
Series on Earned Value Management¹

Applying Earned Value to Overcome Challenges In Oil and Gas Industry Surface Projects

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Abstract

Statistics show that the failure rate of projects in the oil and gas industry is greater in comparison to other industries. To overcome this particular challenge, a new project management methodology based on earned value is outlined, because new and emerging ideas are needed to reverse this trend in the oil and gas Industry.

Introduction

Even though there is an effort to implement the best project management techniques worldwide, energy projects regardless of their size still experience difficulties, particularly in the oil and gas industry. Oil and gas surface facility projects have difficulties meeting the three successful criteria; delivered on time, with a final actual cost on or below budget, and in full compliance with the requirements.

This article describes the main characteristics of oil and gas surface projects and analyzes the major challenges encountered during the planning and execution of these types of projects. This article also addresses the current use of earned value project management in the oil and gas industry and presents a reason why this technique has not been widely applied. In the last part, a new project management approach is presented to facilitate an effective implementation of earned value in the oil and gas industry, in order to increase the probability of success and return of investment of capital surface projects in the near future.

Oil and Gas Surface Projects

Oil and gas industry surface projects are needed to transport and process the crude oil and gas from wellheads to shipment facilities. Usually wellheads are in remote locations such as deserts, jungles, offshore deep-water and onshore desolated areas. These remote locations are also usually under seasonal cold or hot temperatures and with restricted and difficult access roads. To move the multiphase flow (oil-gas-water) from the wellheads, it is required to install multi or mono phase flow lines and artificial lift equipment like pumps, compressors, pressure vessels, and electrical and remote control units. On the other hand, oil sands deposits are mined when they are close to the surface and large trucks are used to transport the oil sands to the extraction plants.

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Surface process plants are needed to separate oil, gas, water, and sand streams into independent ones. These process plants are located also in remote and sensitive natural areas, relatively close to the wellheads and oil sands. Further process facilities are needed to take each independent stream into specification and ready for distribution or usage. The crude oil is mixed with other oil streams or further dehydrated and transferred to field storage tanks. The gas is processed in extraction and compression gas plants for distribution and commercialization. The subsurface water is cleaned for reinjection into the reservoir as a pressure recovery method, and the sands (plus residual water) are transferred to holding ponds for reclamation. The previous steps are called upstream process, which are part of exploration and production companies working on the oil and gas extraction business.

At the field storage tanks or shipment facilities the oil and gas are finally transferred to downstream process refineries through pipelines or floating ship vessels. Pipelines are the most efficient method to transport hydrocarbons. A pipeline project usually requires pump stations to keep the liquid flowing or compressor stations to transfer the gas to the destination points.

Project Challenges

From the wellheads and oil sands deposits up to the refineries, oil and gas surface facilities projects challenges are related to the process and transfer of large volumes of hydrocarbons across remote natural and sensitive areas. These projects are risky and complex. They involve all disciplines; process, mechanical, civil, piping, electrical, instrumentation, control, and project management. Health, safety and environment are paramount from conception to start-up; therefore, the project management discipline has to coordinate efforts to effectively comply with all government and regulatory entities.

The capital expenditure in surface facilities projects is high, specifically for new installations. Let us consider the project sizes according to the total installed costs (TIC), as follows:

- Mega projects have TIC greater than \$1B
- Large projects have TIC between \$100M and \$1B
- Medium projects have TIC between \$1M and \$100M
- Small projects have TIC less than \$1M

Taking into consideration the previous assumptions, the order of magnitude of oil and gas surface project costs are as follows:

- 1) Greater than 12 inches diameter and more than 1000 km pipeline projects cost several billion dollars.
- 2) Design and construction of floating production storage and offloading vessels (FPSO) are also mega projects.
- 3) A 30k barrel of oil sands plant project costs around 1.5 billion dollars.
- 4) A 10k barrel of oil and gas flow station facility costs around \$150M (this is a large cost range project and the cost depends on the plant capacity).
- 5) Plant capacity expansions are medium cost range projects.

- 6) Installing an artificial lift method in an oil well is usually a small project ranging between \$0.2M and \$0.5M.
- 7) Installing a 10M standard cubic feet compressor in a gas wellhead is typically a small project that can cost \$0.5M.

There is no doubt that oil and gas surface facilities projects are capital intensive projects, and the size factor increases the risk of failure, because statistics show that the larger the project, the greater the percentages of cost overrun and schedule slippage during the project execution phase.

