real options approach delves into both risk and strategies, one can perform it under risky situations. It is thus feasible in the present day scenario where the world economy is volatile.

By contrast, traditional analysis methods (i.e. the net present value (NPV) or discounted cash flow (DCF) seem to be obsolete in the real options context (Donald and Lorsch, 1983; Trigeorgis, 1996). The NPV approach takes into account present day statistics and thus cannot be termed dynamic in its assessment. This method could be used for strategic planning as well as risk assessment. Although a particular venture might produce a negative NPV, with dynamic market values, it can become positive at some point in time. The NPV analysis fails to analyze the previously mentioned postulate.

The real options approach is far more suitable, as it takes into account all market dynamics, thus making it far better for strategic planning. However, it has various shortcomings (Donald and Lorsch, 1983). The first drawback is the option to defer, which allows management to hold onto a particular investment (such as land or any kind of resource) and wait to see if the resulting prices justify the investment. This could be applied to different scenarios, including natural resources and extraction industries.

Further, the time to build an option (or staged investment criteria) opens up outlays for an investment procedure and thus we can withdraw from any unfavorable situations. Every stage might also be viewed as an option with the subsequent options depicting it as a compound option. This is accessible to all R&D projects and large-scale industries, including the energy and power sector, as well as capital-intensive projects.

Next, we look into the aspect of an option that can alter the operating scale of a venture. Under this option, every firm is entitled to an option in order to expand or contract given the various shortcomings – both favorable and unfavorable. An unfavorable situation demands contraction or shutdown, whereas a favorable situation demands expansion or restart. It could be adopted by natural resource industries such as mining as well as industries that operate cyclically. Moreover, the option to abandon gives the owner a choice to walk away from all activities in the case of market slowdown. This prevents the owner from incurring further losses. It is also accessible to capital-intensive industries.

Next, the option to switch entitles a firm to switch its products if a previous product is not performing. Here, the owner can switch to either output products or input products, based on whichever seems more feasible in the prevailing situation. This can generally be taken up by small-scale industries, as major shifts are generally avoided.

Growth options refer to the investment structure wherein one grows on the previous investment made. Firms invest in various projects relating to R&D and strategic acquisition and when these investments form a chain, a formulative approach can open up for further growth. It is thus a compound interrelated project that is taken up by infrastructure-based and strategic companies as well as multiple product firms.

Multiple interacting options also open up potentially enhancing call options as well as protection put options. Thus, this intermingling of options has been termed a multiple interacting option. As previously mentioned, because capital-intensive and R&D firms have a number of options, these are applicable under such a scenario.

Various types of models have been generated to value real options. First, the binomial model describes a numerical model in which the price of the asset can move to two possible prices in a given time period. This movement is based on the description of an underlying asset in a particular time span rather than at a single point. The method makes use of a binomial lattice wherein every node represents an option and the value represents the price of the underlying asset at that particular point of time. The process starts by working at each of the final nodes and then proceeding iteratively backwards towards the first node. The binomial model provides a very discrete valuation procedure for the determinants of option value but it requires a lot of inputs at each node, and this makes it taxing.

The Black-Scholes Model is used for the valuation of real options. It is a mathematical model of the financial market that is bound by certain derivative instruments, namely contracts between individuals or firms working on a joint venture that define the conditions under which payments have to be made (Hull, 2002). This model governs the timeframe during which the underlying asset can be traded, ultimately eliminating risk concerns using the fundamentals of hedging. It is thus valid for a frictionless market with all transactions at a constant risk-free interest rate and when no dividends should be paid.

The Monte Carlo method is another mathematical model that assesses asset value by simulating uncertainties. The values obtained can be averaged over a particular range, with the average value determining the asset value. We can use stochastic models for calculation purposes. Uncertainties are defined by their random characteristics and are denoted mathematically. The result allows us to analyze average NPV as well as the various volatilities observed in the course of calculation.

Finally, the finite difference method for pricing is used to solve derivative pricing problems and is limited by the number of underlying variables. It is modeled as a partial differential equation as a function of the time (the duration under consideration) and pricing of the asset. For final results, the partial differential equations are discretized using finite differences.

4. CSR as a real option

CSR is a corporate decision that involves not only the allocation of resources but also the careful analysis of the costs and benefits in terms of cash flow, using traditional techniques of valuation. Therefore, it often leads to decisions to forego investments. Such a traditional approach has been criticized because of its inability to measure market value and thus

generate losses for stakeholders (Friedman, 1962).Therefore, we apply real options to CSR, which looks at a wider field or inspects a wide horizon before the final outcome.

