Applying Visual Frameworks to Optimize Innovation Strategy

David Ross
Georgetown University
McDonough School of Business
Adjunct Professor
Washington, D.C.
USA
dr332@mail.msb.edu

Abstract— ***All companies have goals or targets as well as projections for various metrics. External and internal environmental factors, more often than not, push a company off course. This tendency, when a company strays from the optimal projected path, is called the Path/Goal problem. In the course of this paper, a framework will be constructed for managers to visualize their current position and path, with regard to their goals, competitors and environment. The framework will also provide insight for making decisions and crafting strategy. Furthermore, this paper will discuss and quantify when a course change (pivot) should be considered by evaluating the nature of the distribution of possible outcomes at any given point in time. The framework will then be used to contrast incumbent firms versus new entrants to a market as well as continuous versus discontinuous technological innovation strategies. More importantly, the framework will demonstrate how these situations relate to a company's path toward their end goal. The final discussion will focus on strategies as well as their implications and risks with the goal of helping managers not only understand their situational environment, but also the implications of their decisions.***

Keywords- Agility; Bang the Corner; Continuous Innovation; Corporate Inertia; Course Change Coefficient; Course Correction; Discontinuous Innovation; Disruptive Innovation; Environmental Conditions; Environmental Volatility; Environmental Factors; Evaluation Cycle Time; Framework; Goal; Goal Boundary Plot; Incremental Innovation; Incumbent Firm; Innovation; Innovation Strategy; Middle of the Road; New Entrants; Optimization; Outcome Boundaries; Outcome Distribution; Strategy; Technological Innovation; True North Plot; Visual Framework; Zeta;

I. INTRODUCTION

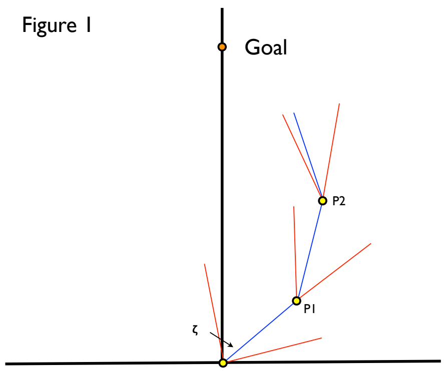
All companies or Strategic Business Units (SBU) have goals of one type or another. These can be strategic or tactical in nature. If the firm has been planning properly, then they have a projected or estimated plan or path to reach their goals. The problem is, reality is often very different than the plan. When the inevitable happens and the firm finds itself off track, most managers will try to correct the path (pivot). While some do this successfully, others do not. This is called the path/goal problem and, this paper will build a framework that highlights the dynamics of this situation and provide an outline to visualize the problem, thus enabling managers to make better decisions.

II. THE PATH/GOAL MODEL

Let us start by looking at a typical situation involving some type of target, such as revenue, installed base or production levels. While all are common goals established by firms across industries, any metric will serve for the purposes of the framework. Figure 1, the True North Plot, is a graphical representation of a typical situation in which one knows where the starting point and the goal are. As the figure shows, the shortest course to take is a straight line connecting these two points.

However, the course represented by the straight line is only a best or initial estimate in an ideal climate. In fact, this course may not be navigable due to the presence of many unforeseen factors as well as errors in the projections. As a result, the actual course will be different than the ideal course due to the unknown variables surrounding the initial estimate.

Figure 1



Because the straight line is merely based on the assumption of a stable set of external and internal conditions, which all vary across industries and firms [1], the actual course will differ from the ideal straight line. In Figure 1, the actual path taken is represented by the blue line and is based on the progress toward the goal as evaluated at the points P1 and

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P2. While this path function is continuous in nature, it is represented as discrete for simplicity. Thomke [2] contends that taking a straight-line course of action does not work well in external environments that consist of continuously shifting dynamics. This assertion further complicates the decision making process, because it calls into question the reliability of the assumptions.

Environmental factors considered external to the firm include, but are not limited to, aspects of the competitive, political, technological, ecological and legal landscapes. Whereas, internal environmental factors include, but are not limited to, patterns of communication, knowledge flows, process and work routines existing within the firm [1]. When looking forward in time, the situation is best represented as a distribution of potential outcomes rather than a discrete value. This distribution is based on the inevitable uncertainties that accompany environmental dynamics and is a representation of several different courses, depending on the probability of the outcomes of external and internal factors. The situation that results is in itself a challenge for decision makers. This challenge is with the distribution's unknown shape and characteristics. However, establishing a reasonable confidence interval can serve as a boundary of where the expected outcome rests and is hypothesized to facilitate the decision making process and address this challenge accordingly.

The confidence interval in this context will be defined as Outcome Boundaries (OB), which are graphically displayed as the two red lines that share a common endpoint at each point of evaluation of the function in Figure 1. These OBs define all potential outcomes within the confidence intervals. For example, if a confidence interval of two standard deviations is used, then the OBs will define the actual outcome with a confidence of 95%. In figure 1, OBs for three points in time have been notated. Additionally, OBs do not tell us if one path, or course of action, is statistically favored over an alternative path within the boundaries of the outcomes distribution. What they do tell us is that the actual path will most likely reside between the OBs within a known confidence interval.

