What do I know?
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The main goal of this white paper is to talk about business models, their usage, and how we could improve their value under uncertainty.

It is universally accepted that different types of businesses under different conditions require different types of analytics and on the market there are solutions for most traditional problems when enough good quality data is available. It isn't however so straightforward what to do when true ambiguity reigns and most well-known analytic methods tackle poorly the foundations of decisions under uncertainty. In this paper we'll talk about why true ambiguity is so difficult to manage, how the business model and even leader's mind set has to adapt to it, and how analytics can help.

We'll also show how Innovatorium helps its customers solve its business decisions challenge fast and efficient and prepare for cases of true uncertainty.

The Known, Unknown, and Unknowable

Let's start from a conjectural perspective by using Gomory's taxonomy (1995) distinguishing the data between the known, unknown, and unknowable, and Diebold (2008) distinction between knowledge as measurement and as theory and the fine line separating and linking them.

Obviously the most common case is a company selling a pure commodity product in a perfectly stable market. Based on Gomory's taxonomy this is the classic case of Known (K). Courtney (1997) describes it as level one uncertainty or a clear enough future with an irrelevant residual uncertainty. We could argue that the known applies to the historic and present variables which were measured. A company operating under the known is like an ant colony. The winner has optimized operations by perfecting the mathematical models up to a fraction of percent and relying heavily on them. Modeling is classic science derived from engineering and operational research and is known as Descriptive Analytics. In this environment employees seem to be also very predictable performing mechanically and responding linearly to rewards (Pink 2009).

The second case involves the same company facing uncertainty because it's bidding on a large contract. The outcome could be described as few discrete scenarios and the risk modeled as a fork. This corporate model is similar to the lions' pride where the lionesses hunt and the lion fights only in case of extreme danger or to defend bigger prays. Success is based on plan B which involves all corporate resources. Courtney describes it as level two uncertainty or a set of discrete potential outcomes.

The third case involves a company facing uncertainties in ranges more or less well defined. For example an investment fund buys shares in Microsoft and although it doesn't have a clear ball it can infer from the past the

probability distribution function of daily returns. The outcome could be described by the integral of the product of daily return and the probability of reaching that particular level with the integral estimated over the entire range of possible returns. According to Courtney this is level three uncertainty having a range of potential futures. The organizational model of a successful company operating with this uncertainty is similar to a pack of wolfs. Their success is based on the ability to quickly redistribute resources to fight a larger enemy by using a highly cooperative strategy. Survival is based on the capability to continuously assess the situation and retreat when the chance of success is low.

The second and the third case represent the unknown (u) in Gomory's taxonomy and are modeled by Predictive Analytics. The unknown could be data from the past, present, or future that we could have measured but haven't at least not yet.

The fourth case involves a company facing an absolute uncertainty becoming impossible sometimes to even identify the variables. An example could be a start-up trying at the same time to decide on the features of a new product, pricing scheme, tech support, predict demands and regulatory hurdles, etc. Even if this is not a very common case it is very useful to think of it because at any given moment a large company can find itself for a short period of time in this environment. Bear Sterns did.

According to Gomoroy this is an example of unknowable (U) or level four uncertainty (true ambiguity) based on

Courtney's model. To succeed with level four uncertainty a company has to operate like the vultures, dynamic and opportunistic prepared to scrutinize the field, wait for days ready to attack the easy prey. Modeling the risk is a very complex task requiring the capability of predicting low probability events and estimate their consequences. A company operating in this environment has to base its operations more on its leaders' intuition and prepare them with the extraordinary capacity to see events ahead of their competitors based on advanced analytics. An example of company thriving in an environment characterized by level four uncertainty is Apple apparently inseparable from its leader Steve Jobs. There is no traditional method of modeling level four uncertainty. Let's expand on this case by first trying to understand how we react to uncertainty.

Business Models under the Unknowable

Darwin taught us probably one of the most important lessons in life, the survivor is the most adaptable not the most fit as some may suggest. And interestingly enough this conclusion applies not only to live beings but also to corporations, organizations, and even states. Let's take a look at some recent events.

On 3/17/2008 the Associated Press announcing a potential deal with JPMorgan to buy the previously high flying investment bank Bear Stearns at an astonishing 98.8 % discount to its book value (as of 2/29/2008) was commenting:

> Bear Stearns was founded in 1923 and in recent years was best known for its aggressive investing in mortgage-backed securities

— and what was once a cash cow turned into the investment bank's undoing.