We suggest that CSR is a form of real option. As a real option, CSR formulates solutions to reduce business risk, and thus is central to a firm's risk management strategy. Options imply preferential access to future opportunities. Real options have been effective at giving us a detailed analysis of acquiring resources and their viability (Sanchez, 1993). They even give us the opportunity to defer our decisions when events turn futile or become inappropriate for future investments.

CSR is increasingly becoming crucial as a means not only to create goodwill but also to generate revenue. Indeed, it has become a potential entrepreneurship venture with social and environmental gains (Menon and Menon, 1997). Since there is no definite valuation for the CSR option, it is always considered to be risky (Kytle and Ruggie, 2005; Clarkson, 1995). With real options, every firm can decide whether to invest in a particular social or environmental aspect based on a definition of the risks and options available. The factor of uncertainty also reduces over the time span, ultimately reducing the risks involved. Real options are confined not only to financial adjustments but also to the strategic feasibility of a project, which widens the field of view for every real option including R&D developments, technological investments and global manufacturing decision (McGrath, 1997; Kogut and Kulatilaka, 1994).

The benefits of real options can be accessed in terms of direct and indirect benefits (Burke and Logsdon, 1996). Direct benefits cater to products and services that create direct revenue, whereas indirect benefits refer to the potentially value-adding behaviors with regular investments. Direct benefits are central to value and easy to evaluate, and thus they can be estimated. By contrast, evaluating indirect benefits is difficult because they are intangible. CSR creates goodwill among the general public, motivating them to buy stakes in the company, thereby justifying the investment made. Although CSR is voluntary, for any firm that has growing environmental and social concerns because of pressure groups being proactive can be seen as a necessity.

Two kinds of risks are associated with CSR options, namely systematic risk and unsystematic (or business) risk. Systematic risk is the option's correlation with market returns, whereas business risks ''reflect the variation in a option's return ascribable to firm-specific forces'' (Amit and Wernerfelt, 1990). The systematic risks associated with CSR options can influence the flexibility and uncertainty of the natural resources system. The future availability and accessibility of natural resources is of prime concern, which triggers unsystematic risks. Unsystematic risk in this aspect takes into account ecological limitations and the environmental risks associated with it. Business risk is fundamentally irrelevant in financial theory, since different objectives can eliminate business risk. A well-managed firm can eliminate the business risks associated with CSR options, ultimately leading to higher returns for stakeholders and local communities (Husted, 2005). Under certain cases, a situation might occur where norms or basic regulations might get violated and there pertains a risk of delay in production. Such cases of unforeseen situations shall also cater to unsystematic risk.

Further, the risks associated with CSR options can also be categorized into perceived risks and objective flexibilities. This is generally used to forecast the risks and uncertainties associated with the future business environment. In such a context, perceived risks are recognized to be easier than objective risks, which can justify a change in business environment but not in individual behavior. Perceived risks generally offer flexibility in decisions about future development (Kogut, 1991). The perceived risk takes into account the functional, physical, social, psychological and time related risks that define the chances of occurrence on perception which again is difficult to be quantified.

We can access the uncertainties in the implementation of CSR options from three different aspects (Triantis, 2000).The first perspective is the economic uncertainty that stimulates volatile product prices and costs, which is external and thus dependent on market demand and supply. The next is technical uncertainty, which is an internal matter that focuses on keeping pace with technological advancement and varying production size. This aspect also includes R&D expenses as well as the major risks associated with it and managerial

flexibility, which works on the allocation of scarce resources and effective decision making to improve firm outcomes (Bowman and Hurry, 1993).

Under financial uncertainties, we encounter the risks associated with interest rates and commodity prices. There are even uncertainties regarding the performances of third parties and contractors. Finally, legal uncertainties include changes in the tax structure and environmental regulations. Even with changes in political regime, there may be a new structure for work and tax payments.

The various costs that a company incurs could be related to its development costs, which include capital investment in infrastructure growth and labor. If CSR real options are higher than the price estimated, the firm can look to realize the option and reciprocate in the opposite case. The value of the CSR option is affected by five variables, namely the value of the project, time to the maturity of the project, price being exercised, the risk-free interest rate and the uncertainty associated with project returns.

