Project Risks and Mental Errors

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At the time of uncertainties and risks the most important thing is not to lose a head.

Marie Antoinette (allegedly)

In this paper we will learn how to estimate probability and impact of the different events. We will also try to answer another question, what to do with them. Risk assessment is not trivial as it is subject to multiple mental errors. Among them are zero risk bias, loss aversion, ignoring base rate frequencies, gambler's fallacy, overestimating the probability of compound events, and others. People's response to risk and uncertainty varies due to the different risk attitudes of individuals and groups. Risk attitude measures how much risk an individual or group is willing to accept and is based on different factors, including emotions and biases.

Which risk is the most dangerous?

As you go about your life at home, at work and even on vacation, you are surrounded by a myriad of risks. When you step out your door having managed to avoid a house fire, you could be hit by debris from a plane flying overhead or struck by a falling branch. According to official statistics, 600 Americans each year fall out of bed and die (Kluger 2006). When you wake up, you are at risk from heart attacks and poisoned toothpaste. When you go to work, you might collide with lamp pole or die in car accident. Finally, having successfully avoided all of these risks, you arrive at work and discover that there is now a risk that your project will be over-budget by 5%. Compared with the risks with lethal consequences you have just avoided, the over budget project should be your least concern. Nevertheless, for some reason, you are more preoccupied with project delays

and far less with traffic accidents. You might ask how we made this assumption. Well, you are reading this paper, not "How to survive electrocution and common fatal accidents" or "How to avoid falling out of bed". In fact, 411 people died from electrocutions in the US 2001 or 0.63 per million (Wrong Diagnosis, 2008). At the same time, we could unable to find any official statistics on how many project managers died due to budget overruns.

Many of the difficulties in projects we cause for ourselves because we are not able to rationally assess risks. What project delay and cost will occur if management lays off the IT analyst? What is the chance that software developer will attempt to use a new untested software tool? In this paper, we are going to learn how mental mistakes affect our assessment of the probabilities and impacts of risks.

Are you afraid of falling asteroids?

Do you think asteroids represent a real danger? Should we do something to protect Earth against asteroids? Here are few facts about asteroids:

- Probability that big asteroid would hit the Earth from now until its final destruction an estimated 4 billion years from now equals 1.
- There are no confirmed human deaths due to asteroid impacts.
- The chance of been killed by the asteroid on an annualized basis is somewhere between the chance of being killed by shark attack and bee stings (Lynch 2008). This means that if you are concerned about been killed by a shark or a bee, you should be concerned about asteroids as well.

What we are illustrating here is our analysis of this risk; we determined the probability for the risk and compared it with the probability of other risks. By doing this, we to put the information regarding a potential asteroid impact into perspective. Based on this information, we can make an informed decision regarding how we should view this risk. It happens that the risk of asteroid impacts is a real one and real projects are under way to reduce these risks. Apparently reducing the probability of the risk by blowing it up with a nuclear blast (see the movie "Armageddon") does not appear to be a good idea. More likely, in the event that a large asteroid's orbit takes it into close proximity to Earth, it may be possible to deflect it using either a nuclear blast or by hitting it with a heavy fast moving probe. So we are not completely doomed.

The problem with risk is that people often do not perform the necessary level of analysis and even when they do, the results may not be very intuitive. To further complicate things, different people and organizations have different *risk attitudes* which affect their decisions.

What is Risk Attitude?

Built in 1985-89, the Sayano–Shushenskaya hydroelectric power station on Yenisei River in Siberia was sixth largest hydroelectric power station in the world with three times the power generation capacity of the Hover Dam. You may now be wondering why we are talking about it in the past tense. While, on August 17, 2009, the Sayano–Shushenskaya hydroelectric power station violently broke apart, flooding the turbine hall and engine room. The ceiling of the turbine hall collapsed, 9 of 10 turbines were damaged or

destroyed, and 75 people were killed (Demchenko, Krasikov, et. al. 2009). The entire plant output of 6400MW, a significant portion of the supply to the local grid, was lost leading to widespread power failure in the local area and forcing all major users in the regions, such as aluminum smelters, to switch to diesel generators.