Another way of quantifying this relationship is to consider the angle defined by the two OBs. This angle, referred to as ζ (Zeta), is illustrated as such in Figure 1. ζ is a measure of uncertainty and risk at a given point in time as represented by the distribution of outcomes. In other words, the larger the ζ, the bigger the uncertainty and range of possible outcomes. Because the distribution of outcomes may not be symmetrical around any given position, ζ likely will not be centered on the best guess or projection.

Establishing OBs and ζ provides a useful tool for visualizing and quantifying the degree of knowledge and uncertainty at a given point in time. Furthermore, as time passes and progression along a given path occurs, the progression of success relative to the goal can be evaluated. Graphically, the actual path, as displayed in Figure 1, is a blue line whose length is proportional to the time elapse. As many decision makers know, the actual outcome of a given situation tends to be something other than the outcome originally projected. The difference in the actual outcome from the anticipated outcome is a reflection of the uncertainty that occurred during the time period.

The need for path changes can occur because of an internal or external force. An internal change can either be intentional or unintentional, and is related to something internal to the firm. Each time a path change occurs, a new set of OBs and a new ζ are defined and can be used accordingly during the decision making process. Over time, with each path change, the decision makers typically become more aware and knowledgeable about the environmental dynamics at play as well as the degree of influence these dynamics have on the situation and the path.

Accompanying every course of action is the passage of time and, with each passage of time, a new measurement of success relative to the goal is established. The results of these measures are highly reflective of the environmental dynamics at play during each specific time frame. In addition, these results influence the next course of action to take in reaching the end goal. As time passes and the results of successive measurements in response to changing environmental dynamics are evaluated, a point is reached whereby a decision, or set of decisions, must be made to keep the organization on track toward its goals. The decisions made at these points in time influence the direction of the next course of action in reaching the end goal.

Following each decision, a new set of OBs and a new ζ are defined. These new values are reflective of the changing environmental dynamics, course and distribution of outcomes during the passage of time up to the decision making point. Furthermore, these intermediate results strengthen the decision maker's awareness and understanding of the environment, as well as the uncertainties and risks that accompany the environmental conditions.

Following a course of action based on heightened awareness and understanding of the environment typically affords two effects. First, generally, there is a decrease in risk due to the attainment of more extensive knowledge, which causes a reduction in ζ. Second, ζ will tend to rotate toward the goal, unless something else has changed in the environment. This process, reduction and rotation of ζ, continues until the end goal is reached or until one gives up and terminates the project. If this process is observed until the end goal is achieved, as stated earlier, the actual path will be longer than the original projection. This longer path corresponds to the passage of more time than the hypothesized ideal path.

Figure 1 illustrates this conceptual process, where P1 is a point in time whereby a decision is made to change course. The decisions made at P1 should factor in this new information and knowledge about the environment, which will create the new pair of OBs and a new ζ. Each blue line illustrated in Figure 1 represents the implementation of a different course of action and the time that passes during the course of action. Surrounding each blue line is a pair of red lines, which are illustrative of the new OBs at that point in time. This representation allows managers to graphically see the relationships between their decisions and their goal.

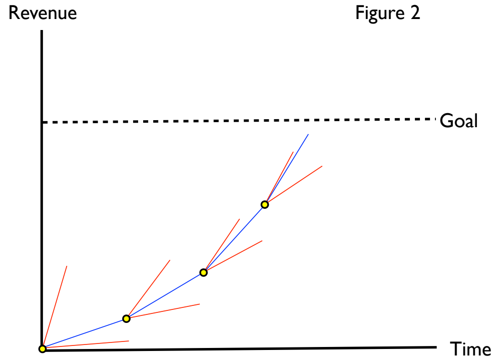
III. ZETA

Although the exact shape and characteristics of the outcome distribution are not known, a multitude of exploratory questions can be asked of the situation in order to gain greater insight into the shape of the probable outcome distribution. The first area of consideration shall be a focus on whether or not the distribution is symmetrical or asymmetrical around the mean. Outcome distributions that are symmetrical in shape suggest that the outcomes on each side of the average would be equally likely to occur. However, and arguably so, this is not realistic for most organizations and metrics given the dynamic environmental conditions. In many realistic situations, decision makers have observed that obtaining outcomes closer to the OB adjacent to the goal, rather than the one furthest way, is much more difficult to achieve. Furthermore, many variables that effects ζ, such as cost and quality, are non-linear and non-symmetrical in shape across the possible outcomes within the distribution. Consequently, decision makers are pressured to identify how far skewed the outcome distribution is away from the original goal. The potential implications resulting from this as well as strategies for reducing the potential adverse effect of the outcome distribution will be discussed later in future papers.

