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Integrated Software Based Project Controls on Major Capital Projects

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Abstract

In any company that builds or executes large scale projects, ask any resident project controls (PC) personnel and their most dreaded time is invariably month end reporting and the ensuing late nights in getting data ready for monthly stewardship reports.

This paper attempts to outline the benefits of having an industry developed and tested software tool that incorporates the entire gamut of the PC function within its scope; utilize it to do the leg work on data collection and formatting; and allows skilled PC personnel to analyze and trend the data to focus in on the message they want to give out.

Essentially this paper will show that in this age of advanced digital technology, skilled PC personnel should spend less time on data collection & formatting and more time on data analysis and key message delivery.

The software package ideally should incorporate abilities to perform all levels of estimates, budgeting, cost control and forecasting, seamless scheduling data transfer, management of change (MoC) and benchmarking as well as variance analysis. There are various benefits to this which will be expanded in the paper. These integrated software modules do exist in the marketplace currently. However, the adoption of these technologies by big companies is slow due to the relatively heavy initial capital investment of implementing these solutions.

The benefits of this however, on a long-term basis, far outweigh the initial costs when looked at on an overall portfolio basis as will be shown in the ensuing sections.

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Introduction

The advent of computers is meant to automate repetitive activities that can be programmed into a task, thereby creating systems and modules by which various sequenced tasks can be performed. This then, in theory should free-up the higher level intellectual human mind to concentrate on analyzing data trends and elicit forecasts, instead of wading knee deep in data morass.

In project execution, this is no more evident when the management team attempts to execute large, multi-faceted projects in the same way as we successfully executed smaller projects. Often, it is executed approximately with the same number of 'experienced' people and with the same number of tools and resources. The often-hailed words "We have done it before and we will do it again" are mostly heard at the start of the project.

However, the results speak for themselves, where in larger projects, project managers, project engineers and project controls personnel simply cannot handle the amount of data being thrown as them from various quarters. This then leads to 'rolling-up' of data and loss of data clarity. Inevitably the project controls team become a project reporting function, rather than delivering on its primary mandate to assist project management in project forecasting. Instead of providing look-a-heads at timely intervals, they instead report on events that have already happened, thereby crippling the management team of its most valuable planning resource.

Based on the argument above, there should be no doubt as to the benefits of using automated, integrated software tools that utilize the full power of modern-day computing to help management teams in successfully building ever bigger and more complex projects successfully. These software solutions do exist currently and this paper will attempt to exhort the benefits of using these tailored software solutions to deliver project objectives.

Most of the challenge from the outset stems from each company's army of 'experienced people' who are resistant to change and prefer not to upset the 'status-quo'.

If change is only requested at the working level, this integration of software tools into the execution team is doomed to failure. It is only with the backing and initiative of senior management and company executives that there is a possibility of successful implementation of this change within their organization. This can only occur if senior management themselves buy in to the advantages of the tools being brought in to their organization and allocate sufficient resources in its training and implementation.

This paper will attempt to show the benefits of using an integrated software solution for project controls on major capital projects.

Process Standardization

One of the main benefits of using software-based tools is process standardization. For people to be able to find answers quickly and easily, pc personnel must know where to look. If Excel® has been your go-to solution, looking for the right data amongst many spreadsheets can be a time-consuming exercise.

Excel® also implies a large amount of manual data input that leaves a significant margin for making errors. Inherently, it assumes disconnected processes for estimating, cost control, progress measurement and therefore forecasting.

In world class tools, the latest cost engineering best practices are embedded into each routine, tasks and sub tasks, yet still leaving enough room to customize the data input and output to each customers' unique requirements.

This would therefore negate the need to develop special Excel® based, user-specific tools for each activity that is usually understood only by the person that developed it. In today's fast paced and quick changing world, company personnel move from role to role and from company to company multiple times within their career. Therefore, these custom solutions do not lend themselves to long term use. Typically, they get parked when someone new comes onboard, doesn't understand the developed solution and inevitably, develops their own custom solutions, thereby perpetuating the issue. These efforts use up valuable work hours that could have instead been put to better use in analyzing the resulting data.

Using a project controls software tool can help to standardize work processes, customize it to individual company requirements, organize big data, save finalized documents at a centralized location and more. When data is saved in this manner, it is possible to create templates with company-specific data, including the usage of cost breakdown structures (CBS), work breakdown structures (WBS) and contract breakdown structures (CTBS) to facilitate alignment of cost data for the various departments within the company for their specific needs. This can then be easily reused by any new project. That can also facilitate easy access to any (new) team member and assist collaboration by sharing documents, timelines and status updates.

