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Qualitative and Quantitative Risk Analysis

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All projects have risks and uncertainties. In some cases, for example in most research and development project the effect of such risks and uncertainties can be very significant. However many managers still did not employ proper project risks management processes for their projects. In many cases they don't believe, that establishing and implementation of such process will be beneficial, since it is difficult to predict all potential risks and their affect of the project.

There is a classical example. One of the Intaver Institute's clients, the large oil company, performed a drilling of the well with total cost about \$2M. Project schedule has been created based of analogs: drilling of similar wells in the similar geological conditions. At the middle of drilling the mud, required to this technological process, starts disappearing. Project engineers have tried different solutions. It delayed the project so significantly that total cost of the well has almost doubled. Later on the project manager has admitted that it would be cheaper to abandon the well and drill new one somewhere else. Or perhaps don't start drilling in the particular location in a first place. Unfortunately the company did not have well established project risk management process at this time. What should be done is to properly analyze project with risks and uncertainties at the stage of project planning, and then reassess risks during a course of the project.

To explain how proper risk management process should help, let's analyze some physiological issue related to estimations. . In 2002, Daniel Kahneman was awarded the Nobel Prize in economics "for having integrated insights from psychological research into economic science, especially concerning human judgment and decision-making under uncertainty." According to this theory, fundamental limitations in human mental processes cause people to employ various simplifying strategies or heuristics to ease the burden of mentally processing the information required to make judgments and decisions. During the project managers rely on heuristics or rules of thumb to make estimations and manage the project. Under many circumstances heuristics lead to predictably faulty judgments or cognitive biases.

One of such “rules of thumb” is availability heuristic. Decision makers assess the probability of an event by the ease with which instances or occurrences can be brought to mind. For example, project managers sometimes estimate the chance of risk occurrence based on similar tasks that have been previously completed. If they are making their judgment based on risks they remember, it can cause inaccurate estimation.

The anchoring heuristic refers to the human tendency to remain close to the initial estimate. For example, during brainstorming meeting engineers estimated the chance of the risks equal 10%. During a discussion they said that actual chance will be between 8 and 12 percent. So they always remain close to the original estimate.

Judgments concerning the probability of a scenario are influenced by amount and nature of details in the scenario in a way that is unrelated to the actual likelihood of the scenario. It is called the representativeness heuristic. For example the project has two potential risks. One of them is very well documented, but another one has a very limited descriptions. Decision maker sometimes may assume, that chance of occurrence of the first one will be higher than second, which in reality may not be the case.

Decision makers can be exposed to many cognitive and motivational factors that can lead to biases in perceptions. This effect is often referred to as selective perception. For example, estimation of a task’s cost can be influenced by the intention to fit the task into the project’s budget. As a result, some of the project parameters can be overestimated. Another type of biases is related to management push for a better project performance. Such management biases may cause underestimation of certain risks.

With so many potential pitfalls in decision-making, is any way to reduce biases and provide more accurate estimation and analysis of project parameters? Many project managers recognize this problem. But in many cases they response is provide very basic project risk management or sometimes don’t bother with risk analysis at all.

Most uncertainties in project management are related to the lack of knowledge about the incoming activities and risk. For such so called epistemic uncertainties, there are two major strategies of performing risk analysis:

1. Properly capture all historical information and use it to make estimation and analysis.
2. Carefully track a project performance including information about risks and uncertainties; update estimation when new information about current project performance become available.

Most real life projects have multiple risks and uncertainties, which affect project different way. In such cases computerized qualitative risk management tool could become the only feasible way not only to manage project uncertainties in current projects, but also to provide input for future projects.

Let’s see how qualitative risk analysis software can help to mitigate negative effect of heuristics and biases.

If risks and uncertainties are registered in comprehensive database, it will help to mitigate availability heuristics. Decision maker will judge about probability of the event’s occurrence based of reliable set of data. In qualitative risk management software each

risk has accompanied by the set of standard parameters: severity, impacts, mitigation plans, etc. It helps to mitigate representativeness heuristics, because decision will less likely be influenced by more detailed scenario. If risks are properly registered and updated during the course of the project, it helps to mitigate negative impact of selective perception and management biases. Assessment of risks of future project will be done based on objective analysis of risks in current project. If assessment of risk is done based on objective recorded historical data, the “anchor” for decision making may not be present. It can reduce negative impact of anchoring.

Sets of risks recorded and analyzed in qualitative risk management software, can be a foundation of quantitative risk analysis. Quantitative risk analysis will help the manager to determine a chance, that project will be completed on time and within a budget, identify critical project parameters, which affect project schedule at most, determine project success rate, make a decision about viable project alternative, etc. All these wonderful things can be meaningless, if they are not based on reliable set of historical data about risks and uncertainties. Moreover such data must be updated during the course of project based on actual inputs. This principle of decision and risk analysis sometimes calls “Garbage In – Garbage Out”. Quantitative risk analysis will be subject of the same heuristics and biases: availability, anchoring, etc. The most straightforward solution will be to import data for quantitative analysis from qualitative project risk management software. Such integration has been already implemented between some qualitative and quantitative risk management software tools.

Quantitative risk analysis software can statistically process data from qualitative tools. Most quantitative risk analysis tools perform Monte Carlo simulation to determine how risks will affect project schedule. One of the methods of modeling risks and uncertainties calls Event Chain Methodology. According to this methodology, an activity in most real projects is not a continuous uniform process. It is affected by the external events, which transform task from one state to another. These events should be properly captured in qualitative risk management software. The events can cause other events, which will create the event chains. These event chains will significantly affect the course of the project. The identification of the critical chain of events makes it possible to mitigate their negative affects.

Now we can come back to our original drilling example. If oil company had qualitative risk analysis software, they would have comprehensive historical data about events, which could happen during drilling, not just duration or cost of similar wells. It will help them to make an informed decision. In decision still has been made to perform drilling and mud disappearing has occurred, both qualitative and quantitative risk management software working together will help the engineers decide about further course of actions. Establishing proper project risk management process will help oil company to save million of dollars.