

## **With New Tools, Changes in Engineering and Construction Management are Needed**

**Martha Garcia-Saenz, MSCE**  
Purdue University North Central, Westville, IN, USA  
[mgarcia@pnc.edu](mailto:mgarcia@pnc.edu)

### **Abstract:**

Nowadays with globalization and competitiveness, proactive managers are needed. Proactive managers take advantage of the uncertainties and flexibility to capture value for their projects. They change events rather than reacting to them, and they make things happen. This paper shows why changes in management have to be done. Managers can not continue protecting themselves from uncertainties in a reactive way, applying big discounts rates when calculating Net Present Value (NPV) to make decisions about the future of their projects, killing the projects even before they even born. With new tools like Real Options Approach (ROA), and looking at competitiveness, the approximation when valuing projects has to be done in an opposed manner: with proactive managers that constantly look for options that increase project value.

### **Keywords**

Construction Management, Proactive Management, Real Options.

### **1. Introduction**

The world of management moves in waves where every wave is a new tool for decision-making. Change from one wave to another can be difficult because people get accustomed to using a tool and might not be aware to the new ones. They don't see the need for changes because the tool they are using has worked or because they do not know a new tool or tools exist. For a very long time managers used their intuition for decision-making and when businesses were not good, they always said "some business are for loosing money and other for wining". The wining-loose game gave managers a passive character to accept results. With the Net Present Value (NPV) and Discount Cash Flow (DCF) as tools, managers kill many projects and only decide to go forward when intuition made them think that a specific project had some potential to exploit.

Some builders like to have passive managers who tend to accept situations without attempting to change or fight. These passive managers have only one objective in mind, build the project according with the provided schedule and budget. They are considered good managers when they finish the projects on time and within a budget. This approximation is no longer true, because an ingredient is missing, added value.

Having new tools, there is a need for change; the problem is that engineers and managers do not use Real Options Approach (ROA) because this approach remains largely unknown, or because they find difficulties in identifying options, or because they do not believe that a theory from the stock market can be applied for decision-making in real projects. Options can be found during the planning and design phase and can be taken into account when assessing the different alternatives. Other options can be found during the development of the project like flexibility to upgrade the project, to accelerate it or slow it down, to scale it up or down. All these options can add value to projects and to find options in projects,

proactive managers are needed. Unfortunately, managers are many times product of the knowledge they have related with the different tools available for decision making and as they are familiar with a specific tool, they do not like to change for another. It carries different styles of management as this paper explains.

## 2. Tools for Passive Managers

Net Present Value (NPV) as a tool to decide the future of a project has been common for more than a half century. The NPV is defined as the present value of the future cash returns, discounted at the appropriate interest rate given by the market or the company, minus the value of the investment. The basic logic of the discounted cash flow valuation methodologies is built upon the simple relationship between present value and future value as it is shown in the following equation (1):

$$\text{Net Present Value} = \frac{\text{Future Value}}{1 + \text{Interest Rate}} - \text{Investment} \quad (1)$$

Managers and owners of projects protected themselves from uncertainties **in a reactive way**, applying big discounts rates when calculating Net Present Value (NPV) to make decisions about the future of their projects. When the valuation involves more than a year, the Discount Cash Flow (DCF) has been the tool used, as it is expressed in the following equation (2):

$$\text{Net Present Value} = \sum_{T=0}^n \frac{E(CF)_T}{(1+r)^T} - I \quad (2)$$

Where  $E(CF)_T$  are the expected future cash flows, discounted at the market risk rate  $r$ .  $T$  is the number of years and  $I$  is the initial investment or cost of the project. This method is simple, but has to be carefully used. Risky cash flows have to be discounted at a risk-rate, and inflation must be handled consistently.

The discount rate used at the formula is expected to protect the owner against the project risk, the market risk associated with sales and revenues and the changes in the value of the money through the time. That is why when the risk is high, the discount rate is high.

