Survey of Models and Tools for Project Monitoring and Control

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Abstract

In software project development the monitoring and control stage perform the crucial role in project development success or failure. Project monitoring collects information of project development against the plan if a deviation occurs the appropriate corrective action is performed. There are different models, tools are used to monitor and control the project development. This paper discusses these models and tools with their limitations and also further research directions.

Keywords: Models, Tools, Project Monitoring and Control, EVA (Earned Value Analysis)

I. INTRODUCTION

Nowadays each organization wants to use the web application, software to manage their organization data so projects are becoming the important part of any firm, organization, industry. Any project can be developed using plan, do and check. So project monitoring and control is checking or tracking of project progress and control it when necessary. In software project development the monitoring and control stage perform the crucial role in project development success or failure. In project monitoring and control tracking is performed by checking status of project development and comparing status with the plan. If any deviation is detected then implement the appropriate corrective actions. So main purpose is to reduce the deviation. Therefore it contains set of methods, tools and policies would ensure the achievement of the planned targets of project. The following policies should be clearly defined by effective system:

1) Tracking policy: what, how, where, when and by whom to track status of project development,
2) Identify deviation and implement corrective action policy: what, how, where, when and by whom to restrict, check and implement corrective actions[1].

To develop successful project company should give special attention to project monitoring and control. Generally, project manager does this task and also sometimes the senior head of company also involved in controlling activity when the high-level problem occurs. Controlling the project development depend on the monitor activity if monitoring is not done efficiently then to achieve planned work appropriate action cannot be determined.

Today’s companies located across the globe having subsidiary branch and software project development teams so currently software development activity is distributed among different branches of the company. So project monitoring and control activity should be changed to cope up with these changes of organizations. Latest researches are going in this direction to achieve efficient monitoring and control of a project.

Monitoring and control of project can be done using different ways so these different ways are considered as models. We can apply the monitoring and control model based on our project development environment. The project development environment like agile development method, so monitoring and control activity performed according to the agile process. One another example of a model is multi-agent workflow system.

Tools are used to do a particular specific task, in software project monitoring and control tools are available to monitor and control project development process. The software project management meets at least following three objectives

1) Delivered software should satisfy the customer requirements. It functions properly without major faults.
2) The developed project should be well engineered, architecturally robust, and allows smooth integration and further development and maintenance.
3) On time software project should be delivered[2].

Software project management needs tools to monitor above key goals and alerts early in case of any goal are not achieved. Then management can take appropriate action to deal with the problem. Also, tools monitor the project and store the monitored data so that these data help management in controlling activity.

The most widely used tool is the EVA (Earned Value Analysis) in the industry as management monitor and control tool. As per the PMBOK Guide,

“Earned Value Management (EVM) in its various forms is a commonly used method of performance measurements. It integrates project scope, cost, and schedule measures to help the project management team assess and measure the project performance and progress.”
This paper discusses the models for project monitoring and control. Some models are evolved considering working criteria. In this, some tools are described with their techniques. EVA is the most important tool so this paper focuses on this tool specially and also limitations and solutions. EVA is implemented using different strategies so these strategies concluded as a survey.

This paper organized into three sections, the first section describes different models that can be used for monitoring and control. Then the second section describes the tools used to monitor and control the project. The third section concludes all things presented in this paper.

II. MODELS

A. Ontology-based Intelligent Decision Support for CMMI Project Monitoring and Control

C. S. Lee, M. H. Wang, et al described an ontology-based intelligent decision support (OIDSA) to use to project development observations and management of CMMI (capability maturity model integration). The OIDSA collection of three agents a fuzzy inference agent, a natural language processing agent, and a performance decision support agent. Ontology repository contains details of the OIDSA, containing the project personal ontology and the CMMI ontology[3].

The collection of key concepts and their inter-relationship collectively provides an abstract view of an application domain called as ontology[4]. Ontology is necessary for agent system; user and system can communicate with each other by a shared and common understanding of a domain. An agent is capable of an acting environment, it can be a virtual or physical entity, it can interact with other agents directly[4]. CMMI is a version for manner improvement and offers a facility to keep away from or remove the bottlenecks and boundaries that exist in corporations via included models that transcend disciplines [5].