In order to identify the rough characteristics of the outcome distribution, influencing factors affecting ζ should be considered and analyzed accordingly. When analyzing the individual factors that influence ζ and their potential impact on reaching the end goal, decision makers must examine which factors can result in not only adverse outcomes, but also favorable outcomes with relatively low costs and relatively higher efficiencies. In other words, some influencing factors will have a minor or varying effect on ζ and the outcome, whereas others will have a significantly large impact. Factors that influence ζ at a relatively small degree can simply be ignored, whereas factors of greater influence capacity must be taken into consideration when making decisions. The key, however, in optimizing factors with strong influence capability, is to identify precisely what those factors are and leverage them appropriately.

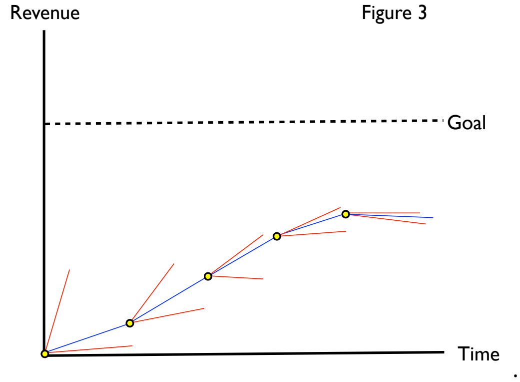
Changing one of the factors that contributes to ζ can have two effects. The first is a reduction in ζ, which corresponds to a reduction in the risk or a compression of the distribution. This can ultimately lead to a path that brings an organization closer to reaching the end goal, Figure 2,

Figure 2



or a path that moves in the opposite direction of the goal. For example, a decision maker can pursue a strategy that minimizes the total risk of the path, however, in doing so, the potential for high rewarding outcomes is likely diminished, thereby making the end goal achievement very difficult as shown in Figure 3.

Figure 3



The second effect is a rotation of ζ in either an advantageous or disadvantageous direction with respect to the goal. This rotation represents a changing of the distribution in some fundamental way. Both of these effects are graphically represented in the True North Plot (Figure 1) and the Goal Boundary Plots (Figures 2 and 3).

As a result of the necessity to shift in response to changing environmental dynamics, risk assessment and estimation are crucial in minimizing risk and uncertainty while maximizing the potential for a successful outcome.

Rigorously determining ζ is a relatively challenging process. However, calculating a rough estimation of ζ by analyzing, interpreting and synthesizing the characteristics of an outcome distribution is critical.

IV. COMPARING AGILITY

Course changes need to occur for a number of reasons, notably because of the dynamic shifts within the external and internal environment, or to improve the rate of travel toward the goal. Thus, the ability of a firm to effectively respond to dynamic shifts by changing paths lends credibility toward the conception that organizational agility is paramount in creating competitive advantages, particularly ones that leverage technological innovation. There is considerable evidence, produced through research, asserting that a linkage exists between the agility and the competitiveness of an organization [2].

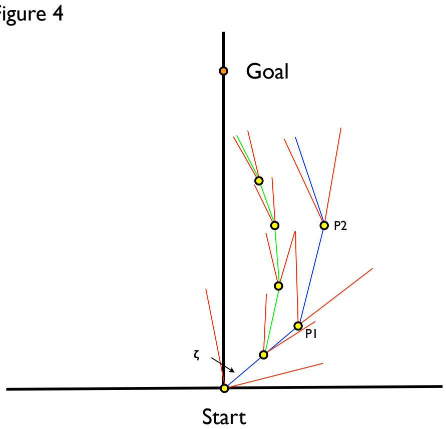
For incumbent enterprises, path changes can result in internal destruction and a pronounced disruption to the equilibrium entrenched within the internal organizational environment. Consequently, incumbent firms are often reluctant to change paths in response to environmental changes because of the potential for internal disruption that stems from rigidity and deeply rooted operating customs [1].

Let us now comparatively review how organizational agility affects the rate of progress toward goal attainment. This comparison will encompass two different companies operating in the same industry and market while sharing a common goal and starting point. However, these two companies are different in that one is relatively small and agile while the other company is relatively large with less agility. In other words, each set of OBs and their corresponding ζ are independent.

For illustrative and comparative purposes of these two companies, Figure 4 displays the paths of the small and agile company as well as the path of the large and less agile company. In this comparative review, the small and more agile company displayed in Figure 4 shall be named Company A and is represented as such by the green line. The large and less agile company displayed in Figure 4 shall be considered Company B and is represented by the blue line. The green and blue lines that represent the course of action during the passage of time are both surrounded by their respective OBs at each point of evaluation of the path function.

As time progresses, both companies reach decision making points and each company makes their own respective decisions based on the internal and external environmental dynamics and the measures of success relative to the end goal. At the decision point, the companies can decide to stay on the same path, pursue an alternative path or quit altogether. If the option of quitting is not taken, then the process of time passage, measuring results, establishing new OBs and a new ζ, and making decisions continues to occur repeatedly for each company until the end goal is reached.