Integrated Systems

The use of a software tool facilitates the integration of data within the various modules of cost engineering, namely estimating, project controls (cost control, progress measurement, change management, forecasting) and benchmarking. This provides for data integrity as the data is entered once using a database. The same data is then cycled through the various modules depending on the phase of the project.

Purchase orders, accounts payable and receivable, procurement systems, progress data, might come from multiple systems within the company such as finance, project management or ERP systems. Aligning data, when they come from different resources can be tricky. A commercial

project controls software, usually already allows for data integration with ERP systems and can be also customized for each customer's proprietary tools. This therefore allows for the integration of the output of those systems within one tool, saving valuable time and coordinating data.

Estimating

Estimating is generally where all the cost data is generated for the project. Based on one of AACE's recommended practices, shown in Table 1, estimates are usually classified in 5 levels, based on increasing levels of definition [1].

	Primary Characteristic	***Secondary Characteristic***		
ESTIMATE CLASS	**MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Table 1 – AACE Cost Estimate Classification System

However, it should be noted that a good estimate includes not only cost, but also all data related to the way the project was envisioned to be carried out. In early stages of the project, various methods are applied to developing estimates based on available data. This includes capacity factoring, equipment factoring and parametric estimating [2].

In most cases, this exercise is completed early in the project lifecycle, the approved for expenditure (AFE) funds obtained and all that data promptly filed away and forgotten.

The project then moves on to its execution phase and the best path forward is chosen, neglecting in most cases the differences between that path and the path envisioned while creating the budget, that is the estimate.

If instead a software tool is used, and it encompasses all the modules of project controls, it would not be possible to ignore the execution changes after the budget is baselined from the estimate data. This is because as the data is the same, the inherent software structure forces any changes

to be flushed out and be clearly differentiated from the baseline. Figure 1 below shows a typical visual representation of a cost summary chart in an integrated pc software solution that was used to create an estimate.

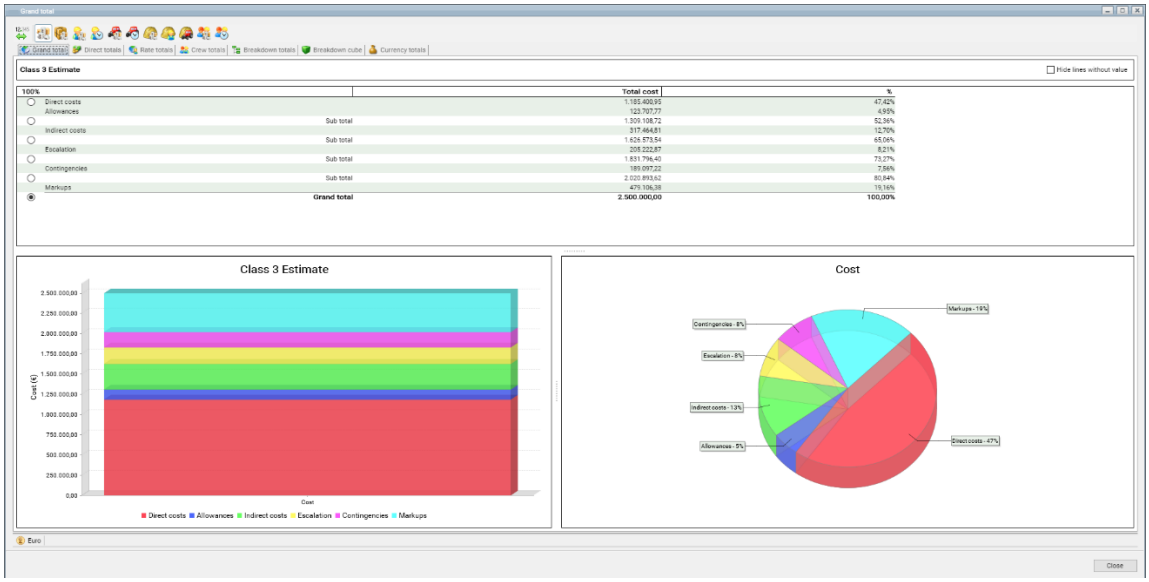

Figure 1 – Typical cost summary chart from an integrated software solution

Another key deliverable from the estimate is the creation of a spend profile. This allows the organization to track its cash position relative to its commitments. If an Excel® template is used to create the estimate, the spend profile would have to be manually created. In the case of a software solution, the spend profile is created automatically once the required information is added. Figure 2 provides a typical cashflow analysis provided from a software solution.