The CMMI consists of specific dreams of undertaking tracking and control. The primary unique purpose is to screen if real overall performance and deliberate progress are not matching. The second specific aim is to manipulate corrective actions whilst performance or end result of task deviates appreciably from a plan. desk 1 indicates the specific exercise to specific purpose dating of assignment tracking and control system area[3].

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<th>Specific aim</th>
<th>Practice to goal relationship of project monitoring and control process area[3]</th>
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<td>Specific practice</td>
<td>1. Display task towards plan</td>
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<td>1. Display assignment planning parameters</td>
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<td>1.2. Screen commitments</td>
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<td>1.3. Display assignment dangers</td>
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<td>1.5. Display stakeholder involvement</td>
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The OIDSA can deliver effects in the completed percent of progress primarily based on the deliberate progress document for subsequent work and real progress document, which now not only reduces the fee of the project and effort of human beings but also affords a foundation for the task supervisor to evaluate the overall performance of every project member[3].

To put formally the method described by authors in three parts.

- First natural language processing agent preprocesses the documents of planned progress and actual performance based three factors part of speech similarity, range similarity, and distance similarity then it offers the result as key phrases and passes to inference agent.
- Second, the bushy inference agent processes the key terms and generate the level of similarity based on above three key factors.
- Using the information given by inference agent the choice assist agent offers the measurement of completed project in percentage. And it compares the percentage of different members if the difference is small then the performance of OIDSA are better.

The experimental results state that the OIDSA for CMMI efficiently evaluates the percentage of finished task. there may be additionally trouble like if the project member reviews “to attain an understanding of requirements” within the planned development report, but reports “Failure in an know-how of requirements” within the actual progress file, then such collisions are still resolved by means of the mission manager which need to be resolved in in addition research[3].

B. ESSENCE and its Alpha

ESSENCE is an effective strategy to communicate with work team in a timely and accurate manner. The primary focus is on the people involved in project development and on the delivering the product that satisfies clients requirements[6]. ESSENCE is an OMG (Object Management Group) standard of great value and it can provide domain model organizing the factors that affect the success of the project.

ESSENCE composed of two parts the kernel and language, the kernel contains the small number of things that always we work with and things we always do while the language used to describe methods and practice. The Kernel includes a set of ideas called ALPHAs that provide an object-oriented state-based totally model of a software engineering undertaking[6]. Authors described [6] three main benefits of ESSENCE model as following:
Survey of Models and Tools for Project Monitoring and Control

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- It provides massive-scale complete model for the large scale process development undertaking.
- It makes visible to practitioners both theory and practice. So it is context-aware model.
- Anybody of work team can use this model at any time so it is evolvable and participatory model.

ALPHAs are the higher level concept which refers to the software engineering endeavor relevant to project progress and health. The main purpose of ALPHAs is to determine fast and at anytime how a project is doing. It provides measurable objectives and consistent language to articulate next step and goals.

The following listed are the components of ALPHA:
- A representative and unique name.
- A set of states through which ALPHA passes during its lifecycle.
- A checklist for each state to determine the state is reached or not[6].

The following figure shows the seven APLPHAs divided into three groups which are Customer, Solution and Endeavor concern[6]:
- Customer(green)
  1) Opportunity (6 states)
  2) Stakeholder (6)
- Solution (yellow)
  1) Requirements (6)
  2) Software System (6)
- Endeavor (blue)
  1) Work (6)
  2) Team (5)
  3) Way of Working (6)

So in ALPHAs the states are maintained and practitioners can easily evaluate project progress by checking states and there is also the limitation that sometimes cards sets are not handy because of ALPHAs have too many states. In this paper[6] authors share practical survey of using APLHA in the industry and also they gave some advises of using ALPHA.

In ALPHAs following further research described: (i) to establish patterns, like usage scenarios, of when, how and what particular problem ALPHA(s) could solve; and (ii) to determine how the ALPHAs overlap with other standards in order to define a harmonized multi-model process and not implement each one separately. Lastly, (iii) the organization under discussion started to explore how the ALPHAs could be integrated into enterprise architecture services.

C. Software Project Monitoring based on the Similarity of Software Project

The research in this direction also done the paper describes the way how the similarity of the project helps to do monitoring activity in project development. Also based monitored and result from data the corrective action performed in controlling the activity of project development.
Now the similarity can be measured in terms of deviation scenario. To measure similarity authors proposed different formulas of simPDS (similarity among project deviation scenarios). simPDS consisted of two project deviation scenario the current deviation scenario (DSc) and previous deviation scenario (DSP) [7].

