Overlapping Boundaries of the Project Time Management and Project Risk Management

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Based on utility function, milestones during project and/or the end of projects or programme may be categorized in what are called soft-deadline and hard-deadline. In contrast with the soft-end projects, the hard-end projects posses a decrease of utility function with a vertical asymptote character around the deadline for project completion. In extreme situations, the utility function itself may fall under zero (projects may generate losses to both constructor and customer). Existing risk analysis methodologies observe risks from monetary terms. The typical risks are correlated with an increase in final project costs. In order to estimate hard-deadline milestones and/or end of projects or programme is critical to employ the time dimension rather than the typical cost-based risk analysis. Here, we comprehensively describe a structured methodology that focuses on minimizing and mitigating project specific delay risks. The method may supplement existing cost-based risk analysis in projects. We aim to elegantly combine moderation techniques to reveal the intrinsic risk of the projects. In addition to the technical risks, the moderation techniques are able to bring evidence of risks as the team efficacy, diverse un-correlations or miss-understanding about the roles of the team members in the team – most of the project soft risk. Described methodology encourages the common understanding of risks for participants, crystallizing the essence of what can go wrong in complex situations and where the opportunities can be unlocked.
Keywords: Project Management, Risk Management, Time Management, Deadline, Delays

1 Introduction

In this paper we describe overlapping boundaries of the Project Time Management and Project Risk Management. It can be regarded as a special case of the risk management, when from the project objectives the timely achievement of milestones and/or end-of-project is critical. In addition to critical situations, there are projects (e.g., software development projects) where the time is the essential characteristic; the development time is directly translated in cost of personnel.

By definition, project risks are uncertain events or conditions that, if occurs has a negative effect on a project's objectives. Contrasting, positive uncertain events are called opportunities. More, risk management aims its practices to be tailored to the project and congruent with the organizational culture, processes and assets. Risks are unequally important, that's why it is very important to filter and prioritize risks for further attention. Organizations have increasingly been using projects to achieve their strategic objectives [6]. Projects are dealing with increasing complexity, uncertainty, and ambiguity affecting organizations and the socioeconomic environment within which they operate [2]. Through projects, resources and competencies are mobilized to bring about strategic change, and thereby create competitive advantage and other sources of value [1].

Known as project planning or project scheduling, Project Time Management includes the activities and processes required to manage timely completion of the project and is a project management subcategory. Time Management has been identified as one of the core functions in project management. The PMI® standards [7],[8] define project

time management processes to include the following:

- Definition – The process of identifying the specific actions to be performed to produce the project deliverables;
- Sequence – The process of identifying and documenting relationships among the project activities;
- Resources – The process of estimating the type and quantities of material, people, equipment, or supplies required to perform each activity;
- Durations – The process of approximating the number of work periods needed to complete individual activities with estimated resources;
- Develop Schedule – The process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule;
- Control Schedule – The process of monitoring the status of the project to update project progress and managing changes to the schedule baseline.

In the context of project risk and project time management we describe a method that provides realistic delay-estimates in complex projects/programme roadmap. We combine the time management structured approach with the classical risk management. Advances are based on moderation techniques and data-mining specific delay analysis tasks.

This paper proposes a structured methodology that focuses on minimizing and mitigating project-specific delay risks. It aims to offer a method to analyze delay risks in large and complex projects with hard-end where the utility function falls under zero. In such situations it is critical to estimate the end-project from time perspective. An approach that models risks as cost-based management is biased.

2 Cardinal Utility Function

Economists distinguish between cardinal utility and ordinal utility, the last being a rank-comparison of: options, contracts, projects, execution quality etc. In risk assessment activities, customer made already a decision that company "YZ" is executing the project. Therefore, the cardinal utility function over time is more appropriate, while ordinal utility may captures only ranking and not strength of preferences.