Another characteristic of these capital intensive projects is that there are long lead items to procure, like process equipment (e.g. pumps, heat exchangers, compressors, separators, scrubbers, storage tanks or control valves) and material (e.g. line pipe). Exploration and production companies need to manage a large number of service providers during the engineering, procurement, and construction project phases. There are logistic challenges involved during the transportation of equipment and material from the fabrication shop to the construction site. A constant review of the local transit regulations is required to avoid interruptions of high-load moves that may result in unnecessary delays or increases in costs, due to the impact on construction schedules. Cost and time for the movement of modules, equipment and materials need to be included in the project plan.

On the regulatory side, companies are dealing with more exigent regulatory requirements that incorporate complexity in the permit submittal and approval process. Currently, new pipeline projects increasingly face environmental resistance due to the environmental impact caused by pipeline failures in the past.

What is more, a variety of stakeholders are involved in oil and gas energy projects. Producers, service providers (such as engineering, procurement and construction companies), material suppliers, government entities, and the public, are typical stakeholders that require attention and need reliable project status information.

Earned Value in Oil and Gas Industry Projects

Even though earned value is the most effective way to determine project status and measure project performance, it has not been widely applied or used worldwide. During the execution of projects, a comparison between the resources planned to be spent (budget) and the resources spent (actual cost) is not sufficient to determine the project status and performance. It is necessary to include in the comparison the actual work accomplished in order to really understand the actual completion level of a project.

The use of earned value as a project management technique is important to increase the probability of success and return on investment of oil and gas surface capital intensive projects worldwide, because for this particular industry, the rate of project failures is higher than other industries. Two examples:

- 1) In Canada over the last 30 years, 5 billion dollars have been overspent in 28 gas plant and oil sands plant projects (the original budget was \$16B). More than half of these projects experienced schedule slippage, according to an

article entitled “Successful Project Execution Through an Integrated EPC Delivery Approach,” written by Robert Walden and published by the Association for the Advancement of Cost Engineering (AACE) in October 2012.

- 2) Independent Project Analysis (IPA) CEO Ed Merrow stated at the Calgary Project Management Conference in 2011 that, “1 in 5 mega projects in the oil and gas industry have reasonably acceptable results.” To determine this, they studied around 300 mega projects (oil and gas, minerals and metals, chemicals and power) worldwide over the last 20 years.

Our research is telling us that one of the reasons why earned value has not been applied across industries is because of the current project management practice of determining the project progress through the activity/task-based percent complete. This technique is not only an indirect method to determine physical completion, but also incorporates subjectivity in the measurements of project performance. In addition, most people say that earned value management is difficult, expensive, and time consuming to implement, because of all the administrative processes involved. Therefore, a simplified, practical, yet effective approach is needed in order to help implement earned value, specifically for the oil and gas surface capital intensive projects worldwide.

Complexity to Simplicity – A New Project Management Approach

A move from complexity to simplicity in project management is presented by INEXERTUS through a simplified and practical approach that focuses on one technique in both the planning and execution phases of projects. In the planning phase the focus is on the scope definition, and in the execution phase, the focus is on applying a simplified approach to earned value. These two techniques are described below.

In the planning phase the steps are as follows:

- a) Defining and organizing the entire oil and gas surface facility project scope of work in a consistent work breakdown structure. Listing all the project deliverables (e.g. a technical report, an engineering work package, or a gas compressor), and milestones (e.g. the purchase order issuance, a process plant simulation, or a contract sign-off) at the lowest level of each work breakdown structure branch (see figure 1). Focusing on deliverables and milestones, instead of activities or tasks, increases the objectivity when reporting physical project progress.
- b) Grouping the deliverables and milestones in control accounts to estimate the resources and time required to produce these results. Developing a work plan with the involvement of the people that are going to execute the project (see figure 2).

- c) Discussing the plan with all main stakeholders and approving the work plan, in order to generate a consistent and more realistic project baseline (see figure 3).

