USAGE OF PROGNOSTIC METHODS IN LARGE PROJECTS
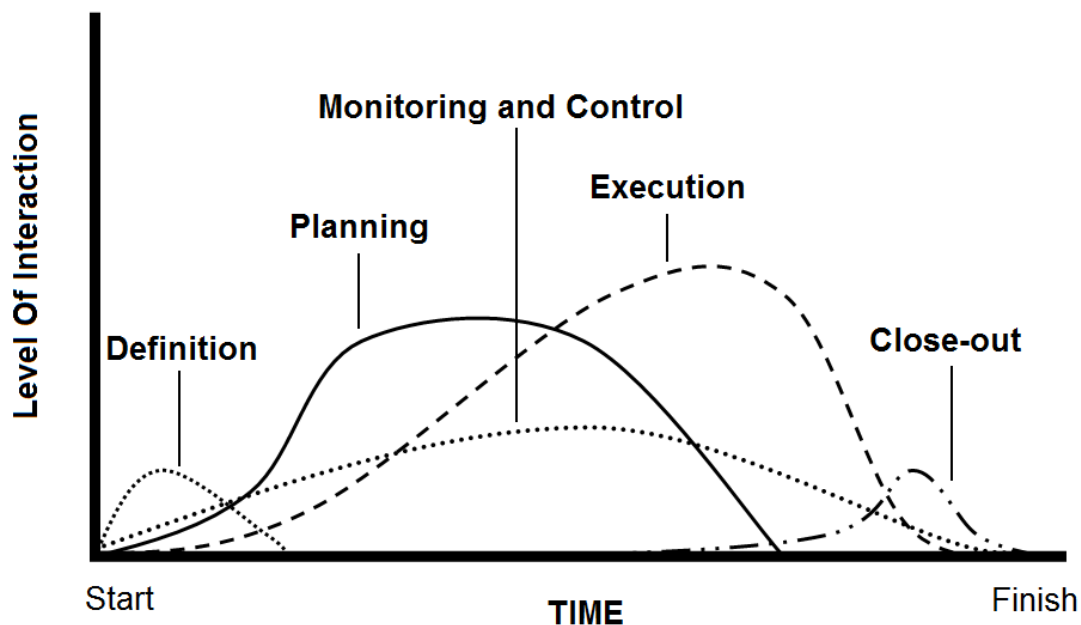
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Summary: This article discusses the aspects of relationship between prognostics and project management as two distinct study fields. Main commons and differences are discussed and allow considering similar approaches for large or very complex projects where those approaches can be used.

Key Words: Project management, Project Risk Management, Prognostic Methods, Forecasting.

INTRODUCTION

Prognostic methods and Project Management are two different disciplines with one very close area which is the methods used in Project Risk Management. Project Risk Management is one of nine Project Management knowledge areas (1) that run through all project cycles in every project. It is present in Definition, Planning, Execution, Monitoring and Control and Close-out of the project (Figure 1). Much like in Prognostic methods, in the discipline of Project Risk Management are used the techniques allowing estimating the future states on the project.

Source: Author

Fig. 1 – Project cycles in accordance with PMI methodology

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1. RELATIONSHIP OF PROGNOSTIC AND PROJECT MANAGEMENT

1.1. Differences and Commons

The most significant difference between the two discussed study fields is in the timescale limits of the forecasts. From the definition of project itself it is evident that: "A project is a temporary endeavor undertaken to create a unique product, service or result. The temporary nature of projects indicates a definite beginning and end. The end is reached when the project's objective have been achieved or when the project is terminated because its objectives will not or cannot be met, or when the need of the project no longer exists. Temporary does not necessarily mean short in duration. Temporary does not generally apply to the product, service or result created by the project; most projects are undertaken to create a lasting outcome. For example, a project to build a national monument will create result expected to last for centuries. Projects can also have social, economic, and environmental impacts that far outlast the projects themselves." (1)