Figure 4



As shown in Figure 4, Company A initiates its first decision and executes the first change of path, whereas Company B decides to continue on the same path for a longer period of time before making a path change. As illustrated in Figure 4, the effect of agility on organizational efficiencies is compounded as time progresses. Although Company B holds relatively the same awareness and understanding of the environmental dynamics at play during the beginning, Company B decides to remain on the original path much longer. Thus, Figure 4 is intended to demonstrate that smaller companies with higher agility levels (Company A), relative to larger companies (Company B), are able to respond with greater speed and efficiency. In the example, the environmental factors have held constant, but this agility effect produces even more benefits when these factors are allowed to vary, which is representative of the real world.

In the case of Company A and Company B, Company A comes closer to reaching the goal much faster and at a lesser cost than Company B as a result of staying on track and reducing their respective ζ faster than that of Company B. Reaching a goal relatively quickly while decreasing uncertainties, risk and related costs simultaneously are all derivatives of efficient decision making, which stems from organizational agility.

So far, in this example, the nature of the overall environment has not been discussed for either company's products and processes. At a more granular level, organizational agility can be seen in how products and services in general evolve in response to environmental change. In addition, organizational agility is seen in the reengineering of processes, procedures and systems that are intended to support a company's products and services operations. Assumptions of clear and stabilized product concepts and related specifications do not tend to work effectively in environments characterized as turbulent [2]. For example, according to Thomke [2], organizational agility inherent in product design represents two types of agility, one of which includes process range whereas the other is process mobility. Process range, according to Thomke [2], is the typical result of having flexible technology in place to support easy adaptation into other products in order to reduce overall product design times.

Process time reduction, on the other hand, often translates to overall cost reductions [2]. Practically speaking, when the time and cost of changing a product's design is high and low, respectively, the design flexibility is often defined as low and high, respectively. Time and cost reductions stemming from flexibility are advantageous and tend to bring exceptional value to a company in the form of risk minimization and efficiency maximization.

As depicted in Figure 4, Company A could have a relatively high degree of design flexibility, which allows for fewer time and resource requirements and related constraints. These constraints can be burdensome to a company's ability to reach the market quickly enough to reap healthy returns on investment and to create and sustain a learning environment that occurs in real time. A correlation exists with a firm's level of flexibility and the firm's performance. As seen with small and more agile firms, such as Company A, the ability to quickly produce innovative, cost-effective and market satisfying products and services to consumers is positively correlated with the level of agility the company has as well as the relatively smaller ζ. Thus, given the agility factor, start-ups and other companies in their early stages of growth are better positioned than larger, less agile companies to bring technology innovation to the market faster and at a lower cost. While they might start out with a larger ζ than incumbents or larger companies, they have the ability to reduce ζ much more quickly. Another way of looking at this is that agile companies have the ability to "learn" faster.

V. Comparison of Incumbents and New Entrants to a Market

Larger and less agile companies, referred to as incumbent enterprises [3], often experience significant challenges with technology innovation and often face declines in performance [3]. Declining performance in the wake of technology innovation for incumbent enterprises is purportedly due to two leading factors, which include differing economic incentives and the forces of inertia [3]. For incumbent enterprises, the economic incentives for embracing and leveraging technology innovation are lower and less attractive than for entrant enterprises. In comparison, for entrant enterprises, these economic incentives are much higher because of their higher agility capabilities [3]. Inertia, which is known as embeddedness, is the second factor proposed by Hill and Rothaermel [3] as attributing to performance declines among incumbent enterprises in the wake of technology innovation.

Well established firms, through their experience over time, have a naturally reduced ζ. They are not very aggressive at making path changes; when they do make changes, they are small incremental changes. This causes a small rotation or reduction in ζ, but not much of an actual change in direction.

New entrants, on the other hand, have a much larger ζ. Generally, new entrants are trying to maximize the likelihood of an outcome that would be to the extreme of the distribution of an incumbent enterprise. Maximizing the likelihood of an outcome by entrant firms is achieved through initiating disruptive changes to the underlining variables. Entrant firms also make path changes more rapidly because of the reduced cost of change and smaller company inertia. Therefore, the combination of quicker path changes and the shifting of the market by disruptive innovation are very effective for new entrants while, for the incumbent firm, these external forces can rotate their ζ away from their goal.

VI. Types of Innovation and their Relationship to zeta

The types of technological innovation and their use within the incumbent and entrant firms will now be discussed. Macher and Richman [4] state that successful incumbent performance in the wake of technology innovations is the result of discontinuous innovation, which is generalized in literature to encompass two types of change, one being radical and the other being architectural. However, Macher and Richman [4] argue that discontinuous innovation “unsurprisingly contrasts with ‘incremental innovation’ or ‘sustaining innovation’, which typically introduces relatively minor changes to existing products, exploits the potential of established designs, and reinforces the dominance and capabilities of incumbent firms” [4]. Paralleled with Hill and Rothaermel’s [3] definition of radical innovation, Macher and Richman [4] state, “radical innovation requires knowledge that is usually based on engineering and scientific principles that are unfamiliar to incumbent firm” [4]. Whereas, architectural innovation leaves the core components of a system untouched, radical innovation usually connects individual pieces of technology together as a way of reengineering a system or a process that is supported by a set of core components [4].