The value of the project is calculated as a forecast of the revenue that could be generated from investments into CSR. The time of the maturity of the project relates to the time-to-defer option. Under this criterion, the more time available for exercising real options the better it is in the context of the project. However, we must also assess competition from other market substitutes, which might decrease the value of the option. In such a situation, exercising the option as early as possible seems to be best available choice.

Exercise price gets affected by the CSR policies of a company. This represents the investment of a mining firm into CSR in the future and implies the price at which we can exercise the option under consideration. The US Treasury regulates the risk-free rate of interest and thus it is not under the realms of the holder of the option. A higher risk-free rate suggests that CSR options have a higher value. However, it also implies a lower exercised price in the present day context, which increases the value of the option at the present value. Finally, uncertainty term in CSR option valuation is governed by the entire project returns, which are further stimulated by technical, managerial, legal and geological uncertainties. Options have a defined probabilistic bar set for expected negative returns. This helps stakeholders add benefits from increased returns. The higher the variance in the return, the greater is the value of the CSR option.

5. CSR options during the different stages of mine planning

Mining is perceived as an activity that creates many problems, such as environmental damage and social inconvenience. However, this image is becoming confused over time. Mining firms must try to pacify the public and adhere to environmental norms. Mines must also tap into local communities for labor. Some local communities are dependent on the mining enterprise for their survival – even creating temporary employment for migrants (Triantis, 2000). Under this social aspect, mines have been able to create a social environment and this has been a stimulus in affecting local communities more broadly.

Different types of mining communities are involved in different mining projects, such as established mining communities with or without diversified economic bases, company-established mining towns, temporary encampments, fly-in fly-out operations communities and ''mining metropolises''. Management's approach to CSR issues would differ widely for each, but irrespective of mining projects, companies must adhere to certain guidelines and follow certain frameworks when dealing with CSR issues. We have thus developed a CSR options framework from management's perspective, which illustrates the various options available to companies during different stages of mining.

Mine planning involves the discrete analysis of all aspects of mining from the exploration stage to closure. This process includes ore reserve estimation, the technology to be used, labor to be employed, resources to be extracted, investment statistics and financial aspects, all of which should be outlined in the mine planning stage. All activities are optimized before mining begins; thus, mine planning plays a crucial role.

Although it is not obligatory for every firm to allocate funds for CSR, with increasing environmental norms and social concerns, investment in CSR should be viewed as an

investment in the future. Funds are allocated to every stage of CSR – sometimes firms can even wait for an event to happen so that the investment can be made logically. NGOs can cater for every aspect of a company's CSR investments, while local communities can be harnessed at a social and a cultural level by investing in the infrastructural development of the nearby areas. Ultimately, CSR aims at catering to the best of needs of people while keeping financial profit in mind (see Figure 1).

Our model starts with the mine exploration stage, which is an organized and intensive form of mine prospecting. It includes area or province selection and resource estimation by using various geophysical and geochemical methods. It also delves into the administrative aspect of mine planning such as signing agreements. This stage further involves the initial development of the mine, including the assessment of alternative development plans.

Firms aim at catering for the needs of the local community during the process of land acquisition. Production scheduling in the mine planning stage indicates the amount of labor, while environmental norms are recognized. Active NGOs are associated with in order to pay proper heed to the grievances of the local community. The environmental impact assessment is undertaken to understand the environmental standards in that particular area.

Various options are available to management at different stages of mine exploration. To begin with is land acquisition cost, which the firm might defer in order to see how the environment unfolds and thus prevent losses or pull out as early as possible. When agreements are completed, the firm needs to respect all the obligations of the local community. Thus, in order to comply with a particular schedule the firm might proceed by involving the NGOs active in those regions as well as directly interacting with the local community to solve any issues. Management also has the option to create a Community Monitoring Committee or establish a processing plant at the site of operation to reduce the burden on transportation and thus improve feasibility. However, there are certain costs that are compulsory for the firm to bear in the exploration stage:

- All the administrative costs associated with the formulation and signing of agreements as well as land acquisition costs.
- The initial setting up cost of the plant.
- The costs related to carrying out the environment assessment and social assessment plans (see Figure 2).