The similarity of project deviation is calculated for different attributes of the project like software complexity, requirements stability, application type, project size, project technology, project team size, lifecycle model etc. The calculated similarity level is retained between 0 and 1. After followed process of all calculation the percentage of similarity will have resulted. Based on the similarity the Corrective Actions Recommendation System – CARS the deviation scenario captured into the case repository and corrective action is recommended to execute. After execution of the action, an effect is analyzed and knowledge learned from analysis and knowledge is saved into case repository for future deviation [7].

**D. Project Monitoring and Control in Distributed Project Environment**

The number of companies increases the software development in distributed manner around the world so that distributed development attracted the researchers to pursue research in this direction [8]. The main key factors which affect the development of distributed software are priory, language, culture, distributed information and technology. So the project manager should give special attention to these key factors and at any instant of time he should able to know project status.

The developed model is based on bibliographical research that is systematized aspects of the monitoring and control of a production process that is the pioneer of management or toyotism. Toyotism defined as the consolidated production process. Proposed model is the combination of a tool that allows collaboration between team physically distant and their aspect with toyotism [8].

The proposed model has 4 processes interconnected execution process, work process, monitoring and control process. These processes are theoretical it can be implemented using following activities:

- The hypothesis is defined.
- Experimental protocol designed.
- Set of rules Environmental and behavioral factors in which experiment.
- Execution of the experiment.
- Analysis of result [8].

The BPMN (Business Process Model and Notation) used as the language to model process in notations. So any process verbally described can be represented by BPMN in notations [8]. Kanban can be defined as the tool for project monitoring, in this it can measure the progress of the project and it was used as of online type [8].

Above described model is limited to the group of developers it still cannot be generalized even its use is positive data because of its simplicity. After future enhancement it can be used by companies [8].

The BPMN (Business Process Modeling Notation) is a standard for process modeling and it is maintained by the GMO which can provide graphical notations for modeling a process as Business Process Diagrams (BPD). It consists of a network of graphic objects like Pools, Activities, Gateways and Sequence/Message flows that defines a business process [9].

BPMN has many advantages some of them are easy to understand, intuitive, and set of rules on the common flowchart in the business processes [9].

**III. TOOLS AND TECHNIQUES**

**A. Most widely used EVA**

EVA (Earned Value Analysis) is a broadly used managerial approach to reveal and manage undertaking and it makes use of the pecuniary unit to degree and speaks progress of an assignment. It compares the real and budgeted values of the paintings performed, the time taken and the price incurred. Consequently attitude of time and value of a task manipulate gadget are incorporated. The evaluation of calculated cost and time table variance for modern-day venture progress and also overall cost and period for the task is expected [1].

In exercise, EVA has been usually used to measure challenge overall performance throughout the life of a task. But, it can also be used in forecasting the resulting challenge outcomes; especially to estimate the anticipated task time and value using the modern-day repute of the challenge. On this element authors evolved 3 forecasting strategies which are primarily based on EVA metrics and in comparison them in terms of prediction accuracy. For that purpose, 9 situations and feasible outcomes were taken into consideration and Monte-Carlo simulation was hired. similarly, pastime sensitivity measures and their relationships with forecasting and use in deciding on task control method had been investigated [1].

To enhance the prediction overall performance of EVA, statistical techniques will be integrated into the evaluation. On this regard, authors followed Bayesian approach and integrated expert’s reviews in describing the probability of events. Similarly to statistical evaluation, learning curves and risk management tools have been additionally combined with EVA. Authors investigated the results of gaining knowledge of and advanced a spreadsheet-based DSS [1].

Authors developed two metrics that determine project over run within project structural deviation. For corrective actions authors have used the simulation and statistical control chart as corrective actions became critical. Authors also performed an evaluation in percent completion of the project using fuzzy logic for estimating project performance [1].
To degree the performance of the tasks authors mixed EVA with a multidimensional manipulate gadget and used information envelopment evaluation (DEA), which is a mathematical approach to comparing the performance of choice-making devices (DMUs)[1]. In the assignment tracking, the performance may be measured as a weighted sum of its outputs divided with the aid of a weighted sum of inputs to assess the task performance of engineering design initiatives the use of DEA[1].