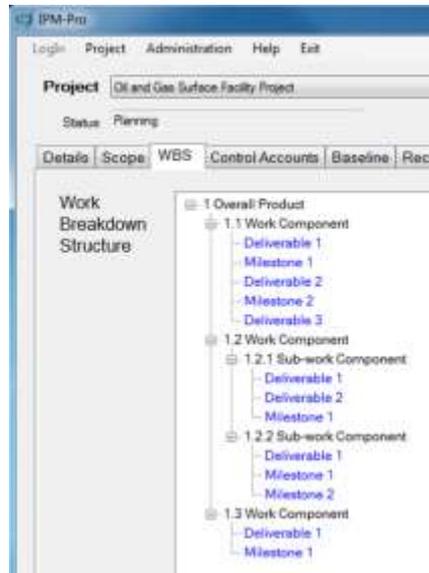


Figure 1. Work Breakdown Structure with Deliverables and Milestones

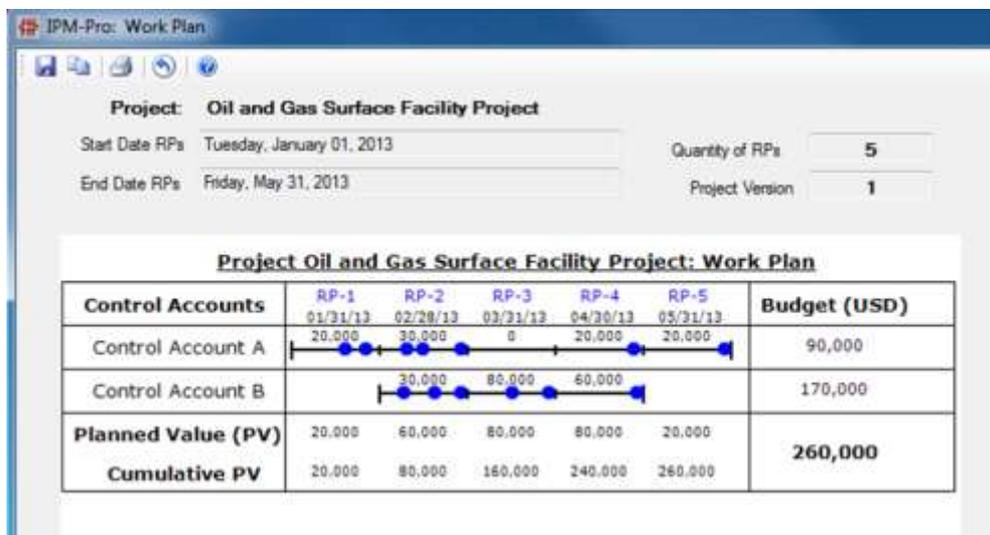


Figure 2. Work Plan with Deliverables and Milestones

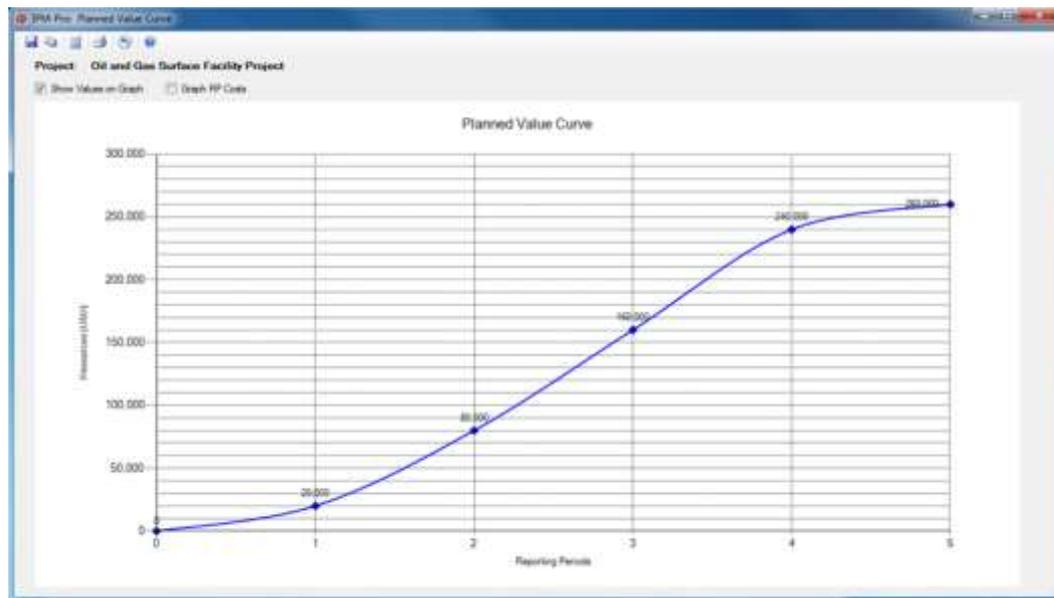


Figure 3. Project Baseline

The planning process is a preliminary stage to prepare and approve the project baseline. After the approval, the baseline is frozen, published, and sent out to all stakeholders. This is an important step to start the project execution, because one of the reasons why projects fail is due to the lack of effective communication (everyone is not always on the same page). The publication of the baseline communicates the agreed execution plan and expectations, and makes the alignment of stakeholders stronger from the beginning.

During the execution phase a simplified and practical approach to earned value is applied to credit value only for the work that has been completed. The earned schedule concept is also applied to forecast the project completion date. With a work plan based on project results, it is possible to determine the project progress more objectively, as deliverables are finished or milestones are achieved. As time goes by, the completion of deliverables and achievement of milestones are verified with a “Yes/No” question posted to the project performers, and confirmed by inspections according to the quality plan. This question reduces the subjectivity at the moment of reporting project progress, because the real status is based on facts, instead of opinions. Here, the earned value is credited on discrete amounts only if deliverables are completed or milestones are achieved during a reporting period. If not, the earned value will be credited when the work is accomplished in a future reporting period.