The mine development and production stage involves all mining activities from production to the transportation and processing of ore. In this stage, all heavy machinery is procured and

Figure 1 Key for the ''CSR Options Framework'' illustrated in Figures 2, 3 and 4

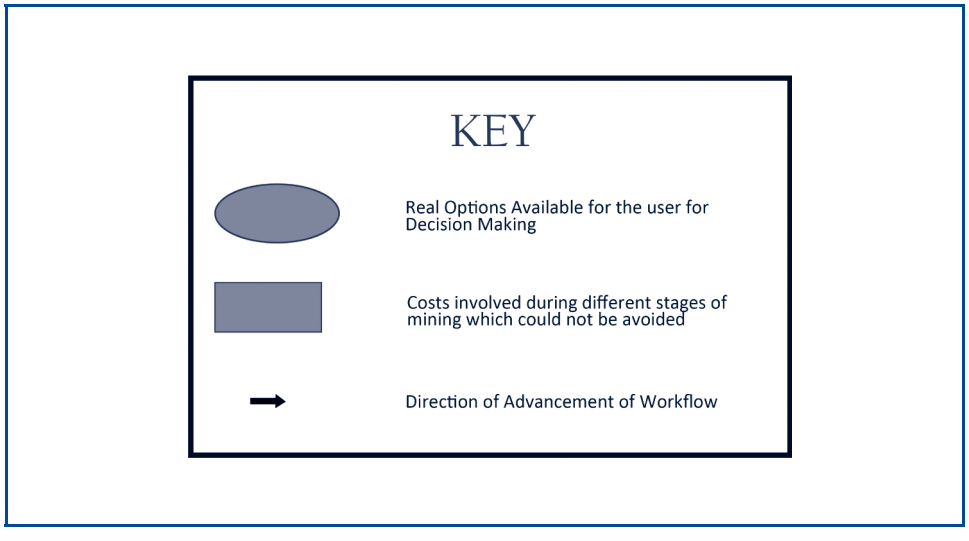
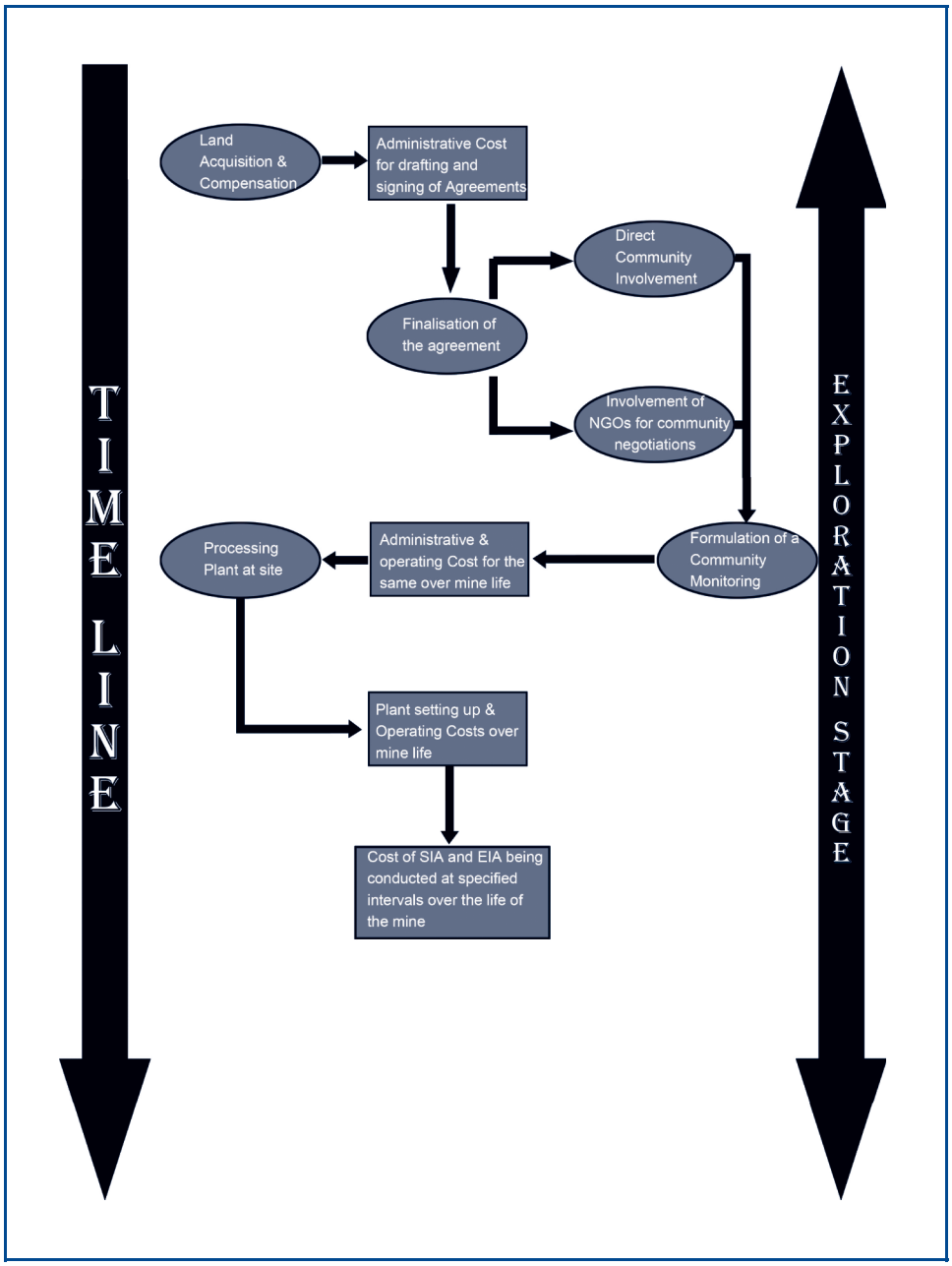