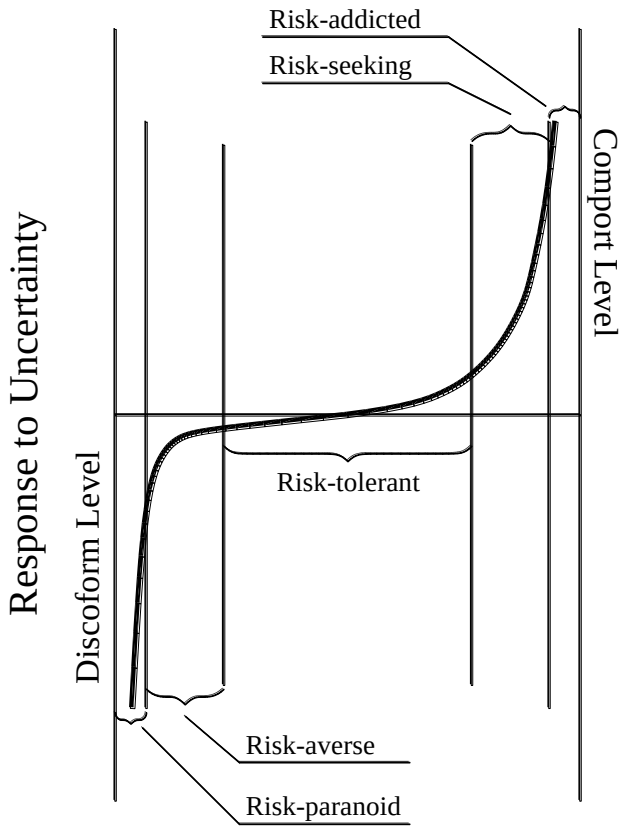
How did it happen? As it turns out, Turbine 2 had had a long history of problems prior to the 2009 accident. The turbine underwent a number of repairs, most recently from January to March 2009 in response to an elevated vibration emanating from it. By the beginning of July, the vibration exceeded specification and continued to increase with accelerated speed. On the night of August 16–17, the vibration level jumped substantially. By the following day, the vibration levels were extreme and were now registering with seismic instruments in the plant. During attempts to shut it down, the rotor inside the turbine was pushed up, which in turn created pressure pushing up on the turbine cover.

At 08:13 local time there was a loud bang from turbine 2. The turbine cover shot up and the 920-ton rotor shot out of its seat. Water spouted from the cavity of the turbine into the machinery hall. As a result, the turbine hall and rooms below were flooded. At the same time, an alarm was received at the power station's main control panel, and the power output fell to zero, resulting in a local blackout. The steel gates to the water intake pipes of turbines, weighing 150 tons each, were closed manually by opening the valves of the hydraulic jacks keeping them up. 74 people were later found dead while 1 person is listed as missing.

Turbine 2 had major structural defects since its installation. Some of these defects were known well before the accident. A former power station director actually warned about the potential problem 10 years before the accident. Nevertheless, the automatic system which was designed to to shut off water flow in case of high vibration was not engaged. Before the accident, when vibration increased dramatically, it was possible perform an emergency shutdown of the turbine by shutting down the water flow. But apparently, in this case the people who were operating the station did not understand the potential risk impact of a turbine failure. In other words, the people who were trying to fix the problem before the accident and those who operated the troublesome turbine had a high risk tolerance: they were willing to accept higher level of risk.

Risk attitude is the chosen response of an individual or group to risks and uncertainties

People always have an attitude towards risk. David Hillson ad Ruth Murrey-Webster (Hillson and Murrey-Webster 2007) suggested a Spectrum of risk attitudes. The vertical axis of the charts represents uncertainty; the horizontal axis represents different individuals or groups.



Risk Paranoid	aka. Melvin Udall (Jack Nicholson) from the movie As Good as It Gets a cranky, bigoted, obsessive-compulsive writer.
Risk Averse	aka. Felix Ungar (Jack Lemmon) from The Odd Couple, a neurotic, neat freak news writer, who is thrown out by his wife.
Risk Seeking	aka. Marko Ramius (Sean Connery) from the movie The Hunt for Red October, a decisive Russian navy captain who hijacked a nuclear submarine
Risk Addicted	aka. Indiana Jones (Harrison Ford) who miraculously survives extremely risky encounters with enemies, deadly beasts, and dangerous traps, but the number of these miracles exceeds any reasonable limits.

Table 11.1 Risk Attitudes

We mentioned before that it is not just individuals, but also groups, such as companies, possess a certain attitude towards risk (Hillson Murrey-Webster 2008). For example, the street gangs from West Side Story were risk seeking. Apparently, the same could be said for the banks and financial companies in the center of the 2008 sub-prime mortgage crisis. Here is an interesting coincidence: both the gangs and financial companies were from New York, and the risk seeking activities that they both engaged came to a bad end.