The rule to measure the future of a project is simple: “An investment is worth if it has a positive NPV, and if the investment has a negative NPV, it should be rejected.” (Ross et al., 1996). According with today tools, these rules have many times killed projects before they are even born. This approach, in particular, makes implicit assumptions and expects management’s commitment to a certain operating strategy to get the calculated results. In other words, a passive manager is expected.

### 2.1 Passive Management Style

Independently if managers are risk takers or risk averse, their wish is to get at the end the result calculated by the NPV. To get it, they follow step by step the schedule provided to build the project. In other words, a passive manager is required to reproduce every thing that was fixed in advance because that’s the only way they think, they will get a profit. Any variation is not a voice of alarm; passive people think every variation is covered when the calculations are made. Any variation is normal and it is included in the project cost when the discount rate was assessed. Project Managers will react only when the situation gets to an intolerable moment where almost or not profit will be get. This type of managers belongs to the old way of thinking where projects some time have a profit and sometimes do not. This situation was typical some years ago where no competition was present, owners decided how many units (for example houses) to build, and they were aware of positive and negative results. They only reacted when situations where

extremely difficult. Bad results were attributed to bad luck or miscalculations, since there was a perception that in business sometime one win and sometimes one loses.

Passive people tend to accept situations with resignation without any attempt to change or fight to get things to normal. Passive owners are not aware of project managers' performance; it is irrelevant. External forces cannot be controlled, and project managers find protection in those external forces. They take a "there is nothing I could do" attitude. Passive owners and passive managers are everywhere. Tired of passive managers, people developed other tools that allow them to react when expectations were different than the ones they anticipated.

### 3. Tools for Reactive Managers

One of the main concerns for some companies was the discounted rate that many times did not reflect the real cost of the money invested. Then other techniques were developed to improve the traditional NPV and DCF: the  $r_{WACC}$  or Weighted Average Cost of Capital rate. The new value to replace the rate calculated in formulas (1) and (2), is the one from the following expression (3):

$$r_{WACC} = \frac{S}{S+B}r_S + \frac{B}{S+B}r_B(1-T_C) \quad (3)$$

Where,  $r_B$  is the cost of the debt,  $r_S$  is the cost of the equity, and  $T_C$  is the corporate tax rate.

When  $r_{WACC}$  is used as a discount rate, it is supposed to pick up the tax advantage associated with corporate borrowing. To have some control over the evolution of the projects some other techniques were developed to appraise the investments like the internal rate of return (IRR), profitability index (PI), cost/Benefit ratio and many other index and ratios. With more controls in place, reactive managers are expected to fix the problem if something is going wrong.

#### 3.1 Reactive Management style

Reactive owners and managers react to situations or events rather than initiating new things. They do not make any effort to anticipate issues or plan for future eventual problems; they just do something to change the uncomfortable situation that acts as a stimulus. They respond to exterior demands and emergencies. Reactive managers are passive managers. They respond to external or third party actions tracking down how the competitor attacked the project, and they try to avoid similar situations so that they won't happen again. Of course a reactive reaction is necessary when an outside stimulus occurs and when a crisis appears. Reactive people are necessary, because many good things can happen when a crisis exists. They react and do something, even if it is wrong. A crisis usually brings visible reactions. There are things that cannot be anticipated or predicted in normal activities. To have reactive people in companies are good.

The difference between the reactive and passive management style is the awareness of performance problems: the passive manager do not do anything about it, and the reactive manager feels like having a heart attack and needs reactive strategies to be more effective when solving problems. Then, the problem is that projects can not be manage responding only to outside stimulus because companies or projects can not be eternally in an emergency room. More active managers are expected to get projects out of the emergencies, doing things to get more information before is too late. It is why more tools became available.

## **4. Tools for Active Managers**

The Cash Flows used to determine the NPV are a result of a forecast derived from many variables. A sensitivity analysis can be used to identify the key variables that make impact in the cash flow. The changes of these variables over time are crucial when analyzing the influences over the cash flow. Sensitive analysis helps active managers pay more attention to those variables that are more sensible to adverse changes. Sensitivity analysis allows changing one variable at a time to see the changes in the NPV.