In contrast to the common theme of declining performance among incumbent enterprises that face technology innovation are the entrant firms, who do not face the same set of challenges with technology innovation. Findings from research conducted by Macher and Richman [4], suggest that entrant enterprises achieve victory in most of the technology battles even though the incumbent enterprises have a significantly larger pool of resources, experience, market presence, market influence, and stability. While these characteristics have numerous advantages for incumbent firms, they can also work to the disadvantage for incumbent firms with respect to innovation in technology. Accordingly, entrant firms are arguably better suited than incumbent enterprises to develop and commercialize technology innovations because of their smaller size, minimal historical events that create precedents, fewer regulatory and business requirements, and fewer commitments that exist in incumbent firms [4]. Technology innovation often places intense competition between incumbent enterprises and entrant enterprises [4]. However, regardless of the competition stimulated by technology innovation, there are a number of factors, as described in the preceding sections of this paper, aimed at reducing the anticipated performance decline of incumbent enterprises, thereby reducing their risk [3]. As mentioned earlier, the key to building and sustaining organizational agility to support healthy internal change and development begins with evaluating the dynamics of the external and internal environments as well as the interplay between the two sets of dynamics. Proactively scanning the environments for changes in dynamics positions companies to consider potential downstream effects that may occur. These potential downstream effects may occur as a result of a decision as well as for the purposes of developing contingency plans necessary for addressing issues upon decision implementation.

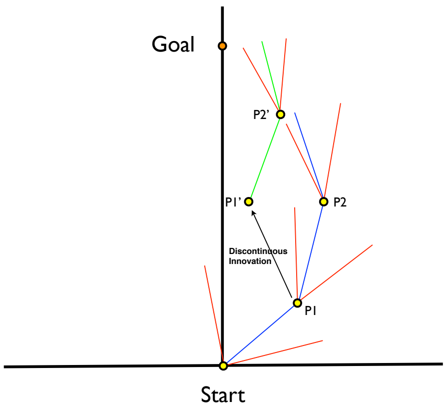
Assessing the environment starts with gaining awareness of what dynamics exist in the environment, the degree to which they can shift, and the potential impact they can have on the organization.

There is increased attention placed on how these two types of technological innovation, incremental and discontinuous, impact ζ. As time progresses, ζ will decrease and rotate toward the goal in the presence of incremental or sustaining innovation. However, as a company or product matures, the incremental improvements will continue to become smaller over time. As the incremental improvements become continuously smaller, as shown in Figure 3, ζ will continue to decline accordingly. Often, companies that employ an incremental innovation strategy never reach their end goal and, instead, reach a barrier in which further improvements in technology become increasingly difficult to apply. Furthermore, an incremental innovation strategy can also result in a dead end or limit a company’s ability of introducing and embracing technological innovation. Conceptually, incremental technological innovation runs parallel to the colloquial expression of “low hanging fruit” in that relatively simplistic innovation strategies may produce significant improvements in the beginning. However, the magnitude of the improvements becomes continuously smaller and harder to obtain over the passage of time. As the magnitude of technological improvements becomes increasingly smaller over time, a company's ability to compete and survive through the use of technology innovation becomes severely impaired.

The use of a discontinuous innovation strategy, on the other hand, generally produces different results for organizations. Discontinuous innovation entails a sudden, or radical, change in the rules or methods and modes of operation within a company. Radical change within an organization can bring drastic effects on variables including ζ and the time scale as well as environmental dynamics.

The effects of discontinuous and continuous innovation are supported by the illustration contained in Figure 5, whereby the blue line symbolizes a company applying a continuous technology innovation strategy and the green line symbolizes a company applying a discontinuous technology innovation strategy. For the company applying continuous innovation, ζ becomes increasingly smaller over the passage of time between P1 and P2 continuing on a rotational path towards the end goal. Figure 5 illustrates the learning process that a company experiences when a continuous technology innovation approach is applied. As time progresses, during continuous innovation, the company learns how to operate and produce more effectively and efficiently. The shrinking and continuous rotation of ζ are evidence of this phenomenon.

Figure 5
Continuous vs Discontinuous Innovation



In contrast to the blue line, the green line represents a discontinuous approach to technological innovation. With discontinuous innovation, the company begins at the same point as a company taking a continuous innovation approach. However, companies using a discontinuous approach are able to jump the curve and end at P1' instead of P1. Although the company represented by the green line takes a continuous approach to innovation following this movement off of the original path, the discontinuous approach places the green line company far ahead of the blue line company. In short, a company that follows a continuous path of technological innovation generally operates within their OBs, whereas a company that follows a discontinuous path implements a course change thereby jumping onto a new path.