Let X be the specified set of requests agreed under the contract and desired by the customer. The customer-specific utility function $u : X \rightarrow \Re$ may estimate the achievements. To the customer-specific function, we may calculate the execution costs (or depending on the situation customer scheduled payments) $e : X \rightarrow \Re$. The overall cardinal utility function would collect the customer utility and execution/investment utility functions (money spent). When cardinal utility is used, the magnitude of utility differences may reflect the rank-comparison when treated as an ethically or behaviorally significant quantity.
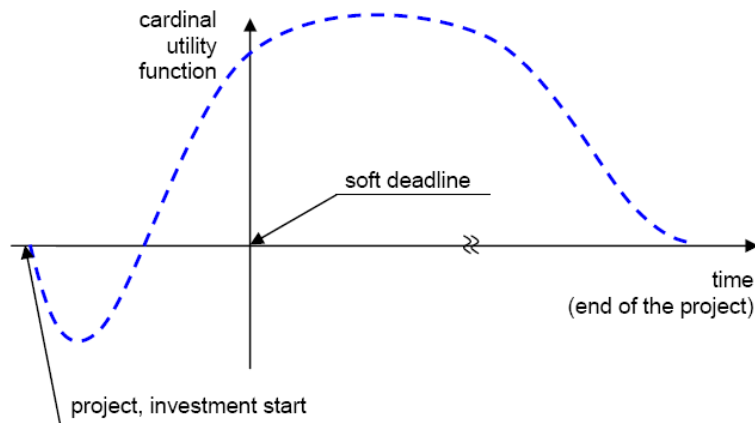

Fig. 1. Projects with soft deadline, comparison of hard deadline and soft deadline with implications for $\partial_{utility} / \partial_{time}$ slope
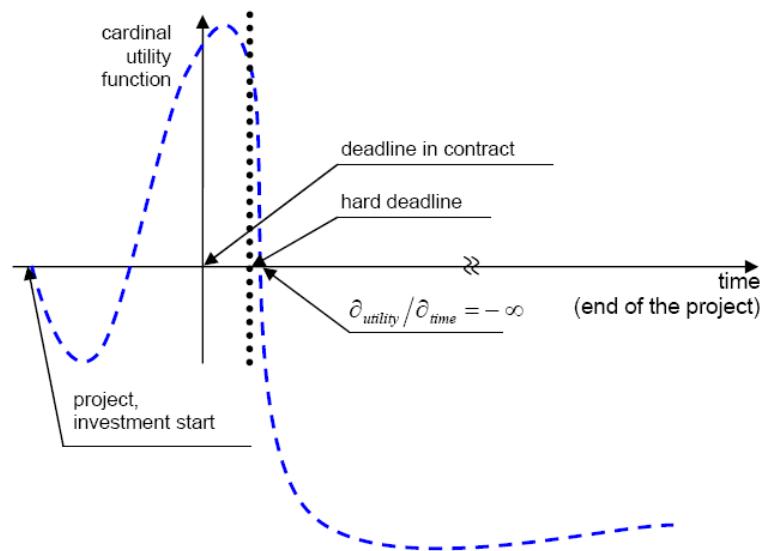
Fig. 2. Projects with hard deadline, comparison of hard deadline and soft deadline with implications for $\partial_{utility}\big/\partial_{time}$ slope

A simplified example of a cardinal utility is the probability of achieving project target multiplied with its value, minus the costs involved in execution. In the case of a hard deadline project that is completed after the deadline, the project is deemed "un-useful and costly". In addition to the loss on execution costs, loss of materials, we may add the loss of credibility for execution capability (loss of future contracts) and customer losses which could gain if he was commissioning with other company. The Figure 1 and Figure 2 present the comparison of hard deadline and soft deadline with implications for $\partial_{utility}\big/\partial_{time}$ slope.

In certain situations when the time-to-market is critical, either because of the competition pressure, or because customer willing to drop the contract; when upper management pressure for the respective department lead is high – a hard deadline may present more or less transparent.