Except for the usage of EVA in forecasting and overall performance evaluation the graphical illustration of EVA parameters utilized by mission manager to take control choice. So a few researchers proposed the graphical and tabular illustration of EVA. Monte Carlo simulation used to replicate and simulate the unsure situations in assignment environments. Using this simulation other researchers evaluate pinnacle down and backside up techniques of challenge or interest primarily based. In task based EVA records is used for early warning alerts, whereas hobby based makes use of activity sensitivity data to determine and cognizance on important hobby. The venture-based totally totally approach observed extra green for networks with serial hobby structure, even as activity based totally approach turned into extra green for networks with parallel interest shape[1]. The main goal of EVA is to give early warning signals about cost and schedule performance of the project development[10]. EVA has also some limitation which is described as following[1]:

- Important and noncritical activities are not differentiated.
- Activities are assumed to be unbiased.
- Behavioral factors of management are not taken under consideration.
- The excellent of tactics and output aren't assessed.
- Statistics requirement is high.

The main drawback of EVA is that it measures quantity not quality. So researchers [10] proposed the technique based on fuzzy logic. They used the new parameter quality performance index (QPI). Earlier than this paper[10] researchers also done the research in the quality status but they had not given the formula for Estimate At Complete(EAC)[10]. The researchers proposed the model which integrates the cost, schedule and quality to form the holistic view of the software project. The enhanced EVA model is shown in the following figure.

![Fig. 2: Suggested earned value model enhancement][10]

The course of the future research is likewise to examine the elements, apart from the extent of reworks and requirements volatility, which includes the mission complexity and the software program development method which can also have influences on the QPI and the proposed a version as an entire[10].

Monitoring and control need tools so in Business Intelligence software EVA was used using agile methodology and result were proved to be viable for micro and small companies[11].

### B. Software Measurement using Statistical Process Control

This method contains three components: an Instrument for Evaluating the Suitability of a Measurement Repository (IESMR) for SPC, a Body of Recommendation for Software Measurement (BRSM) Suitability for SPC, and a Reference Software Measurement Ontology (RSMO) [12].

Software Process Monitoring is a monitoring of software processes and detects the related problems and the causes of detected problems identified using causal analysis. Determining the actual causes from a large number of causes detected by causal analysis requires significant effort[13].

The four items related to size evaluated the use of checklists contained in IESMR; the 4 gadgets are the measurement plan, the size repository shape, the measures defined, and the facts accumulated for the measures. The IESMR gives the approaches for evaluating each requirement and the viable corresponding corrective movements ought to be taken while the necessities aren't glad[12].
The principle purpose of RSMO improvement is to offer a not unusual vocabulary and relevant understanding about the software dimension area, consisting of traditional and excessive adulthood measurement factors [12].

The BRSM presents sensible steerage to perform software program size appropriate for SPC. The BRSM composed of eighteen elements divided into 5 businesses: (i) recommendation associated with software program instruction, (ii) hints related to the alignment among software measurement and organizational desires, (iii) suggestions associated with the definition of software measures, (iv) pointers associated with the execution of software dimension, and (v) pointers associated with software dimension analysis.

In the beginning, the approach did not have any precise equipment to help its use. The RSMO and the BRSM had been defined as documents. The IERSM in flip became composed basically via a file(the manual), a hard and fast of electronic spreadsheets, and software built using Matlab[12].

Greater currently, to support using the additives, equipment are being advanced. For the IESRM, there is being advanced an internet utility containing the checklists and all of the suggestions about the way to perform an assessment. For the BSRM, a web website online is being built aimed to make the guidelines available to customers and help their use, evaluation and development. by doing this we expect to growth the variety of an organization the use of the additives, and the method as an entire[12].

IV. CONCLUSION

The main goal of this paper to represent the survey on models and important tools for project monitoring and control. Though paper focuses on the Earned Value Analysis as it is widely used in project monitoring. This paper discusses the summary of the referred papers of different journals. The models for software project monitoring and control are based on different category like ontology based, states and checklist based, based on similarity of project and model for distributed project environment. This papers focuses on monitoring and control tools like EVA(Earned Value Analysis) and software measurement using statistical process control. This paper described only these models and tools and also the future research direction also described for some models and tools.

REFERENCES