As discussed in preceding sections of this paper, incumbent firms tend to focus on incremental innovation, whereas new entrants tend to embrace more disruptive and discontinuous approaches to technological innovation.

VII. Course Corrections

Based on this framework, the optimal time for a course correction remains a critical question. However, before this question can be addressed, the cost associated with a course correction must be calculated or, at least, reasonably estimated. In actuality, there are many small costs that must be considered in aggregate for a course correction. For example, retooling or changing the configuration in a production facility represents a large change and, probably, a relatively large aggregate cost will be associated with that change. Other changes like product positioning, marketing or new product creation will have very different costs. If the expected benefit yielded from taking a particular course change is greater than the costs then the change should be pursued and will be discussed in more depth later in this section. This relationship between cost and benefit will define the optimal time for evaluation of a course correction.

For example, an incumbent enterprise might have a larger cost due to inertia associated with a course change when compared to a smaller and more agile firm. As a result, incumbent firms, faced with the effects of inertia stemming from a lack of organizational agility, pursue avenues to minimize course corrections as much as possible. However, pursuing these paths, at the expense of potentially value added benefits gained by the organization making a course correction, might, in fact, contribute toward performance decline.

In order to understand the costs in connection with course corrections, the factors that contribute toward these costs must be determined. These costs will often depend upon a variety of factors including, but not limited to, industry factors, a company's business model, supporting financing and capital structure, and market conditions. For example, a major reengineering of a product, process or service may carry a cost that is relatively high. Conversely, the course correction could consist of a change in the marketing mix with no incremental cost. In some situations, one course might eliminate or restrict future options. In this case, the opportunity cost of these options must also be considered.

Mathematically, the Course Change Coefficient (CCC) is quantitatively defined as the ratio of change in the expected outcomes during the optimal evaluation cycle time (ΔECT) to the total cost of making the change. The cost of making the change is referred to as the Total Cost of Correction, or TCC. The formula for relating these two values is below in Formula 1.

Formula 1: CCC = ΔECT / TCC

$$CCC = \Delta ECT / TCC$$

If the CCC calculation yields a positive result, then the course change is advantageous to the company. In contrast, if the calculation yields a negative result, then the course change is to the disadvantage of the company. As previously discussed, there are often a number of course correction choices that have smaller costs. While some may assume that pursuing the course of action with the smallest cost is the most advantageous outcome, this is not always correct. The reality is that the outcome that maximizes CCC, despite cost, will have the highest projected return and should be selected.

While TCC is challenging to estimate and calculate accordingly, ΔECT is a more difficult value to estimate and calculate. To illustrate this difficulty in calculating the ΔECT, the first step in the calculation process is to define a time period for evaluation of the change in outcome. Too large of a time value for the calculation of ΔECT will mean a change is always considered as too small and will lead to rejection.

Some executives might think of using company's break-even criteria for evaluating projects as the correct value for ΔECT. However, this will almost always be too conservative. While the discussion of how to pick the optimal ΔT will be left for another paper, the process of picking a reasonable interval, given a company's history, industry and other factors, is not difficult.

For some time interval, ΔT, the ΔECT can be calculated by first evaluating the projected value of the course function before and after the change over ΔT and then finding the difference. This is represented graphically in Figure 6.

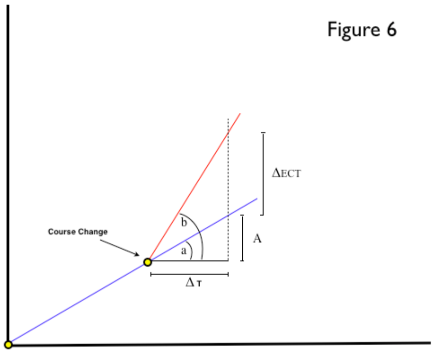


Figure 6

As can be seen from Figure 6, the effect of the change with a cost of TCC is represented by angle b. Therefore, firms are really trying to find the maximum of Δb/TCC. In other words, firms are looking for the largest incremental change in b for the lowest cost (TCC). ΔT is related to ΔECT by:

Formula 2: $TAN(a+b) = (A + \Delta ETC)/ \Delta T$

Formula 2: $\Delta T = (A + \Delta ECT)/ (TAN(a+b))$

Formula 3: $\Delta T = (A+ \Delta ECT)(1-TAN(a)TAN(b)) / (TAN(a) + TAN(b))$

VIII. Shifting Enviromental Conditions

A common mistake that occurs, particularly with incumbent enterprises, is that decisions are made based on the assumption that the environment is stable and constant. Consequently, the uncertainties and risks inherent in the environment go unnoticed and unaccounted for, often resulting in performance failure. Continuous directional shifts in paths could serve as evidence that environmental instability and discontinuities are trying to be minimized by the firm.

To illustrate the point that the real world is made up of constantly shifting dynamics, consider two identical companies, Company C and Company D. In an ever-changing external environment, Company C and Company D have started in opposing directions as shown in Figure 7. Although the two companies start out and proceed on different paths, they both reach the common end goal in the same amount of time because they travel the same distance.