Creating scenarios is another way to analyze the variability of a project through its life. Scenario analysis allows for the change of more than one variable at a time, including probabilities of each variable to see the changes in the NPV. When time past, managers have pictures of the possible outcomes. It allows them to do some corrective actions and adjustments before is to late and economic results become adverse to the owners.

With the arrival of computers, a new tool was developed and made a great advance in the science of business management, simulations. It allows managers to test various alternative strategies in a computer in an attempt to imitate the decision-making in a real world. This technique helps in decisions when many variables interact through time and encounter random events pre-specified in the model. A probability distribution is assigned to each variable and the standard deviation is established after the simulation is done. Monte Carlo simulation is one of the more common methods for doing this kind of exercise. Monte Carlo simulation analysis allows producing an estimate of project NPV values that takes into account the randomness of events that occur in the real world and of many variables that interact across time.

A Decision Tree Analysis (DTA) is an improvement in calculations when valuing flexibility. A manager could face a decision of choosing among alternative actions. The consequence of each alternative action depends on some certain future events which management can measure probabilistically on the basis of past information, or additional future information obtainable at some cost. This means, managers should choose the alternative that maximizes the value of the project. Decision tree analysis is a straightforward way to plan future decisions, but relies on subjective assessments of probabilities and discount rates that as it was analyzed carry their own risk. The DTA then, shares some of the NPV's disadvantages but also has the advantage to offer a structure for decision-making when after future events occur. With the mentioned tools, managers are expected to be more active; they have pictures from the different ways to solve problems.

### **4.1 Active Management Style**

Sensitivity analysis, simulations, scenarios and DTA are tools for active managers that are always doing things or making efforts to improve management. Active managers look for ways to solve problems as soon as they arrive. Active managers work hard to achieve the project goals and especially those related with economic results. Active managers identify performance issues before any complication becomes insoluble. Active managers identify schedule issues before a conflict exists. Active Managers always consider things done. Successful active management requires the ability to continually monitor the project in order to do things as soon they observe deviations from the selected scenarios or changes in sensible variables that could change the expected economic results of the project. That is all they can do. They do not have the flexibility to make changes later during the project life because the previous tools only provide pictures from different scenarios but do not allow them to quantify decisions that could be taken after information arrives. To make decisions of this kind new tools and another management style is necessary.

## 5. Tools for Proactive Managers

Real Options is a contingent of decisions, an opportunity to make a decision after seeing how events unfold. On the decision date, if the events have turned out well, proactive managers can make one decision, but if they have turned out poorly, they can take a different decision. Managers can use Real Options when it is important to wait for more information, when uncertainty is an ingredient for earning flexibility, and when project updates can introduce strategy corrections in the project.

Real Options Approach (ROA) may be intuitive for some managers, but after Scholes and Merton received a Nobel Prize in Economics, some scholars and consultant firms in the financial sector have found that many decisions can be analyzed using options as a framework. ROA is based in the theory used at the stock market to value futures and it was developed by Black, and Scholes at the beginning of the seventies (Black and Scholes 1973). Since then, it has been used extensively at the stock market. But it gained more acceptance after the Nobel Prize in December of 1997 when it got enough attention from the financial community. Options are unfamiliar for engineers and many of them see the real option approach as mysterious. That is why it is important to teach them and modify the corporate culture to incorporate options as a new way of thinking of design and manage strategic investments on projects actively.

Incorporating flexibility and strategic investments during the development of a project, radically changes the management of a project. Changes are necessary to move into a more proactive management style. In advance, the project manager should look for alternatives and options involved in the project, and he or she should know what actions to take when information arrives.

An Option ( $C$ ) is an opportunity to do something at some specific price ( $E$ ), on or before a specific date ( $T$ ). If the option is exercised before maturity, it is called an *American option*; if it is exercised at maturity, an *European option*. An option gives the owner of the option the right, but not the obligation to do something (for example to buy or to build). The owner of the option uses the option only if it is a smart thing to do; otherwise, the option can be thrown away. In an option notation  $C$  is the value of the option.

$$C = \begin{cases} 0 & \text{if } S_T \leq E \\ S_T - E & \text{if } S_T > E \end{cases} \quad (4)$$

Where  $E$  is the exercise price: It is the fixed price at which the holder (the owner) can buy or sell the underlying asset.  $T$  is the expiration date: It is the date the option expires. After this date, the option is dead.  $S$  is the value of the underlying assets.