Was it just chance that the acquirer was JPMorgan, the unloved bank which refused to invest in fancy financial tools or was it predictable? I would argue that at that time JPMorgan was one of the least threatened corporations in the financial industry at least because its leaders had the wisdom to avoid making the company dependent on risky business models. Before the events of early 2008 Bear Stearns was the best fit with profit rates substantially higher than JPMorgan but it was neither prepared for a shock nor adaptable enough to quickly respond to it. In contrast JPMorgan may have been similarly unable to respond to a shock but its leaders were wise enough to avoid exposing the company to a potential risk due to uncertainty therefore almost completely avoiding to be hit by the shock at least not directly.

Under the same circumstances Goldman Sachs survived the shock by first taking over $60 billion in direct and indirect help from the Fed then converting to a holding bank and getting access to almost unlimited TARP funds (Roubini 2010).

If we step back we could easily realize that the three companies may have reacted similar to the way animals including humans respond to danger. In psychology this is known as the "acute stress response" or as Walter Cannon (1929) described it the "fright, fight or flight response".

In our case Bear Stearns followed the fright path, did not have the vision to predict the shock and was unable to react fast enough to save itself from disappearance. JP Morgan followed the flight path by correctly predicting the shock and avoiding it almost completely. Goldman Sachs took the fight path and although it was badly wounded it managed to survive and prosper. But what strategy is right for you?

Looking in perspective it is undeniable that the Goldman Sachs investor is better off. But the real question is can someone predict which of the three paths is the most effective during a shock? To answer some aspects of this question we'll analyze several types of events, what we know, and how we react.

At this point we got a better grasp of the "fright, fight or flight response" and how important it's to match the environment and corporate capabilities in the level four environment. Level four uncertainty is a highly stressful event and organizations like humans may respond successfully only when relying on the human intuition. Traditional analytic methods are not powerful enough to either reliably predict these cases or to construct an instant recommendation because traditional analytics is based on comprehensive processing of large volumes of data. This type of processing takes by far too much time and results become available long after the time a decision had to be made. Descriptive and Predictive Analytics work partially against the human intuition and the more stressful the situation the least effective traditional analytics is.

To use the intuitive approach we need to understand how intuition works, when to trust it and what it needs to be

successful. As we'll see intuition doesn't neglect data but processes it in a different way.

According to Freud it is "an illusion to expect anything from intuition" and Bonabeau (2003) clearly states "don't trust your gut". However, empirical evidence indicates that for very complex decisions characterized by huge volumes of data subjects taking the analytical path were right 25% of the time versus subjects using their intuition who were right over 60% of the time (Lehrer, 2009). On the same line Gladwell (2005) tells us that based on intuition "we figure the game out before we realize we figured the game out and begin making the necessary adjustments long before we are consciously aware of what adjustments we are supposed to make". So, who's right?

Reading between the lines it becomes clear the consensus is toward using intuition under strict conditions. First of all not everyone is capable of intuitively reaching the best decision and even the best intuitive thinker needs the latest information and other supporting resources. These leaders have developed a unique data filtering capability and use their pattern recognition capability to reach the best conclusion in the shortest period of time despite of their own biases.

Jonah Lehrer in his speech at the Commonwealth Club on January 2010 was vividly talking about an US commander that became a hero because we was able to make the proper decision ordering to shut down two Iraqi missiles thus saving many lives. The decision was difficult since his only information was the radar image which appeared very similar to the image captured when US fighter jets were returning from mission. By distinguishing small differences in the patterns he was able to make the proper decision. We could recognize him as one of the few people with such an extraordinary intuition. The really big lesson is more useful: his success was possible because of the tool he relied on (very accurate radar) and his pattern recognition capability.

After ordering "don't trust your gut" Bonabeau lists the reasons why the human mind often fails when using the intuition. He believes that "intuition is a means not of assessing complexity but of ignoring it". He reaches a simple and natural recommendation which most people follow unconsciously even without having heard of it. He recommends keeping all the options on the table while listening and thinking about the problem as long as possible, avoiding biases, and trying to find possible patterns but without reading too much into any of these patterns. This technique is called thin-slicing. At a high level of abstraction patterns could be found not only in data but more importantly in the process of thinking where are named heuristics. Polya (1945) listed some of the most fundamental heuristics as the trial and error, graphic depiction, instantiation, generalization, backtracking. Since then researchers have found many other heuristics and designed complex procedures for selecting and optimizing their usage. One of the most prominent new types of heuristics is based on observers, an indirect measurement with predicting power replacing direct but unreliable, expensive, and hard or impossible to make measurements.