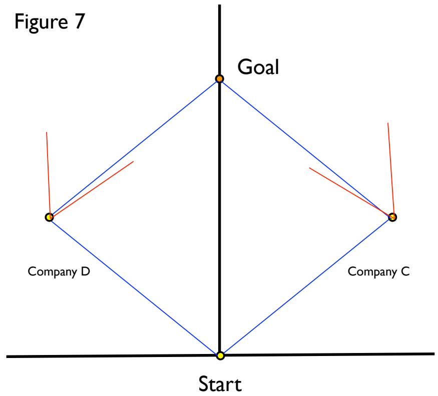


Figure 7

However, if conditions shift to the left, then the company that started out to the left can execute a directional shift in its path and reach the goal much quicker than the other company. As a result of this directional shift in path, Figure 8 depicts a substantially shorter distance and earlier achievement of the end goal for company D.

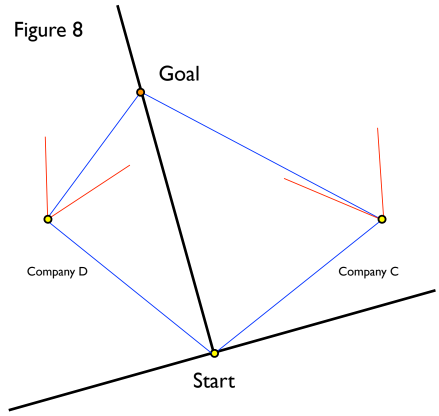


Figure 8

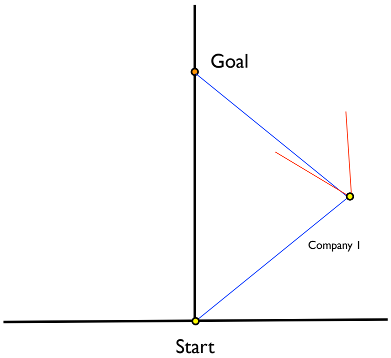
The point is to illustrate that an external shift in the environment can change not only the OBs and the position of the goal, but also the direction of progress without any additional costs being incurred. Unfortunately, the opposite is also true. This tendency for a given environment to shift is called environmental volatility. An environmental shift is represented in our model by a rotating of the axis (Figure 8).

IX. Strategies

While there are an infinite number of potential strategies, this paper will focus on three strategies; two extremes in the incremental innovation situation followed by the discontinuous situation. The first, on the incremental side, is where a company tries to hit their goal with the minimum number of course changes (one). To use a nautical term, this is called "Banging the Corner" (Figure 9).

"Bang the corner — to sail all the way to or beyond the lateral extent of the racecourse (where the extended laylines from the weather mark and leeward mark cross) in search of a (usually mythical) strategic advantage. Banging the corner eliminates any advantages possible from wind shifts; lifts are no help to you and headers help every other boat but yours. Also called "going to Cornersville," "Rightsville," or "Leftsville," where the population is usually 1. British and Commonwealth sailors call it "ringing the bell." See also: overstand."(Reference: http://www.sailorspeak.com/2010/12/14/bang-the-corner/)

Figure 9



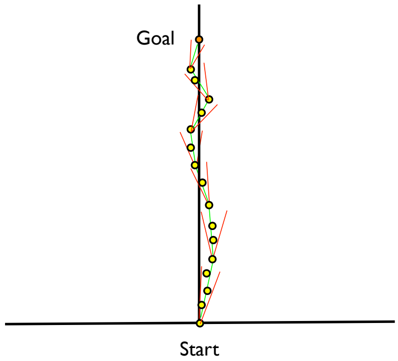
As stated in the definition, this strategy has a couple of weak points. First, it maximizes the risk of being on the wrong side of a shift if environmental conditions change. This means that, if a shift occurs, there will either be a huge advantage or loss. Since most companies are not gamblers by nature, this is a very unattractive and risky way to proceed. Second, this strategy assumes that the company can make a major change to get back on course, which is doubtful. From an alternative point of view, if a company could make such a major change in order to gain improved conditions, the question arises as to why the company would not have taken such an approach earlier. An earlier change would almost certainly have a higher CCC and, therefore, should be implemented. While this strategy tries to minimize the cost associated with a change, it increases risk. This strategy also reinforces the status quo. Companies with large amounts of inertia may follow this strategy either intentionally or unintentionally.

The second extreme is when a company makes changes all of the time in an effort to always be on the direct path. This strategy is coined the "Middle of the Road" strategy (Figure 10).

Meaning: Something unadventurous or inoffensive; opting to go neither one way nor the other.

Origin: This phrase conjures up similar images to that of 'sitting on the fence', i.e. portraying something that is not sure enough of itself to go one way or the other. It seems a rather odd choice of words to describe something that is bland and safe - surely the middle of the road is the last place to expect safety. (http://www.phrases.org.uk/meanings/246900.html)

Figure 10



This strategy can also be proven to be far from optimal. In this situation, one is constantly incurring costs associated with constant changes. While these costs, if considered separately, look small, they can add up in aggregate. The biggest risk is a competitor will make changes more aggressively and gain an advantage. This could substantially limit options and increase risk. The key to picking the right strategy is to know the environmental volatility and the risk profile to decide how far one can stray from the centerline.