Many Engineering projects, especially large engineering projects, need decision flexibility. Monitoring progress becomes very important, and decisions made add value to the project. At the time of the decision, if the evaluation shows that the decision adds value to the project, the decision is made but if not, managers may scale down, defer, or even abandon the project to respond to the unfavorable market situations. On the contrary, if the project shows good results, then managers may decide to scale up or to initiate a new one. These actions are known as real options. The value of the project will be affected by exercising the options embedded in the project.

The ROA has proven to be a powerful tool for decision-making but requires proactive managers that identify opportunities (options), plan and monitor them. When predetermined conditions exist, manager exercise the options. Thus, applications of the real options approach not only presents a more appropriate project evaluation than traditional DCF methods, but also results in optimal project decision strategies.

Real Options is relatively new and Game Theory has been thought for a long time in business schools to simulate competitor's dynamics. Game theory can be used to frame the option and the assumptions to analyze the business plan. ROA incorporated flexibility (to delay or to accelerate, to expand or to

contract, to build or not to build) into the calculations, but it cannot examine the impact of the competition and preemption to invest that Game Theory does.

In an efficient market, prices adjust rapidly and reflect all the information available. Real markets are not always perfectly competitive and investors can earn returns that exceed the cost of capital that some practitioners called economic rents.

An early investment only can produce temporary economic rents, because when investors find that somebody is getting them, as soon they have the information, they will invest too to get part of the economic rents, causing erosion on the economic rents of the first investor. Economic rents can have different sources, for example new product or new technology. When a patent protects the new product or the new technology, the owner of it creates a temporary barrier for other firms to entry as competitors. The barrier is temporary because patents have expiration or companies can develop similar improved products or similar technologies. Consequently, under perfect competition, economic rents are expected to decline.

In the absence of competition, the owner of a project could delay initiating a project. When a second competitor or second firm arrives, a duo-polio is born and of course, economic rents are divided between the competitors. In addition, when more competitors arrive, competitive advantages no longer exist; economic rents disappear and each company gets only the cost of capital. Companies can preempt anticipated competitive arrivals, making a preemptive entry to the market to get economic rents before competitor(s) eroding its economic rents. Competitiveness cannot be analyzed under the previous valuation methods but it can be clearer under the lenses of game theory. To identify options and make decisions later instead before the project starts, proactive managers are necessary.

### **5.1 Proactive Management Style**

The best tools for proactive managers are the ROA and the Game Theory. The ROA is known as a new way of thinking because managers instead of waiting for options or opportunities create options and capture value from them. The proactive managers not only monitor the project, they create models that are base on market realities. The ROA provides flexibility to defer, abandon, expand or contract an investment. For example, a manager may choose to defer an investment for some period of time until it has more information from the market.

To work with ROA and Game Theory, proactive managers are necessary. Proactive manager is the one who changes events rather than reacts to them and makes things happen. Proactive manager is the one that motivates him or her to become the very best. A proactive manager is the one who establishes objectives and thinks ahead, the one who puts goals into actions.

Proactive means acting in anticipation of future problems, needs, or changes. A proactive manager is very active; instead of waiting for the competitor to demonstrate that he or she is vulnerable, discover how the competitor will act and exploits his or her actions. Proactive manager is one who initiates actions, the one who learn while sitting, or move while on their feet. A proactive manager is the one that makes an impact on the world.

Proactive project management requires an anticipative approach that identifies opportunities (options) and puts in place measures to monitoring project variations. Continuous and proactive management is essential during the life of the project.

Proactive managers look uncertainties with different lenses; they see uncertainties as opportunities to incorporate flexibility into the project to make decisions later on, when information arrives. Proactive managers understand that the response to the uncontrollable events is a consequence of exercising an option and it is an opportunity to increase project value.