Figure 2 Flow chart showing the various CSR real options and the costs involved during the exploration stage



electrical connections established. Further-more mined ore is checked to assess its profitability for the firm and heavy infrastructure laid down for transportation purposes. The metal price and timeframe are specifically kept in mind in this stage.

Management should also ensure maximum CSR investment in this stage in order to reap the full benefit and make sure that funds are invested in the societal structure to improve living standards. Moreover, infrastructural development should respect health and safety aspects as well, while training programs should aim to raise the skill level of the labor force. Further, firms should develop the technological front by opening labs for R&D, including new educational programs for the local community.

During this crucial stage of mining, management has a dearth of options and needs robust management skills to take proper decisions. It can look at obtaining cheap labor from the local community and raise their skills levels through proper training programs. Infrastructural development should aim to bring about community development as a whole with better health and safety facilities, which leads to less absenteeism.

Opening up educational hubs would assist firms in carrying out their R&D activities smoothly with little ongoing investment. Foreign purchases and higher levels of technology should ensure better production as well as skilled workers. Mining companies can also explore the possibilities of conducting committee meetings to address the needs of the community. The practice of the previously-mentioned options should ensure less future investment into ventures related to mine closure. The fixed costs that firms incur in this stage of development and production are:

- The royalties and taxes paid to the government in lieu of the resources extracted.
- The expenses for environmental capital and fines.
- Investment into the health and safety of employees.
- Infrastructural development costs for the construction of roads, housing and other community amenities (see Figure 3).

The final stage of mining includes decommissioning and closure. A progressive mine closure and final mine closure plan are submitted to the relevant authorities. A financial assurance plan is also submitted by mining companies to return the land to the borrower in a condition for reuse. Certain requirements for land have to be adhered to, according to Municipal Corporation Guidelines, while all fines because of the violation of environmental regulations should be paid. Management also looks at CSR activities that include the rehabilitation of the land used for mining. Waste has to be treated properly before being discharged into any water body. Any local community members that have been de-settled need to be provided with allowances. The firm also needs to look into infrastructural development for the local community.

Management can use various approaches to create goodwill among stakeholders. At the time of closure, the firm can rehabilitate the land or retrieve it for farming in order to provide alternative employment to local inhabitants. It could provide migrants with relocation expenses or compensation or invest capital into developing small business attributes to make them self-sufficient. They also have the option to open up NGOs for the needs of the local community. Lastly, they can defer the final cessation of operation depending on how the factual situation unfolds. The compulsory costs associated with closure include the costs that ensure the rehabilitation of local communities, the land transferring costs and the post-closure environment mitigation costs (see Figure 4).