Prognostic methods are applied also to relatively strictly set timeframe. Those timeframes are however much longer than in the case of projects. Another very important difference in projects and prognosis is that the scale of the project is always known – and usually known very much in detail. It is therefore much simpler to focus on the areas that directly, or indirectly, impact the project. The situation in prognosis is more complicated. However the first step in prognosis making is to border the scale of studied area, the scale is always much larger than the scales common in projects. Typical project can be in scale of large transportation projects, bridge construction, construction of highway overpasses or multilevel road crossing. However the construction projects in transportation belongs together with building industry to the largest project scales, (in comparison with other industries like IT, Banking, Manufacturing), the prognostic models describe much larger ensemble where the studied area can be the whole technological evolution of the society or the speed of immigration from Asian countries into European Union. The scale of the studied areas in prognostics and its timescale determine the prognostics as a difficult discipline that has many input variables. In spite of the different scale in time and input variables, the approaches for revealing the future states are analogical. The first analogy is the principle of the time and area limitation that makes it easier to grasp the problem both in project risk management and prognostics. The most significant difference lies in the scale. Whilst in the case of prognostics the time bordering is an instrument and the time boundary is logically or practically set, in project this time interval is given directly from the length of the project as stated in the contract. The studied time period on project is significantly shorter than in the case of prognostics. Typical projects are realized in span of couple months to couple years with strong dependence on the industry in which the project is realized. If the complexity of the project exceeds certain limit, which is mainly given by the manageability of the project, the solution is typically divided into multiple individual projects managed and coordinated within a program. (1, 4) Prognostics, in contrast with projects, are elaborated for ten, twenty and even fifty years into the future. The limitation of the scale as used in projects cannot be

used in prognostics because the society, politics, or technology evolution is not managed in individual steps but rather evolve continuously.

1.2. Methods and Tools

There were many prognostic methods developed during the existence of the field study of prognosis making. A good example can be Decision Models, Delphi, Statistical Modeling, Participative Methods, Scenarios, or the Trend Impact Analysis. Those methods more or less correspond with techniques used in project risk management. Whilst Trend Impact Analysis is analogical with Earned Value Management method in risk management (EVM), the usage of scenarios or Delphi approach is almost identical in both fields of study.

1.2.1. EVM vs. Trend Impact Analysis

Trend Impact Analysis is a prognostic method allowing the alteration of extrapolated trends on the base of expected future events which can have an impact on the trend. Similarly Earned Value Management is a method of project management which follows the flow of the project-value-creation process, compare the flow with exercised costs during the project and those two flows compare with trends of already realized set of projects in the same industry. Sufficiently large projects from individual industries have from observations very similar flow of exercised costs and trend of value-creating indicators. With those statistically standardized model trends from individual industries it is possible to compare the trend of currently realized project and foresee the impacts of following progress (5).The extrapolated trend altered by this process enters then the next phase where it is evaluated how the altered trend will affect the forecasted future. Superposition of all those mutual possible circumstances (factors) creates the final forecasted future state. There is never a situation where all the factors apply. Similarly as in project the probability of realizing all identified risks is very low. Therefore the set of the most probable future states is created and only the most probable ones are used for further analysis. Extreme values from this analysis at the same time set the borders of the area where the trend can fluctuate. In most of the projects there are not many possible future states forecasted. The results from future state analysis is rather used as inputs for operative management which are often altered during the execution of the project. Same as in the case of project management, also the future forecasted states in prognostics are adjusted within the time. Studied time interval is however much longer and therefore there are created many future possible states. This process of forecasting embodies work with large amount of data. That is a reason why are commonly employed progressive computer techniques.

1.2.2. Scenarios

Another example of same approaches used both in project risk management and prognostics is the creation of scenarios. From its principle scenarios are stories of possible futures. Those stories connect the description of certain future state with contemporary situation in given area. The scenarios are not definite forecasts of the future. They are rather a manner of organization of many arguments about the future that can, in specific circumstances, become real. Creation of scenarios has long history. They were first time

created in army related and strategic studies in fifties in 20th century. In sixties they were popularized and focused on questions of US public politics. The usage in private sector then followed. Scenarios are divided into two main types: qualitative and quantitative. Qualitative scenarios must be trustworthy, internally consistent, sufficiently interesting and inspiring with a goal of influencing politic decision making. Quantitative scenarios, on the other hand, employ creation of high number of scenarios generated following from common input variables and using random events generators. Both types of scenarios undergo further evaluation and the most probable is selected as a rough estimate. In scenario creation there are three distinguished phases: Preparation, Elaboration and Reporting/Usage (Figure 2). In Preparation the key activity is the definition and circumscription of the studied area. In Elaboration are identified the key triggers (e.g. economic growth, legislation environment, technological evolution), influential events and all those are projected to each other to create individual scenarios. In the last phase Reporting/Usage the documentation is accentuated as well as consequences of alternative scenarios and politics testing.
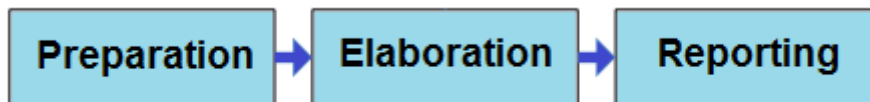
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Fig. 2 - Phases of scenario creation

Exactly the same scenarios are used in project risk management. The limitations of the scenarios are however very strict and forecasted progression of the project is very short. The most probable scenario is often adjusted in following processes of risk management and the adjustments overlap the Reporting/Usage phase (communication of the risks among project team).