A difference between a proactive manager and an active manager is that the first one likes to initiate things and gather information and the second likes to initiate things whether or not there is information available.

Management of uncertainties is a major new topic for engineers that usually do not deal with theories from the stock market. Flexibility to take decisions later instead of before the project starts require that engineers understand efficiently financial options theory and become proactive managers. It means a need for a change from active to proactive management is needed.

## **6. A Need for a Change**

Debates about active versus passive management began in the early 1960's. In 1963, Harvard University Press released the Book "New Decision-Making Tools for Managers" (Bursk, 1963). It compiles seventeen articles on decision-making tools to give a "well-rounded picture" of the decision-making theories valid at that time. With exception of quality control, operation research and mathematical programming, all the proposed tools appeared in the five years prior to that publication. Some were related with scheduling techniques like PERT, but what is important to mention here was the fact that a change from passive to active management was needed. Some of the papers in the mentioned publication, for example, invited the accountants to wear another hat and additionally to produce cold or dead results in their reports, bring life, learn the business language and report return on investment index, ratios and statistics to help managers in decision-making.

### **6.1 What happen with the new tools today?**

Tom Copeland and Vladimir Antikarov in their book Real Options a practitioner's guide (Copeland and Antikarov, 2001) predicted: "in ten years, Real Options will replace the NPV as the central paradigm for investments decisions."

A survey conducted to Fortune 1000 companies in 2002 by a professor from Colorado State University (Ryan 2003) reveal very interesting results that make us think that Copeland and Antikarov prediction will need many more years. There were a thousand companies in the study and 205 answered the survey that the authors considered normal. The study contains the results for thirteen supplementary tools and shows that the preferred tool was NPV with 96%, followed by sensitivity analysis (85.1%) and scenario analysis (66.8%). The ROA was at the bottom with 11.4%. Game theory was not considered in the study. All of these results show that ROA, considered the most sophisticated tool for their practitioners, would take more than two decades to be integrated as a tool for decision making.

The pharmaceutical, oil and mine industries were the first-ones in adopting the new theories. Engineers and managers from the construction industry do not use ROA because it remains largely unknown, because they find difficulties in identifying options, or because they do not believe that a theory from the stock market can be applied for decision taking. That is what happened today and happened in the 1960's too when new tools were available. We are repeating the same story.

The construction industry is not a rapidly changing sector that easily adopts innovations. Manseau (1998) argues that the sector appears to change slowly and with great difficulty. How can its slowness and inertia be explained?. Changing requires learning, and learning carries changes. Kalulanga et al (2001) are skeptical of the learning capacities in the construction industry. They argue that there is a long way to go before organizational learning is fully implemented in this industry.

## 7. Conclusions

Passive management strategies have many limitations. Every thing has to be set up and resolve in advance. Flexibility to make decisions later practically does not exist and when opportunities were found, they were applied in an intuitive way, not because a quantification of economic results was possible.

New managers with a new way of thinking are needed. According with the theories behind the different styles of managers, new proactive managers are needed. Passive, reactive and active managers are also important, but they can more readily be found on companies. A change to have more proactive managers is required, but passive, reactive and actives are required too. There are jobs and situations that call for both active and passive managers. There are jobs for every body and different styles are required in different fields. An active person is important for sales and a passive person is necessary in many systematic processes and combination of them as well.

Proactive project managers that recognize that they can add value to the project are needed. Their actions can make a big difference. The greater the uncertainty and flexibility, the greater the value managers can add to the project through options.

If the construction industry wants to improve its performance and competitiveness, then there is a need for a cultural and behavioral change in managers for whom learning is the norm (Love et al., 2000). We need more active managers who want to be proactive managers that learn about new tools to help them to see more opportunities with new lenses and learn how much value they added to their projects when making decisions while information arrives.

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## **Bibliographic Information**

Ing. Martha GARCIA-SAENZ. Professor Garcia-Saenz is an Assistant Professor of Building Construction Management at Purdue University North Central Campus.