3 Hard Deadline and Soft Deadline Milestones in Projects
Contractual conditions stipulates in most of the large projects the way to deal with delays and the penalties if the delays occurs. Under an old cliché that we all know and understand "Time is Money", most of

existing project risk analysis cover the delays by evaluating and understanding the contractual conditions, later considering the impact resulting from these delays as liquidated damages, also referred to as liquidated and ascertained damages (LDs).

Amount the parties designate during the formation of the contract for the injured party to collect as compensation upon a specific breach (e.g., late performance) are generally detailed in the contract. Further, depending on the activity the delay risk may occur, e.g. certain delay may not be on critical path – the impact may or not be foreseen as cost-risk part of liquidated damages. In certain situations, the combined risk may accumulate and the maximum amount, if stated is reached – the caps (CAPs).

Contrasting situation which may be described as soft deadline, certain projects have hard deadlines. In more rigorous way, the concept of deadline is a time at which the value of the utility function falls to zero. Never the less, in most of the projects described as soft-deadline, although paying penalties there is a clear positive utility function for completing the project after the specified date. In the case of hard deadline the utility function drops dramatically reaching the mathematical zero values. Specific is the slope

$\partial_{utility}/\partial_{time} = -\infty$ with obvious negative trend. A typical example of hard-deadline would be to build a stadium for future Olympic Games. If achieved weeks after the designed Olympic Games, the utility function drops to negative values represented by investment costs and loss at customer.

4 Sources of Risk in Technical, Project or Financial Risk Analysis

In the book [4] "The Failure of Risk Management: Why It's Broken and How to Fix It", the author defines risk management as the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events. For the most part, the methodologies consist of the following five elements: 1. identify, characterize, and assess threats; 2. assess the vulnerability of critical assets to specific threats; 3. determine the risk, i.e. the expected consequences of specific types of attacks on specific assets; 4. identify ways to reduce those risks; and 5. prioritize risk reduction measures based on a strategy. These are basis for our methodology.

More, regarding sources of variability in risk management we identify four circumstances:
1. Event- Risks which infers with the project
2. Intrinsic variability of the accounted activities in terms of costs / duration
3. Correlations on events & variability
4. Environmental changes during the project

1. Event-Risks which infers with the project
Event-risks are the risks due to unforeseen events partaken by or associated with an activity of a project/company/programme. Event risks may affect one or several activities; e.g., in graphical representation we may point changes on the Gantt diagram path. As any risk, event risks are characterized by the impact (either cost or delay) and the probability.
2. Intrinsic variability of the accounted activities in terms of costs / duration

Each of the activities/package representation in the plan is an estimate of its set of actions, implementations. Estimation is the calculated approximation of the result, which is incomplete and uncertain. Based on statistics, in order to arrive at a desired estimator for estimating a single or multiple parameters, it is first necessary to determine a model for the system. The model shall incorporate the process being modeled as well as uncertainty and noise. We can talk about error of the model, as well as optimal estimators. Contrasting, the planned activities are extremely biased into the most-likely duration and cost: the projects present Gantt diagrams of activities based on one value.
3. Correlations on events & variability
Let's assume there are two risks: *Event_A* and *Event_B* affecting the same activity of a project. Each of the risks is defined by their probability and impact. If the two events are independent (which actually is more rare in reality than in theory), the probability of both to occur in the same time is the product of the probabilities. The impact of the new event is frequently several order of magnitude compared to each of the events. Correlation of events can be catastrophic, when occurs. The same logic can be extended to risk-events combined with the variability of events.
4. Environmental changes during the project
The projects that require specific attention of risk management span over several years. The economical conditions over this wide extent may dramatically change the position of the project in the environment, may change the customer and its ability to pay, etc. We recommend attention to environmental changes for dynamical areas.