1.2.3. Delphi

There are many ways to create the scenarios. Method Delphi, as known in prognostics, accommodates multiple runs of questionnaires among the panel of experts. Those investigations are anonymous and after every round the feedback is presented. On large project can be used the shortened version of Delphi approach for identification of risks in possible progress scenarios of the project. Individual rounds on projects are very fast and the experts are exclusively project stakeholders: members of existing/creating project team, sponsors of the project, and managers of the program which the project belongs to. It is needed to say that method Delphi is not commonly used in most of the projects. It can be however successfully used on very large projects in construction industry where the forecasts of progress are complicated by long delivery time and multiple input variables.

1.2.4. Brainstorming

More often used method for initial analysis of future states both in prognostics and project management is Brainstorming. This method uses basic ideas for pronouncing the real

future risks. The usage of this technique is suitable especially in the initial phase of the project: either Definition or Planning, where are identified the limitations of the project. All ideas are welcomed and recorded. The participants of brainstorming sessions are commonly members of project team, sponsor of the project, and eventually the program manager if the project is part of a program. Brainstorming session is lead by one moderator that watches the time and relevancy of the discussion. If the working group shifts to non-relevant topic he or she closes that topic and opens a new one or reopens an unfinished topic from the beginning of the session. During the session are recorded only the identified risks from individual scenarios, not the scenarios themselves. The goal of brainstorming session is identification of the highest quantity of possible risks that can influence the progress of the project. Both negative and positive risks are recorded. (Risk is widely perceived as negative possible event in the future. Project management however defines a risk as an event in the future that, if it realizes, has positive or negative effect on the project. Negative risks are called Threads and positive risks are Opportunities. (1) Good example of very common positive project risk is an opportunity for amendment to the existing contract that extends the delivery of another paid part of the project. Example of a negative risk is a threat of strike in employees and consequent delays that can be even penalized according to the project contract.)

2. USAGE OF CREATED PREDICTIONS

The most visible difference between prognostics and approaches used in project risk management is the activity of managing the risks. Whilst study field of project management includes whole lifecycle of project risks from identification to their management and closure, prognostics embrace the identification phase, creation and finishes with communication of the findings. (Compare Figure 3 and Figure 4)
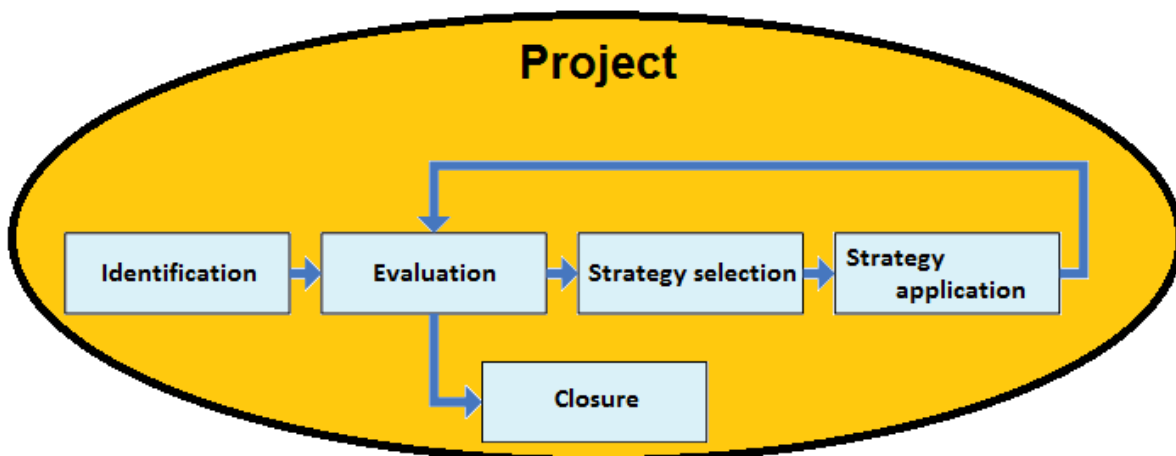
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Fig. 3 - Project Risk Management Cycle
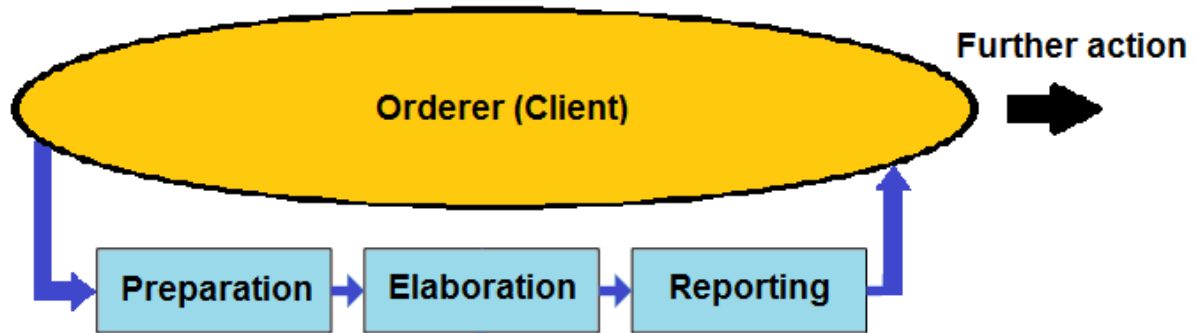
Fig. 4 - Prognosis Flow Diagram