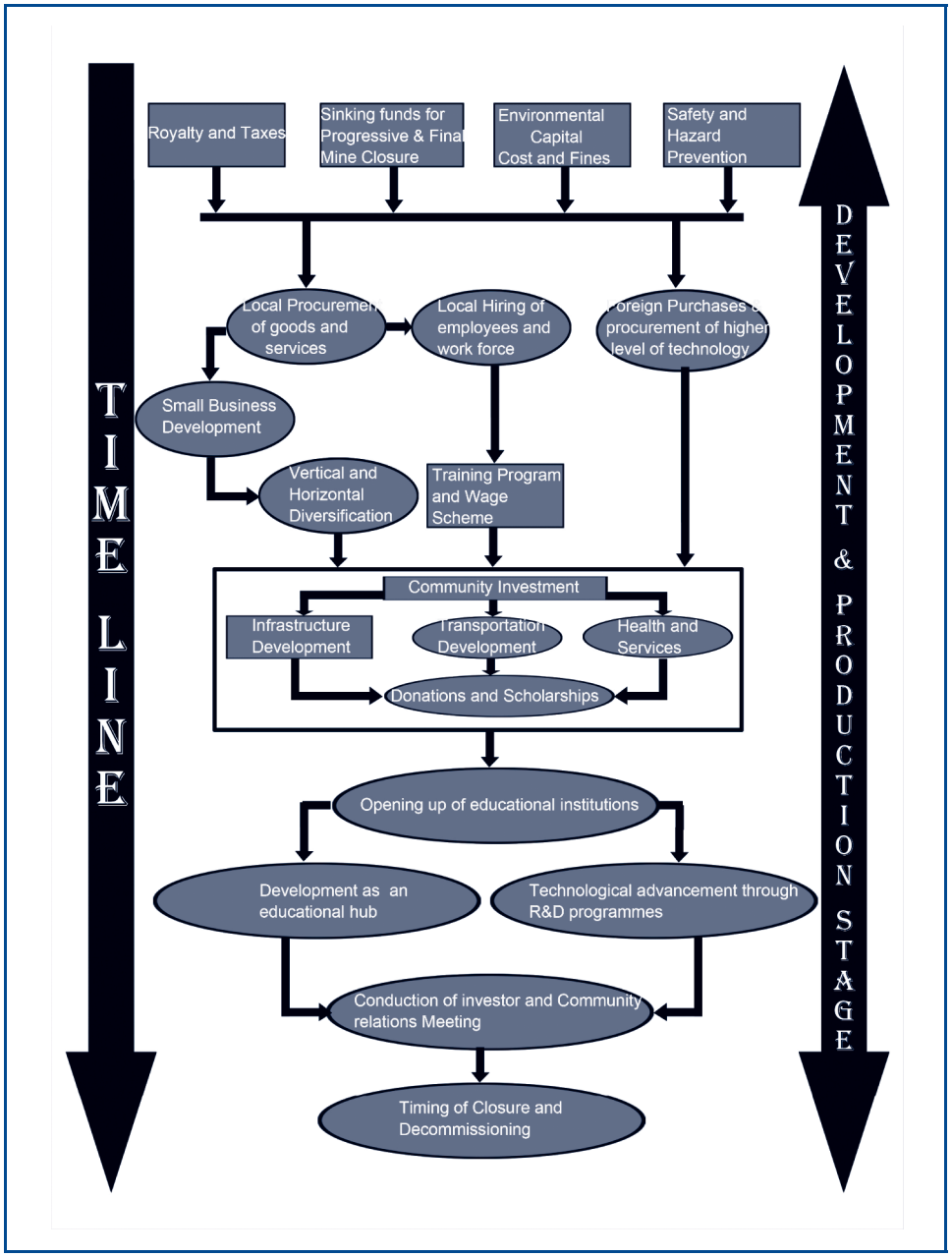
By knowing the various CSR options and their associated costs available at these different stages of mining, mine planners can apply real options theory using a binomial tree model. We can thus forecast the uncertainty involved in terms of project returns, as it takes into account metal price fluctuations and technological and economic risks.

6. Conclusion

The model put forth herein offers a completely new visualization of CSR. We have aimed to justify the CSR investments made by mining companies. It has been compiled for general mining projects. We have considered all the possible risks and uncertainties associated with every stage of mining. A mining company with distinct work procedures needs to modify the model with proper conditions applied. The previous idea describes the choices available to the managerial committee to justify the firm's CSR costs. This provides strategic flexibility for a mining firm and gives equal weight to both environmental stability and social sustainability, thereby laying out a plan for any new ventures related to CSR.