Some organizations, especially large companies in traditional areas such as oil and gas and manufacturing, are risk averse. They significantly reduce activities during downturns in the economy even though it will potentially lead to losses over the next few years. Management of organizations are comprised by individuals who have their own risk attitudes. At the same time, the attitude of an organization will affect the risk attitudes of members of the organization. The question is: how does this risk attitude form and change over time, and why do different people and organizations have different risk attitudes?

Why people have different attitudes towards risk

Why after failed terrorist plots to explode a commercial airplane do authorities and ordinary people become very agitated? New security measures are put in place and people are transfixed to the news for days surfing the internet or TV channels for news regarding this newly emerging threat. We hear about emergency landing due to unruly passengers, suspicious devices, and sometime because flight crews panicked by mistake. However, after a period of time we see that the heightened security measures are relaxed and the public becomes more complacent. Then this cycle repeats again and again. It leaves us with the impression that additional security measures are really just a type of "security theater" and have little to do with preventing terrorist attacks, but rather are designed to show the public that authorities are doing something by imposing extra hardship and inconvenience on travelers.

With some analysis, it is easy to see why this cycle will repeat itself endlessly. After an attempted attack, people's emotions, particularly fear, lead to a significant shift in risk attitude from risk tolerance to risk aversion and even to risk paranoia. On the Hillson/Murrey-Webster diagram, this would be seen as a shift to the left.

Dread factor: people tend to be less concerned about risks that are not catastrophic, but are controllable and are easily reduced.

Interestingly, the more we fear something, the more anxious we get, and the more anxious we get, the less precisely we are able calculate the odds of an event actually happening. This is the so-called *dread factor* (Slovic 1987). The result is what psychologists call *probability neglect*. Since most people's fear will be reduced after some time, the risk attitude soon shifts back to its base state. From this we can see that emotions are one of the major factors which determine risk attitude.

Do you remember the e-coli outbreak 2006 when hundreds of people became sick due to bacteria found in the spinach (CDC 2006)? There was a huge reaction, producers lost millions of dollars as produce was destroyed and consumer demand sagged due to fears of infection. How do you feel about the next potential bacterial outbreak lurking in our food chain? Not so much we gather. This is the *unknown factor*, which affects our perception of risks. People are more concerned about something they have not experienced yet (McComas 2010). In project management the unknown factor plays very significant role, since organizations and individuals may not have experience in the particular tasks or activities. Project manager may perceive that activities related new tools, new software, new supplier, or new team members are riskier.

Another factor which affects risk attitude is the heuristics and biases. Here are a few examples. Terrorism leads to stronger reactions because, according to availability bias, it is vivid and there is easy to recall a recent incident. Because of this, people can empathize with the victims, walk in their shoes as they lived through the attack and therefore their risk attitude shifts towards risk aversion. In project management vivid project failures, especially if there are very significant monetary, job losses, or legal consequences affects risk attitude.

> Unknown factor: people are less concerned about risks that are observable, have immediate effects, and are known to science.

The representativeness bias causes people to judge certain objects, people, or events based on a representative category. For example, a project manager might think that there is a heightened risk in dealing with a certain supplier due to a previous issue with a different supplier from the same industry or region even though the current and previous suppliers are from different companies with completely different processes.

The optimism bias also plays a significant role in forming our risk attitude. Psychological research shows that people systematically believe that they are less affected by risks than others. In other words, they believe that negative events are more likely to happen to other people and positive events are more likely to happen to them. This is called *unrealistic optimism* (Weinstein, 1989). Here are few explanations why we have this mental error:

1. People, due to the representativeness heuristic, incorrectly place themselves in the wrong category. For example, criminals consistently place themselves to the category of "criminal masterminds" who will never be caught. Similarly, project managers consider themselves in the category "project management experts" and believe that project failures will less likely happen to them.
2. People interpret risk information in a self-serving manner. For example, if they have not seen any signs of an issue developing though other team members have reported it, they tend to believe that it is not going to happen. Remember Murphy's Law: if something bad might happen, it will. One of variations of this law states: if everything appears to be going well, you are missing something.
3. People employ the "ego-defensive" mechanism to justify risky behavior. People will say that they took adequate precautions, which happen to be ineffective or irrelevant. For example, project managers who engage in risky project often say that they performed some risk mitigation to lessen the impact, but it turns out that it is not relevant to the particular activity or project.
4. People believe they have more control over a situation than they really do. For example, drivers believe that they less likely to have an accident than passengers. This is called the *illusion of control*.

Unrealistic optimism is responsible for shifting risk attitude on the Hillson/Murrey-Webster diagram to the right towards risk seeking or even risk addiction.