In the same fashion, if some work was completed in advance, the associated earned value is credited at the time of completion. Planned value, earned value, and actual cost are cumulative values in order to perform earned value analysis and forecast the final cost and completion date of the project. The forecasts are based on previous performance, and they are calculated each time a reporting period is closed out.

Earned value and actual cost are updated each time we close a reporting period. For the first closed reporting period, figure 4 shows that the earned value credited in control account A was \$20,000 (because all deliverables and milestones were completed), and the actual cost was \$15,000.

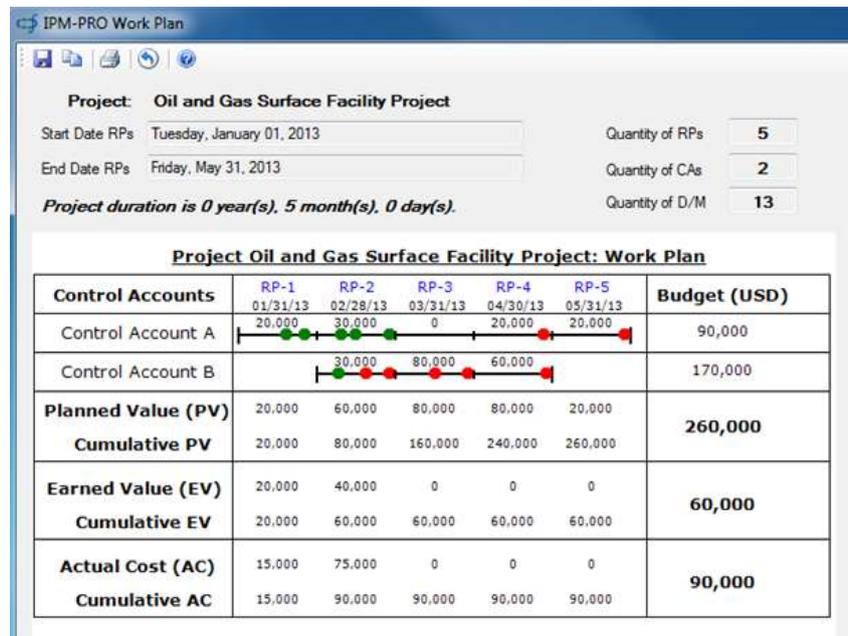


Figure 4. Work Plan during Project Execution

During the second reporting period, figure 4 shows that four out of six deliverables and milestones were completed (in control accounts A and B). The earned value credited was lower than the planned value (\$40,000 versus \$60,000), and the actual cost was higher than the earned value (\$75,000 versus \$40,000).

For the second closed reporting period, figure 5 shows that \$30,000 (\$50,000 - \$20,000) was credited to control account A because the deliverables and milestones were completed, and \$10,000 was credited to control account B (1/3 of \$30,000), because one deliverable and one milestone were not completed.