This new idea has much scope for further study by extending the previous model to a specific community or mining project to analyze the pros and cons of the CSR decisions taken by management during the life of the mine. A case study could also be modeled for every discrete mining operation by imposing suitable boundary conditions. Mining

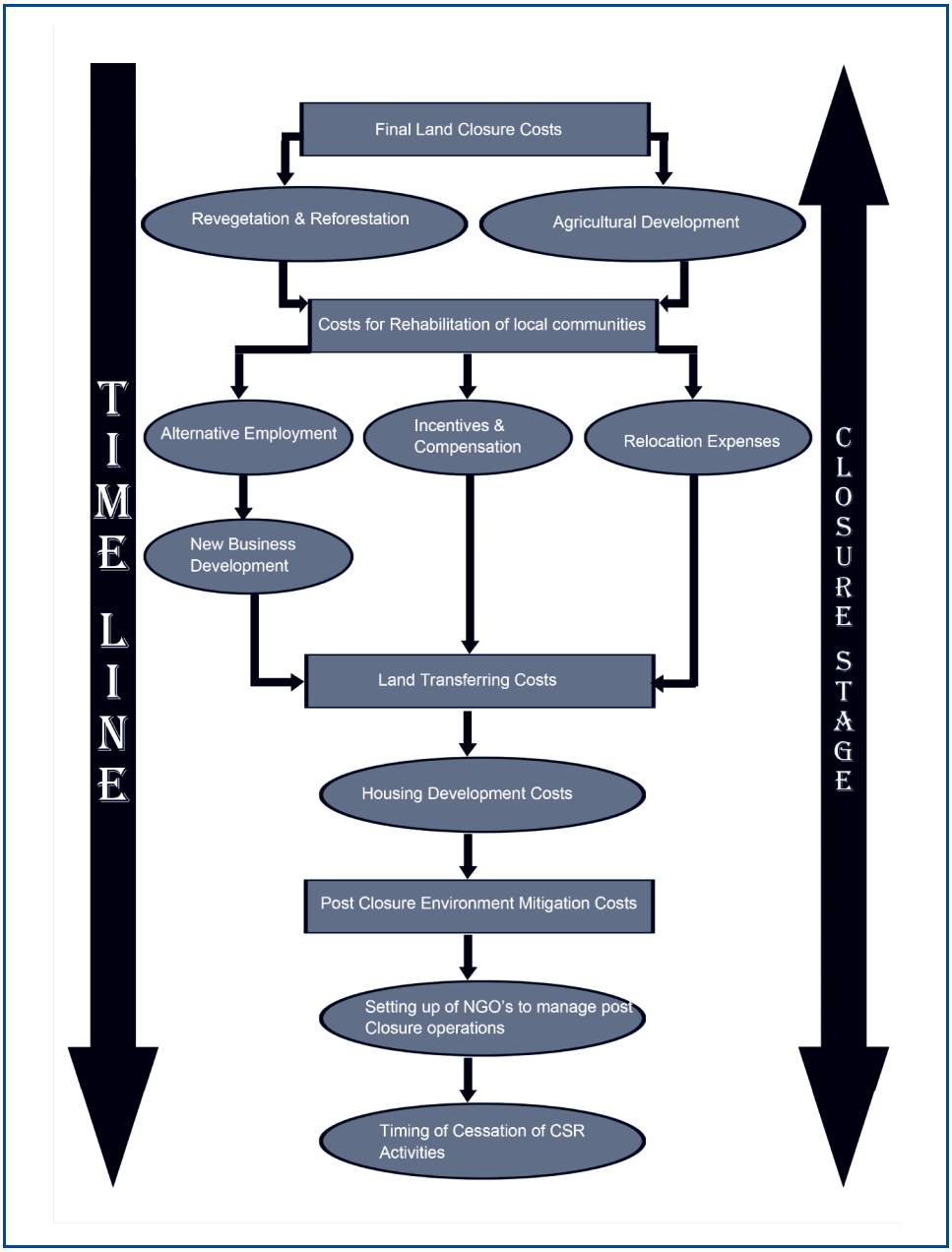
Figure 3 Flow chart showing the various CSR real options and the costs involved during the development and production stage



companies could also incorporate this model at the feasibility stage to go hand in hand with mine planning.

This study has been carried out after the careful analysis of the CSR policies of various companies around the world taking into account the mentality of their management towards CSR. Therefore, the model developed is close to reality in many ways despite needing to adapt to local conditions. Finally, a real options approach to valuing CSR as a corporate investment not only saves time and money for companies but also makes life a lot simpler when dealing with stakeholders, governments and local communities.

Figure 4 Flow chart showing the various CSR real options and the costs involved during the closure stage



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Corresponding author

Michael Hitch can be contacted at: mhitch@mining.ubc.ca