The Calculus of Value

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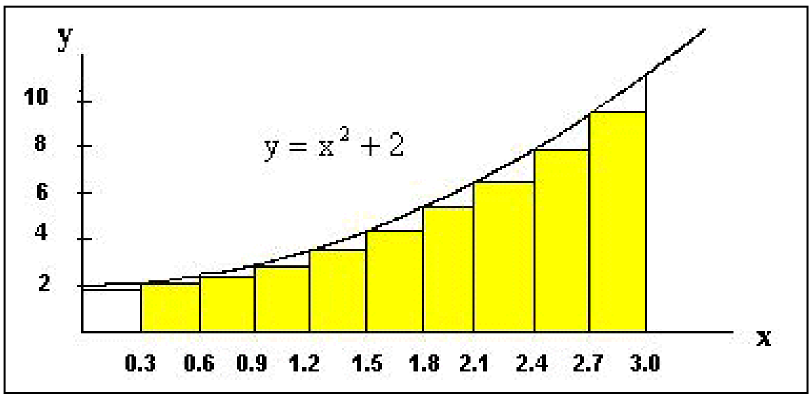
Business executives typically do not turn to Integral Calculus during the value assessment process. Usually, finance, not mathematics, is foremost in the mind of busy managers. However, with a high percentage of decisions failing to return value,[i] perhaps it is time to revisit our school days and use a centuries old tool to help us make better assessments.



Calculus tells us that the area under the curve is approximately the sum of the areas of inscribed rectangles.[ii] This figure shows these intervals and the inscribed rectangles of each sub-interval. Typically, one determines an initial point and a final point along a curve to calculate the value of that segment. It follows that the earlier one begins summing a set of rectangles, the higher the value of area under a curve will be. How does this relate to a business decision process and are there any risks associated with this simple model?

Life Cycle Management

The technology life cycle curve is well understood. In the early phases, the technology is not ready for mainstream deployment, and may even be unstable at times. Early adopters understand that there is a level of risk associated with its use at this stage. Other firms, as a matter of policy, prefer to wait until technology is more mature, acknowledged as fit-for-purpose, and less subject to disruptions. These individual choices reflect the approach to technology adoption that various firms make.

Early adopters believe that by accessing emerging technology, they can secure competitive advantage and hold it, however briefly, before the mainstream deploys a more mature technology. They realize that there is risk and cost associated with moving first, and these factors are included into Total Cost of Ownership (TCO) calculations.

At what point in the life cycle is it appropriate to adopt new technology? While this decision will vary as a function of the RISK – REWARD curve that each firm uses, there are some guidelines available to make that task easier.

Often, management seeks a risk adverse position that provides competitive advantage at little or no cost. Somewhat mutually exclusive, this is the "have your cake and eat it to" scenario that is usually out of grasp.

Mathematics suggests these managers are chasing not just an elusive event, but also an impossible one.

> The probability of either one or other ***mutually exclusive*** events (i.e. events that cannot happen at the same time) is equal to the sum of the probabilities of each event alone. In other words, Pr (A_1 or A_2) = Pr (A_1) + Pr (A_2) for all mutually exclusive events A_1 and A_2.[iii]

This axiom indicates that there are zero scenarios where both mutually exclusive events occur concurrently, and that the probability of either is no more than the sum of probabilities of each event alone. In other words, synergy is not a possible outcome. This also implies that while the probability of either can never exceed one (100%), the likelihood of either is a function of the weighted probability of each. For example, the probability of A_1 may be 75% and the probability of A_2 25%, and so on.

Decision Algorithm

Mathematical axioms dictate that the total area under a technology life cycle curve is greater than a partial area. However, management must factor in the probability that a technology will deliver on its promise. Mutually exclusivity suggests that *certainty* and *uncertainty* cannot occur simultaneously. So if, as theoreticians say, it is "intuitively obvious", and "it follows" that if certainty and uncertainty are mutually exclusive, then value of the area under the life cycle curve is a function of the realistic risk associated with entering at any given point.

These truisms are inescapable. Rose-colored glasses cloud one's judgment, but physics is unrelenting. As agents in a physical universe, whose very nature is currently defined by String Theory,[iv] essentially a unifying theory of the universe, these laws bind us all. So, if physical laws deny *no risk – high return* scenarios, is it any wonder that many *have your cake and eat it to* decisions result in the loss of shareholder value?

Additionally, behavioral economics suggests that cognitive "bounded rationality" dictate decision-making processes.[v] Moreover, microeconomics (analysis of individual economic unit behavior and their interactions) attempts to optimize the outcome of "rational" choices. Economists build mathematical models that investigate scenarios of how these interactions fit together.[vi] These representations are statistically driven, often-called stochastic models, and take into consideration the uncertainty associated with the specifics of a particular microeconomic situation. These scientific tools incorporate the subjective nature of our human condition into behavioral economic stochastic models resulting in powerful decision support instruments, grounded in theory and mathematics.

Conclusion

The expected value (adjusted for risk) of a technology adoption decision is a function of the point in the life cycle organizations implement technology. It follows that while early adopters may gain greater value than others, their TCO calculations must include the risk or "real" costs of obtaining competitive advantage, such as failures, rework, etc. Organizations that adopt at a more mature point in the curve may not receive as much value for their lower entropy decision.

It is intuitively obvious that once the technology is available at very low TCO, e.g., off-the-shelf with minimal configuration required, Calculus tells us that the value is equal for all consumers. Differentiating oneself then, is not a function of the technology, but how it is used to generate value from the knowledge base of the organization.

Perhaps this even means using the disruptive power of some technologies to create new unique curves.

Harness the power of the universe, don't fight it!

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[i] Bonabeau, Eric. (2003, May). Don't Trust Your Gut. Harvard Business Review.

[ii] Educational Tool Company.

iii Stephenson, David (2004, February 25.) The axiomatic approach. http://www.met.rdg.ac.uk/cag/courses/Stats/course/node31.html

[iv] String Theory. http://www.thefreedictionary.com/string theory

[v] Camerer, Colin. Behavioral Economics. http://www.its.caltech.edu/~camerer/camerer.html

[vi] W inter, Joachim. (1999, June 17). Microeconomics. SFB 504 Glossary.