5 Intrinsic Variability of the Activities and "Event Risk" Delays Evaluation
The classical methodology, see Fig. 3, combines moderation techniques with the aim of revealing the intrinsic risk of the projects. In addition to the technical risks, moderation techniques are able to bring evidence of risks as the team efficacy,

diverse un-correlations or miss-understanding about the roles of the team members in the team – most of the project soft risk. As plus, the moderator encourages

the common understanding of risks for participants, crystallizing the essence of what can go wrong in complex situations and where the opportunities can be unlocked.

Fig. 3. General methodology to evaluate risks, it applies to delay analysis

We elegantly combine moderation techniques with the aim of revealing the intrinsic risk of the projects. In addition to the technical risks, moderation techniques are able to bring evidence of risks as the team efficacy, diverse un-correlations or miss-understanding about the roles of the team members in the team – most of the project soft risk.

In complex projects, the chronologic approach or structured manner (following the risk breakdown structure) may ease the moderation. Because the structured discussions help also review the project, we advise to evaluate first the variability of the activities. Gantt-diagrams represent most-likely duration for activities. Viewed from the perspective of estimators, in addition to this "most-likely" value, each activity has an intrinsic variability. E.g., design activities may depend on finding earlier-or-not solutions, these activities may have deviations. The activities span between a minimum expected duration and a maximum expected duration.

Inside this time-window, the end-of-the-activity of multiple similar activities may generate various distributions. Based on the experience of the specialists the moderator acquires empirically the distribution of the end-of-the-activity as it was in previous similar projects. Authors recommend to acquire details for each activity as days-impact, probability minimum and maximum

duration, confidence with the most likely duration.

Following intrinsic variability of the activities, moderator may further focus on "*event risks*". The advantage of this order is the review of activities whiles the intrinsic variability evaluation. There are two parameters that are required for event risks: one is impact [in days, weeks, months] with respect to the current activity. The second parameter is the probability of occurrence.

This method contrasts the classical holistic approach to evaluate the costs that may generate LDs or CAPs to the over-all project at once. Mainly, some event-risks are on the critical path dramatically influencing the project while other events affect peripheral activities. The event-risks own a probability that is roughly estimated from previous projects or situations. From a simplistic perspective the moderator may ask "how often this event occurred in the past situations / may occur in current environment", letting the specialists to give a probability for the current project. When the upper steps are complete, the moderator can follow to extract mitigations and valid approaches that may avoid the presented delay-risk.

As important step, it is essential to acquire the activities that are affected by the event-risks. The moderator should avoid vague collective activities and extract the exact list of activities affected by the risk. There are

two options the moderator asks: "how much in addition" the risk affects the respective activity, or percentage of the respective activity (NB. Values should be greater than 100% in case of risks). Other options may include additional resources, additional plain days.

From past experience in various projects, interesting note is that the specialists of diverse fields that participate together in a moderation workshop agree easy on the probability and impact values. In most cases specialists have an extremely good knowledge about the occurrence about the impact of certain risks. They agree easy on technical areas, as well on mitigation measures that may stop, avoid or combat the undesired event. Contrasting, in most of the projects the opportunity that the specialists communicate is a systematic weak point. Most of specialists would like that they are considered more in the decision process. Also, specialists feel the level of horizontal communication in-between specialists is lower than optimum. Further week point is the structured approach to discuss respective delay-risks. We point therefore that large amount of risks stay in the "soft management" of projects, which is usually easy and cheap to mitigate.

The presented delay method proposes to preserve this particular positive advantage of revealing soft and technical risks, as well, and combines the use of an independent moderator of risk assessment workshop by trained professionals. The moderator discusses the project in a structured manner, following the risk breakdown structure – e.g., derived from work breakdown structure (WBS). The methodology follows a structured qualitative and quantitative risk assessment while the transparent presentation of risk accounts the impact in days and the probability in percentage. Project risk management must be specific for each company but should be adaptable to other companies, internationalization issues being a research interest for several authors [5] and to offer solutions with a low risk for a better

contact with business partners to increase competitive advantages and benefits [3].