The last scenario to consider is to try and jump to a different curve through discontinuous innovation. This situation is shown graphically in Figure 7. In a sense, this is changing the rules of the game and then trying to capitalize on the results. Traditional incumbents overstate the risk of this strategy and choose a more conservative path as discussed earlier in this paper.

In summary, the optimal strategy has several components, which include a constant evaluation of their ζ, risk profile, CCC and position. The key is to know the firm's location and the cost to make a change at all times. The second component is to always look for ways to innovate. With incremental innovation, one can positively affect ζ in both magnitude and direction. With discontinuous innovation, one can move to a more advantageous path. Therefore, the key is to build a culture that is constantly looking at both types of innovation.

X. CONCLUSIONS

The framework presented in this paper provides a graphical representation of the relationship between the starting point, current location and end goal for a company. Furthermore, the framework quantifies a confidence interval that defines the probable location of the future path at a given point in time, including the likely location of the future path following a course change. The confidence intervals and measurability of uncertainty and risk obtained by evaluating the angle ζ between the two OBs at various points in time are advantageous features of the framework. This graphical representation of the situation coupled with the distribution of possible outcomes provides managers with the information necessary to evaluate changes in path.

Combined, organizational agility and organizational competitiveness have the effect of making the less agile, or incumbent, enterprise less likely to change paths. As a result of anticipated apprehension around potential disruptions to internal organizational equilibrium, upon the introduction of technological innovation, incumbent enterprises choose not to change paths and typically experience a longer path toward reaching the end goal. The effect is compounded over time and, on average, corresponds to a longer path for the incumbent than the new entrant. For entrant firms, the situation is the complete opposite. This is due to the entrant firm's ability to exercise agility in changing course midstream in order to accommodate rapidly changing environmental dynamics. Furthermore, the entrant firm does not experience significant equilibrium disruption as compared to the incumbent firm. The model presented in this paper illustrates the faster learning process that entrant firms, or more agile firms, experience when faced with the need to apply technological innovations within their respective organizations. As illustrated by the model, the faster the learning experience occurs, the quicker the reduction in overall ζ.

As discussed in preceding sections of this paper, there are advantages and disadvantages associated with incremental and discontinuous approaches to technology innovation. As for incremental innovation, the disadvantage is that applying a strategy that is exclusively incremental can potentially result in the organization reaching a barrier, or limit, to further growth. This is due to the incremental benefits from each pivot becoming increasingly smaller until there are no additional benefits to be realized. Discontinuous innovation, by contrast, enables a firm to jump off their current path in a radical manner. Applying a discontinuous innovation strategy enables the firm to leap ahead of competitors while also defining new markets. For the incumbent firm, the internal disruption stemming from radical changes to embedded processes, procedures, systems, attitudes and beliefs can outweigh the benefits.

The optimal time for a course correction is a balance between the total cost to implement the change and the expected incremental benefit to the path. Quantitatively, this relationship is defined as the Course Change Coefficient (CCC) and is the ratio of the change in the expected outcomes of the total cost of making the change. Calculating the CCC reveals valuable information such as whether a particular path change is going to prove to be advantageous or not. It also provides for a comparison between two considered path changes. Although estimating the total cost in most situations is relatively simplistic, the process of estimating the appropriate time interval for evaluation purposes is not.

The reality of the external environment, in which organizations operate, is that the environment is constantly changing. A common mistake among incumbent enterprises is that decisions regarding paths and course changes are based off of assumptions that the external environment is stable, predictable and constant. Stability, predictability and continuity are not realistic representations of the external environments in which companies operate today, particularly for companies operating in highly competitive and technology driven industries. Changing environmental dynamics, as represented in the Path/Goal Model, are shown by the rotation of the landscape. Depending on the direction of rotation relative to the firm, the environmental dynamics will produce either an advantageous or disadvantageous effect.

While there are an infinite number of possible strategies, looking at the two extremes provides managers with significant insight. For instance, if a company pursues a position to minimize path changes, then they encounter the "bang the corner" risk where an environmental shift may catch them on the incorrect side of the rotation of the landscape. In contrast, a company who attempts to stay in a neutral position, or in the middle, is continuously changing paths. This strategy often results in a high aggregate cost. The optimal strategy has several components, which include a constant evaluation of a company's ζ, risk profile, CCC and the position relative to their goal. In other words, to achieve an optimal solution, companies must remain aware of their true positioning and their respective costs for instituting change as well as the possibilities for discontinuous innovation.

The Path/Goal Model is designed to factor in these variables and produce a quantitative result which allows managers to evaluate the available options, select the best strategy, drive the company forward and, ultimately, reach the firm's goals.

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