Risk attitude is different based on the magnitude of the problems. For example, if you are considering investing 10% of your company's revenue into the particular project, you may be willing to take some risk. What if the project required 90% of the company's

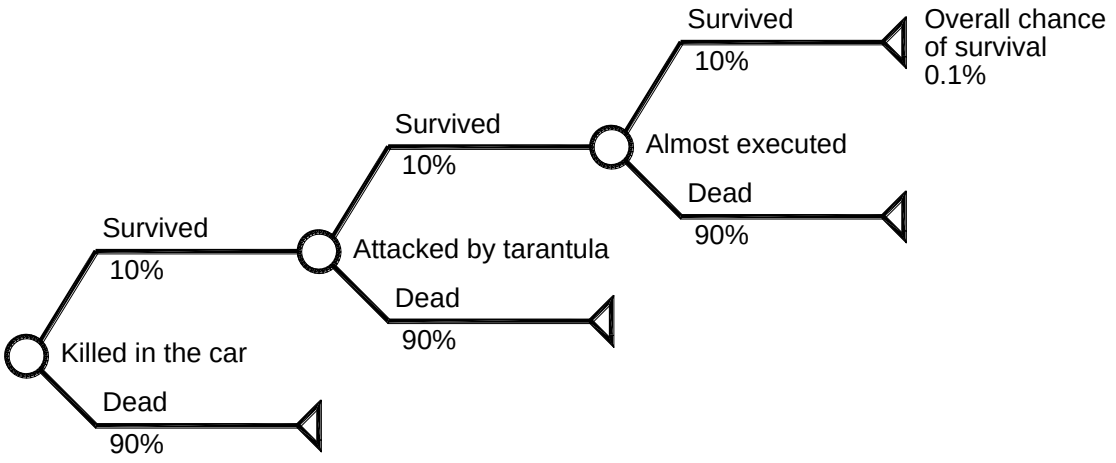
revenue? The risk you would assume would most likely be much smaller. Taking smaller risks where large investments are required is a rational course of action, but you need to make these decisions consistently. The following is fictional, but useful to describe a very common phenomenon. A beautiful young lady decided to embark on a very complex and ambitious project: she arrives in New York with one goal in mind - to move up the social ladder and end up at the pinnacle of high society. Central to her plan is marriage to a rich and well-connected bachelor, preferably young and handsome, but these attributes are not absolutely required. To seduce her target, she decided to take a risk and spent her money on very nice and extremely expensive dress. At the same time, she decided not to invest more on a good apartment in a socially attractive area though she had the funds at the time**.**

How should we judge her strategy? She took one risky investment, but did not apply the same risk attitude to another investment related to the same project. It is irrational and may have had something more to do with her attraction to a beautiful dress than her end goal. Do you think she will succeed in seducing an investment banker? Probably, but not because of the expensive dress.

Paradoxes with Estimation of Probabilities

How many randomly chosen people should be in a room to ensure a 99% chance that at least two of the would have the same birthday? In a room of just 23 people there is a 50-50 chance of two people having the same birthday, boost that number to 75 and the chance is 99.9% (Better Explained, 2010). It is seems to counterintuitive: you would think that to have a 50-50 chance of two people having the same birthday the number should be significantly more. Nevertheless, it is statistically correct and you can find the actual mathematical proof in the reference we provided. This paradox shows how easy it is for mental errors to affect our estimation of probabilities.

Here is one more phenomenon. Take a look at question 8 on the Judgment test. James Bond had so many life threatening situations that a real person would have died a long time ago from accidents, drinking, or multiple sexually transmitted diseases. However the question is, taking into account the probability of survival from all events in just one movie, what is the chance he survives to kiss the girl in the closing scenes? The overall chance of survival, which can be calculated by multiplying chance of survival in each attack, equals 0.01%. Most people will find this figure rather low and the phenomena is called the overestimation *of probability of compound or conjunctive events*. It is very common in project management where managers overestimate the success rate of project with multiple risks, which have a dependence upon each other.



Gambler's Fallacy and Statistical Independence

Take a look of question number 7 on our Judgment test. Would our gambler's chance of winning increase after his many losses? Many people would say yes. In reality, statistically the chance of success remains the same. This is called the *Gambler's Fallacy* (Fallacy Files 2010). In many cases, the Gambler's Fallacy contributes to gambling addictions because people cannot stop playing as they believe that their "luck" will change and they will be able to recover their losses. Do you remember move "Vegas Vacation"? This is exactly what Clark Griswold (Chevy Chase) suffered from when he lost all his money.