Heuristic Analytics uses proactive tools as Observer Design, Weak Connections Detection, Clustering Analysis, and Low Probability Events Analysis.

Heuristic Analytics differs significantly from the Predictive Analytics in the way it selects the meaningful data, type of algorithms, and user interaction. Predictive Analytics makes a forecast by overstretching mathematics and available data and assuming the overall environment doesn't change dramatically. Heuristic Analytics uses the available data only to validate an observer which was designed based on the systemic knowledge about the environment and its intrinsic laws. Forecasts made with Predictive Analytics could be far off if too little data is available or the future is too remote. Sometimes the other extreme of too much data is problematic because processing it takes too much time. Extrapolating too many variables may also increase exponentially the processing time (the curse of dimensionality). With Heuristic Analytics the model has been already validated at the time the forecasting starts and input data is widely available since this was one of the main conditions imposed in designing the observer. Heuristic Analytics is a game changer since it switches the forecast base from the unknowable to the known.

To show the stretch effect to those technically inclined we could mention the forecasts of low probability events as flooding, economic depressions, etc which in the Predictive Analytics are modeled using Poisson processes. Despite all the beauty of the math behind Poisson processes in most of these practical cases its assumption of independence remains impossible to validate. Another good example is the Monte Carlo simulation which in many cases is the analyst's life saver. But how do you use it when variables have statistical distributions far from the Gaussian? Is any random number generator capable to produce really good numbers for any given statistical distribution? Something more common is the case where a perfectly random sequence of numbers appears as having a trend. But when the sequence is very short, how do you distinguish real from fake trends? Bayes' theorem could be written for any number of mutually exclusive events covering the entire sample space. But how many times you don't even know or can't prove the mutual exclusivity? What should you do with the gray area?

There is an incredible convergence toward the idea that leaders need to rely on intuition as their vital weapon. With these tools users become potentially more powerful but may be subjected to the peculiarities of their tools without much chance to detect when tools fail. This is why it is imperative for the tool to not only correctly measure and interpret data but also to indicate the range of expected errors and to help users understand the consequences of ignoring some data. The ultimate benefit of using the heuristic approach is that intermediate values could be compared with what the human intuition may expect, thus raising a warning signal if the analysis seems wrong.

Innovatorium is uniquely positioned to help its customers prepare for and respond to an uncertain future by building

tools that are optimized to react to the unknown and design your strategy to better match corporate capabilities with the changing environment.

Contact us today for an evaluation or your project!

Conclusions

Some of the most profitable companies in the world operating in fields marred by uncertainty remain widely successful due to their opportunistic approach based on human intuition and advanced analytics.

Innovatorium helps its customers with strategic expertise and analytics geared toward managing the effects of unknowable. Because to succeed we need to keep asking what I really know, what I don't know and may never know, how what I don't know could affect the results of my decision, and how may I use what I know to improve my chance of success.

References

Associated Press	JPMorgan to buy Bear Stearns for $2 a share. Federal Reserve bank to provide financing for the deal, Associated Press, 3/17/2008 12:51:03 PM ET
Nouriel Roubini, Stephen Mihm	Crisis Economics, a crash course in the future of finance, The Penguin Press, New York, 2010
Daniel Pink	Drive: The Surprising Truth About What Motivates Us, Riverhead Hardcover; 1 edition (December 29, 2009)
Walter Bradford Cannon	Bodily changes in pain, hunger, fear, and rage. Appleton-Century-Crofts, New York 1929
Ralph Gomory	The Known, the Unknown and the Unknowable, Scientific American, June 1995
Hugh Courtney, Jane Kirkland, Patrick Viguerie	Strategy Under Uncertainty, Harvard Business Review, November–December 1997
Eric Bonabeau	Don't Trust Your Gut, HBS 2003
Jonah Lehrer	How We Decide, Houghton Mifflin Co; 1 edition, 2009
Malcolm Gladwell	Blink: The Power of Thinking Without Thinking, Little, Brown and Company; 1 edition, 2005
Polya George	How To Solve It: A New Aspect of Mathematical Method, Princeton, NJ, Princeton University Press, 1945
Francis X. Diebold, and others	The Known, the Unknown, and the Unknowable in Financial Risk Management, University of Pennsylvania, June 2008

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