Projects risks are not only identified, but are worked with them further to assure the optimal impact: the highest degree of realization of the positive risks and the highest mitigation of the negative risks. There are distinguished risk responses on the project. The most often used responses are the ones for managing negative risks: 1. Avoidance of the risk, where the project manager take appropriate actions to assure the risk cannot be realized; 2. Transfer is a situation when the risk is transferred to some other entity outside the project (Common example is insurance, where the possible negative effect of realized risk is borne by the insurance company for agreed price paid from the project that is expected to be smaller than the possible impact of realized risk.); 3. Mitigation is an approach to reduce either the impact of the possible risk or the probability of the risk that the overall value of the risk is minimal; 4. Acceptance of the risk means that the project is consciously ready to accept the full impact of possible realization of the risk. Besides negative risks there are risk responses for positive risks as defined in (1): 1. Exploitation is an approach that assures the realization of an opportunity.; 2. Sharing is an approach where the opportunity is shared with third party that is better able to benefit from the opportunity to collectively benefit both parties.; 3. Enhancing is an approach that increases the probability or impact of the positive risk (e.g.: Increasing the probability of an earlier delivery even with some additional costs for obtaining early delivery premium where the premium is more beneficial than extra costs spent.); 4. Acceptance is passive acceptance of the opportunity if it comes.

In prognostics the communication of the most probable scenarios is an input into much larger structures. Results of the forecasts serve as one of the fundamental pieces of information for further social, political, or technological evolution planning. They can be enforced in creation of visions of multinational companies, country strategic planning, investing into military sector, or planning of future budgets of International Monetary Fund. Following proceedings are undertaken by the orderer of the prediction who will employ the optimal strategy. Application of selected strategy is more complicated in fact that the researched area is wide and it is directly linked with other industries and interdisciplinary areas. World development of economics, technology, politics, culture, etc. influences each other and a change in one area has direct impact on other areas. Relative isolation found in case of project risks are not present in predictions. If the orderer use the prediction to apply

the steps to influence expected trend of continuous development the impacts of the influential step are notable to other entities which can be allies, rivalry or other engaged entities. The orderer therefore has to take into consideration the possible steps of those entities to apply its strategy. In contrast with project management risk response strategies, innovative steps in influencing continuous trends have to take into consideration the infinite character of influenced development. Project management can for example use the approaches directly coming from characteristics of projects. It can use the risk response Avoidance relatively simply, in the projects where the risk is bound to specific time, by assuring that the project finishes before the trigger time occurs. This approach is not usable in influencing continuous trends. Sound example can be affecting of state economy development. It is possible to artificially stimulate the GDP growth or suppress the unemployment. Consequences of short term goal oriented planning will however result in future economic falls and indebtedness of the country. It is needed to bear in mind that if the state uses a loan for development of one area the loan persists to following epochs and can influence the future development in the way that the sum of total gains can be less than optimal. It is not therefore possible to plan only for one epoch because after this epoch the consequences would be transferred further.

3. CONCLUSION

The importance of future development is evident in many fields of study. Prognostics and project management are examples where methods for predictions are used. Those methods are under continuous development and are successor methods to those used 200 years ago during military actions where they were first recorded. Significant step in methodology evolution is nowadays the employment of strong computational power, usage of random event generators and the possibility of usage of large amounts of automatically generated scenarios. Similarities of study fields can inspire both disciplines to accommodate other techniques not originally developed for them. This is mainly possible due to the evolution of the fields of study themselves. Length of projects is continuously growing and so is the complexity of the projects. It is becoming therefore relevant the usage of new approaches, ideally from other study fields that already deals with similar uncertainties.

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