6 Conclusions
For the entire project we provide and propose four types of results:
- Risk and opportunity identification; based on the proposed methodology, uncertain events are identified that may perturb each project activity. Delay-risk may affect the project as whole, while other risks affect punctually one-or-several activities. When activities are affected by multiple risks, combinations of risks (with respective probability) were taken into account. Because require distinct measures, opportunities are listed separate.
- Assessment of variability in each activity (based on critical path); each activity has an intrinsic variability (e.g., design activities depend on finding earlier-or-not solutions). Between a minimum expected duration and a maximum expected duration, the distribution of the end of the activity is assessed as: 1) uniform distribution - which has an equal probability between min and max; 2) triangle distribution - which linearly increase and decrease to a maximum likelihood duration; 3) beta distributed and modified beta distributed with more sharp shape around maximum likelihood duration.
- Managing activities: cruciality, sensitivity, criticality; duration cruciality is calculated as the product of the duration sensitivity and the criticality index. Duration cruciality measures of how crucial the task duration is to the project duration. Tasks with a high cruciality are likely to effect the plan duration and therefore finish date.
- Correlated and probabilistic end-date for projects (not only end-date, but a probability between optimistic and pessimistic for each project); based on activity variability and risks, projects may end earlier or later date. Duration distribution takes in account current

project uncertainly. Calendar end-date distribution accounts for cumulative effects and variability in linked projects.

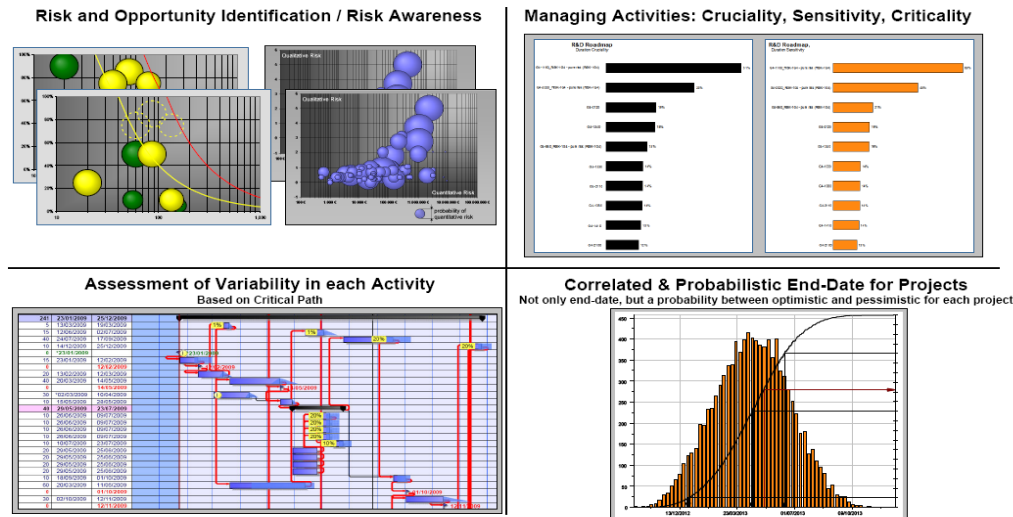We offer the optimistic end-date, most likely end-date, and at each date the cumulative probability.

Fig. 4. Types of results: the "event-risks" portfolio of the project, criticality of activities, Gantt diagrams and the cumulative distribution of the end of the projects

Four types of results may interest our customers; we represent the "event-risks" portfolio of the project – upper left. Using Pertmaster® we provide the standard cruciality, sensitivity and criticality of activities – upper right. We re-evaluate the Gantt diagrams based on the modeling of activity variability's and event-risks – lower left. At end, we propose the distribution and the cumulative distribution of the end of the projects – lower right.

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