A similar effect is called the *Hot Hand Fallacy*. A gambler has had a streak of luck. Therefore, the gambler is either "hot" or "cold", depending on whether his luck is good or bad and the good or bad luck will continue at a probability greater than chance. Both fallacies are based on the same mistake; namely, a failure to understand statistical independence. Two events are statistically independent when the occurrence of one has no statistical effect upon the occurrence of the other.

Take a look at these sequences:

20,22,24,26,28

3,7,13,20,11,31

In the first sequence the next number equals previous number plus two. The second sequence is randomly drawn ruffle tickets numbers. What should be the next number? In the first sequence it is 30. In the second sequence we cannot know. In project management, there are many events in which it is impossible to predict probabilities based on prior knowledge or if prior knowledge is insufficient. Nevertheless, people discern patterns where patterns do not exist or cannot be definitely be identified.

For example, a team member may become sick. Despite the fact that it might be the flu season or the health of individuals may vary, particular event of sickness are hard to predict. Defects in devices or supplies can also be a statistically random event. Of course some brands can have consistently higher quality than others, but within one brand there could be some defective units. So, it might just be your bad luck if you have sticky

accelerator pedal, even while the majority of the other accelerator pedals work perfectly fine.

Just remember not to be complacent and overly optimistic when developing your project plans and account for potential events even if they have yet to occurred.

Loss Aversion in Project Management

According to the research (Kahneman and Tversky 1979) people would prefer a sure bet when they are dealing with gains and gamble when they are dealing with losses. In other words, people are willing to take more risks when they are going to lose something. This effect is called *loss aversion*. Psychologists noticed that losing $10,000 feels much stronger than gaining $10,000. Because of this effect the chart shown on Figure 11.3 is slightly asymmetrical. It means that discomfort level as a response to uncertainties often feels much stronger then the level of comfort.

In project management loss aversion manifests itself when people are more willing to take risk when they feel a threat and much more cautious when they are decided about exploiting opportunities. For example, if a project manager sees that the project is behind schedule, they are much more likely to request more resources. However, if an opportunity presents itself where they could complete project much faster with higher quality, they are less likely to ask for more resources.

The loss aversion effect is not universal: several studies were not able to confirm the existence of loss aversion (Ert and Erev, 2008). One of the explanations is that loss aversion does not exist when there are only small payoffs (Harinck, Van Dijk, at el. 2007).

Risks vs. Opportunities

Remember the movie "My Blue Heaven" starring Steve Martin and Rick Moranis? Vincent 'Vinnie' Antonelli (Steve Martin) is a former Mafia figure turned informant. While under witness protection in the suburbs, Vinnie becomes engaged in various criminal activities. The truck that is supposed to bring him supplies for his criminal businesses, actually delivers empty water jars. "Somebody see a problem, I see an opportunity", notes Vinnie and he decides to use the jugs to collect donations from his community towards the construction of youth sport facility. In reality, his intent is to pocket the proceeds.

In spite of his Vinnie's bumbling, he was absolutely right: in many cases, opportunities accompany threats. For example, a downturn in the economy can cause severe hardships, but it also presents an opportunity for many to successfully invest, start new businesses, or learn new technologies. Project delays are an opportunity to review issues, regroup, and improve management not only for current project, but other projects as well.

Most people know that risks and opportunities are related but it seems to counter intuitive. How can threats be converted to opportunities? Here is one explanation. In the same way that we are surrounded by myriad of threats, we are surrounded by a myriad of opportunities. In most cases, we are so preoccupied with threats that we don't analyze opportunities. PMBOK® Guide has Risk Management Chapter 11, whose focus is primarily on the management of threats, in fact threats and risk are treated almost synonymously. There is no equivalent section on managing opportunities, although

opportunities are mentioned. There are a number of risk analysis and risk management groups or societies, but they are almost all thought of as being preoccupied with threats. Perhaps the preoccupation of risk analysis on threats at the expense of opportunity analysis it is related to loss aversion. However, when you start identifying and analyzing risks, realize that risks do not just represent threats, but are also opportunities staring you in the face.

Opportunities do not always coincide with risks. Sometimes the impact of a risk is quite severe and any opportunity cannot completely compensate for losses. However it is important to remember that even in bad situations, there is room for opportunities.

Smart tips

- Make sure that your place yourself to correct category when you assessing your skills or expertise. If you mistakenly believe that you are an expert, it can cause unrealistic optimism bias and incorrect assessment of project risks
- Try to determine your risk attitude: are you risk tolerant, risk seeking, or risk averse. Use this knowledge to apply to determine probability and impact your project risks. Also always know risk attitude or organization of risk attitude of your team member.
- Opportunities often exist alongside threats. Try to identify opportunity for each risk.

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