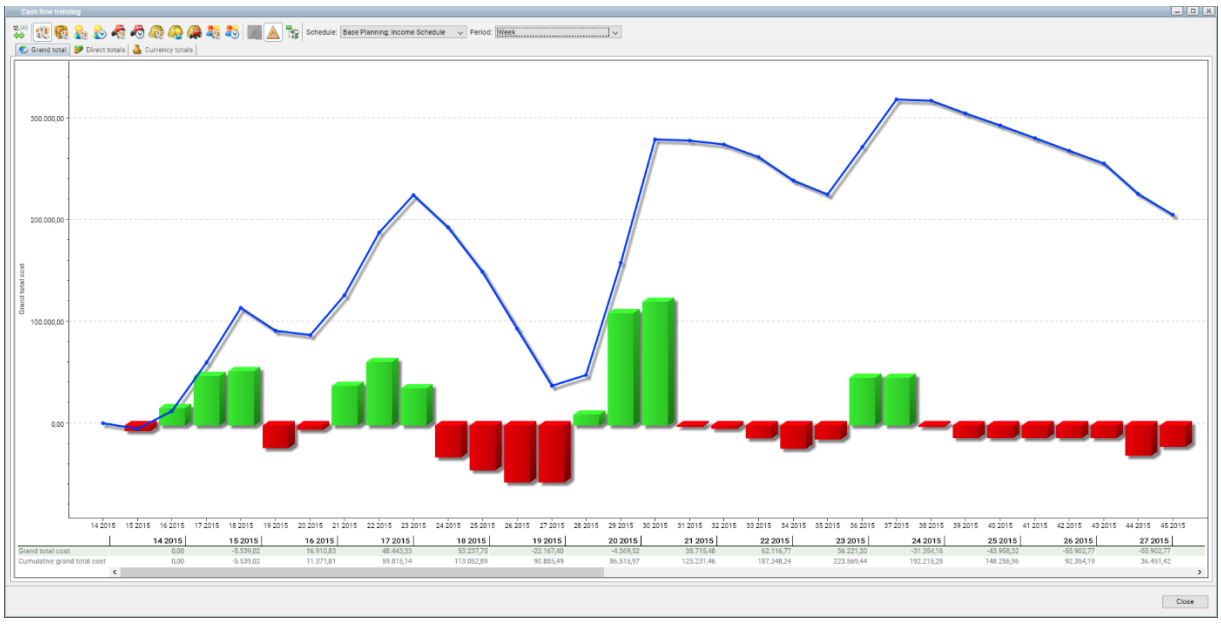

Figure 2 – Typical cash flow analysis from a pc software solution

This, therefore creates a clean transition from the estimating exercise to the creation of the budget and performance measurement baselines. The next phase of the project, the execution phase can then be measured against this baseline to determine the effectiveness.

Project Controls

Generally, project controls can be defined as ensuring that project objectives are met by monitoring and measuring progress on a predefined timeline to identify variances from plan so that corrective action can be taken as necessary by the project team.

To aid in this, the use of the software tool that integrates the budget baseline to performance measurement and 'real-time' field progress would produce the kind of trending that will enable project management to take corrective action before the event happens.

Currently, in most cases, it would be impossible for project management to act as the forecast was never provided to them in time [3]. This is because the data assimilation and organization as well as validation overwhelms the project controls team, thereby reducing them to a project reporting team.

Progress Measurement

Progress measurement can be done in many ways and many different levels of complexity. This is evident by the various types of spreadsheets that have been created for that one purpose, that is to measure the activity progress against the base and forecast the result.

However, to get to this result, using a software tool provides the most consistent measured results. The inherent structure within the tool would not allow for specific customization. The structure would be pre-determined and be consistently applied across all similar scale projects.

Change Management

Changes occur in every project due to internal or external factors, and they can be of different statuses (anticipated, pending, approved, rejected, etc.). Change management in companies can be done via a formal management of change (MoC) trend process or various other less formal processes. However, the basic tenet of this process is to highlight any change from the Baseline in terms of execution, schedule or cost changes by any member of the project team to be approved by the project sponsors before it goes into practice.

In whichever form changes are issued, they should be categorized and registered. An impact analysis should also be performed and finally, if approved, the change should be implemented, and the cost reflected in the EAC.

Where Excel® is used to develop the change management process, the advantage is that the process is done quickly and developed in-house. However, the downside is that there is no

consistency in the manner for which these methods are utilized and because of the heavy manual input, subject to significant margins of error [3].

Recording changes in a dedicated project cost management software tool eases the process of management of change, recording of the change and associated cost impact, approvals workflow and thereby increases the effectiveness of project controls.

Benchmarking

Benchmarking is an integral facet of the cost engineering process whereby the actuals at the end of a project is gathered in the same manner as the initial estimate, so that both can be compared on an apple to apples basis.