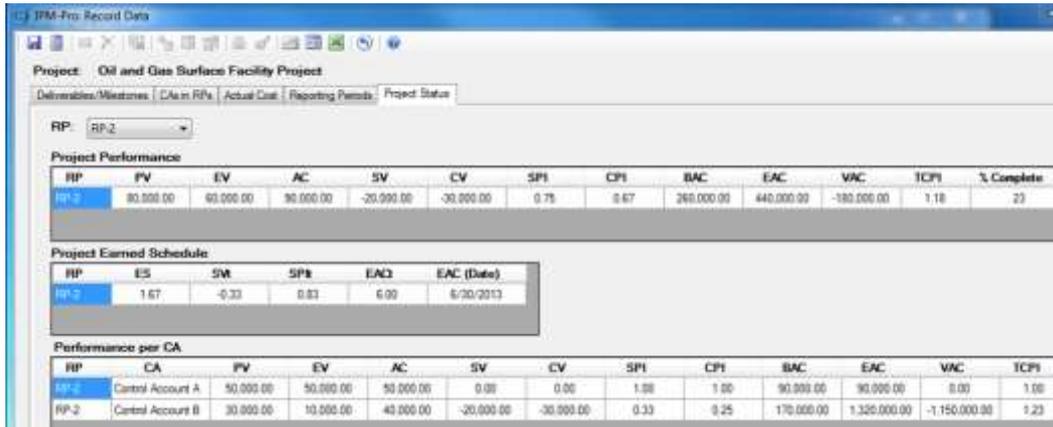


Figure 5. Project Status Report of second Reporting Period

After closing the second reporting period, the project is 23% complete, over budget, and behind schedule. The earned schedule forecast for the project completion date is June 30th, one month later than the original plan (see figure 5). Figure 6 shows the performance curves after closing the second reporting period.

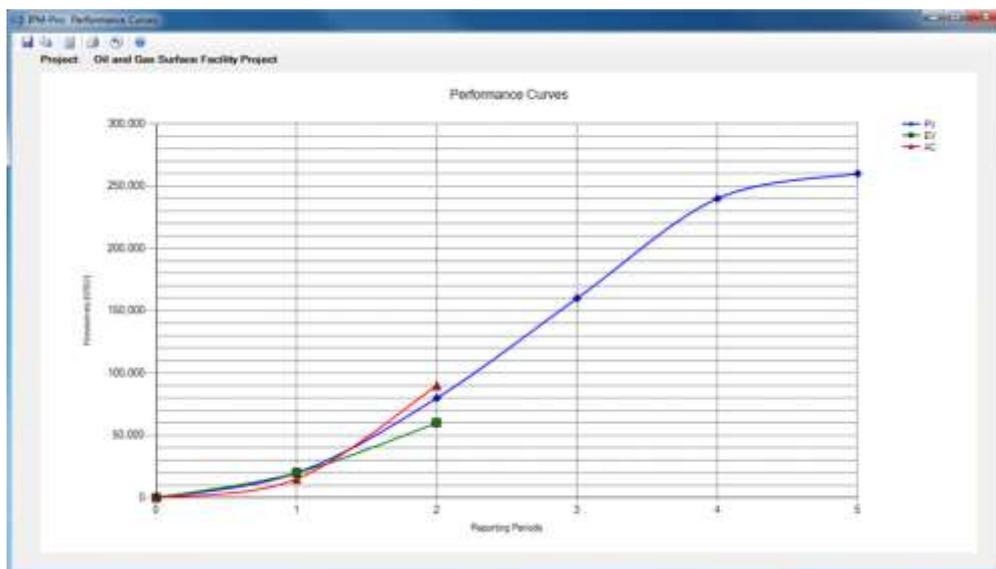


Figure 6. Performance Curves during Project Execution

Conclusion

Oil and gas surface facilities projects are complex, risky, and capital intensive projects, because large volumes of hydrocarbons are processed and transferred across remote natural and sensitive areas. These characteristics have posed particular challenges to properly manage these projects. As a result, the rate of failure for these types of projects is higher in comparison to other industries, which is

why new and emerging ideas are welcome to manage these projects more efficiently.

The new project management approach proposed in this article facilitates the implementation of earned value management. Stakeholders can then focus on generating the agreed results, and project progress can be credited only if deliverables are completed or milestones are achieved. At the end of the day, this approach will increase the objectivity and probability of project success during the planning and execution phases, and will also improve the overall oil and gas surface project performance measurement.

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