This valuable data, if collected properly can provide invaluable insight into how the project was executed. If the project met all its objectives, an analysis or lessons learned report during close-out can provide great overview into how the project successes could be replicated on future projects.

However, to do this, data integrity and all performance results need to be collected in the similar manner for the comparison to be done effectively. If shortcuts are utilized during construction due to time constraints, this is when the effects of shortcuts would be felt.

Elimination of Inefficiencies

There are countless hours that have been attributed to checking of data, reworking, figuring out why the data doesn't make sense, only to find that data input error was the culprit. Excel®, far and wide the most widely used cost management tool in companies nowadays has a lot of advantages. Some of the main ones being:

- Commonly available for all working within a company environment. It doesn't need a special license.
- It generally does exactly what it is told to do.
- It has some very good data analytics tools that are readily available
- It is an extremely versatile piece of software that lends itself to uses in various environments

However, it is in some of its greatest strengths that lie some of its greatest weaknesses. For instance, the versatility of Excel leads to individual customization, so much so that 6 months or 1 year down the line, when the employee has moved on to other jobs or companies, the process is replicated by another employee with his or her own customized spreadsheet. This does not help in aligning the different cost management modules that are required to produce the results expected by a professional project controls team.

Companies do not track the valuable hours spent in developing these solutions. In fact, if that tracking is done, it sure to be significantly higher than the cost of implementing a software

solution. This is not even counting the hours that future employees will spend on developing various versions of the same solution for the same purpose.

Ancillary benefits

Data Analytics

Some ancillary benefits that can be obtained from using an integrated cost management tool also include the data analytics module within the software [4]. Most commercially available project controls software includes a version of these analytical abilities, with some more than others.

However, the ability to slice and dice an estimate and a cost or quantity measurement report and relate it to other projects using standard breakdown structures at the click of a mouse is one true valuable ability of world class project controls software tools.

One can instantly compare like projects at the same level, relate estimated rates of placement against actuals or relate planned progress and budget of work planned to actual costs using earned value management (EVM) and earned value analysis (EVA) techniques.

Data Integration with Other Software Modules

Another ancillary benefit that comes with using a software solution is the ability to integrate to not only with systems within the company but also other commercially available software system modules that specialize in other parts of project management (i.e. scheduling, risk etc.). If the estimating and cost software that's being run can 'talk' to, for instance, a scheduling software, various scenarios could be developed to produce the most optimized manpower distribution curve solution to meet the specified objective for the project, whether it be the cost or the schedule [5].

In terms of project risk, it is quite usual to have the estimate being developed in a separate tool, create a mapping tool to load the data onto a separate risk software, do the required ranging and input the risk events as well as schedule risk items manually, before running the software to produce the risk value for the project.

In the meantime, if any of the estimate parameters change, causing a change in the estimate structure or values, this exercise would have to be repeated (albeit in a shorter timeframe), however significantly increasing the risk of input errors.

However, if there was a software solution that could map itself to the risk tool, then the laborious process described above happens in the background and the results become much faster and more accurate.

In terms of engineering too, if there was a software tool that could utilize the data dumps from engineering modelling software, the entire MTO development process could be completed

within a single day as opposed to weeks of manual data entry and countless hours spent understanding the data.

Conclusion

No matter how much pre-planning is done at the outset, when a project is in the execution phase, it feels like everyone is being pulled in different directions and there is never enough resources to deal with all the issues. How is the project manager to keep track of the project in this situation to ensure that it will meet its cost and schedule objectives?
No matter how much planning is done at the bid stage or the estimate stage, it is inevitable that during the execution stage, things will change, and that change will cause ripple effects to other activities that have not been anticipated. How will the project management team keep ahead of these changes to ensure that the effects can be contained or mitigated and that the project can still maintain its objectives?

The answer to both these questions and more is utilizing a software solution for project controls that will allow the project controls team to fulfil their mandate and forecast the future of the project in 30-day or 60-day lookaheads instead of reporting what is already being done on the project. No one can argue that if an event has already happened, there is little that the management team can do to avoid it. However, if there was a heads-up that an event is likely to happen based on current trends, there is much that the project management team can do to mitigate the effects or even avoid it altogether.

In project controls, history provides a lot of pointers and in the case of project management, history has a way of repeating itself. However, based on recent mega-project execution management analysis, there is ample evidence that lessons from history seem to fall on the wayside.

Granted, that there are many reasons for a project to fail or to succeed. However, it must not be forgotten that even though dealing with problems is part of the job of a project manager, there is no job if the project fails because pc personnel on the project could not monitor it properly or keep it on track. As with most projects, even those that are undertaken in the confines of the home, the right tools need to be deployed for the right job.

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