

Using BIM for project control and monitoring

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Abstract

- BIM is experiencing a high level of development in the project stage and even in the planning stage
- However, it is not finding its true potential for monitoring and controlling the execution of projects, it is necessary to first walk the path in the previous stages, having suitable models and processes and, possibly, because the lack of reference software
- The criteria used for the realization of the 3D model, the obtaining of the 5D cost models and 4D planning oriented to their later use are described
- As well as how to organize a cost and time tracking system based on the information available in the model and how to provide feedback

We look for practical processes for tracking the cost and time that take advantage of BIM, we do not seek to "be BIM" as an end in itself

Cost at the design stage: near maturity

- There are already many tools to perform the take-off task and to develop the estimate from the BIM model
- We have learnt how to model to better measure
- Two-way communication between model and estimate software is assumed, so cost data doesn't need to be in the 3D model
- For the execution stage we assume that the estimate is linked to the model, the elements common to the model and estimate are bidirectionally identifiable, measurement of common elements has been obtained from the model and are the reference for invoicing

We use "model" here as the 3D geometric model managed by modelling programs and "estimate" as a document generated by a specific program.

Cost management software is still needed!

The planning stage: several open paths

- A transition approach: planning is done separately from cost and is subsequently linked to the model
- An innovative approach: planning is done on the cost model in an integrated way with 3D model
- For the execution stage we can use a simplified planning based in financial periods, a detailed schedule based on a Gantt chart, or both

BIM produces a lot of Hollywood BIM but stimulates the need to plan, which is now considered essential in a project

Cost management along the execution

- The objective is to track the cost, both to prepare the invoicing or billing of the executed part of the work and to calculate and monitor deviations
- We have to handle real world conditions and construction complexity, i.e, estimate elements that are not in the model, elements assigned to more than one work unit, differences between estimate and real quantities, etc.

The fundamental decision is to choose where production is introduced, i.e. the executed part of the work, which has to be invoiced

Elements better identified in the model

- Elements who are identified better in the model than in the estimate should be identified or marked in the model
- Items that represent an entity that can be built and paid in one time and are easily selected manually or by automatic surveys; for example, windows, steel beams or columns
- Large elements that are partially executed and paid, when calculating the amount requires geometric operations or modifying the model; for example, digging or filling land, or a partially finished slab

Note: "identifying in the model" refers to entering the data with simple graphic operations on the model elements, not using the model as an input window for a separate database

Elements better identified in the estimate

- Work units not modelled
- Single elements of the model associated with more than one work unit that are executed and paid partially, such as formwork, rebars and concrete of the structural elements
- Items that should be identified in the model as said before but inserting information into the model would not be on time for invoicing and an approximate amount is allowed to be adjusted later

Subdividing take-off lines to introduce partial execution is easier than subdividing model elements

Two-way transfer of information

- The cost management software should be able to receive the information entered in the model and make the necessary breakdowns and adjustments
- In general, the information entered in the estimate is more detailed and must be processed to calculate the percentage and executed amount of each model item; this is the case when the complete formwork of an element has been installed, the rebar has been placed in part and the concrete pouring has not started

The cost software should be able to display this information visually on the model or transfer it when and where needed, as well as any other relevant cost information

Results

- In general, the cost control program is the master document for generating bill of quantities or invoices, and the model a form of visual verification
- Therefore, payment documents should be generated from the cost management software
- Cost differences and forecasts can be obtained by applying the Earned Value Method from the data as entered, comparing the actual cost with the budgeted cost of the performed work
- Therefore, it makes sense to use a combined process, where information is entered where it is most convenient and transferred to the rest of the documents

For ISO 19650 the model is not just the geometric model, so the estimate remains part of the model, as one more document: It's still BIM!

Controlling by financial periods

- If a planning exists, deviations in time can also be obtained by comparison, entering the progress in a consistent way
- Planning can be based on the same financial or invoicing periods, usually months, used for revision and payment of performed works, as is the case with planning for cash-flow estimations
- Control units are the same items used for the bill of quantities
- In this way the comparison between planned and performed works is direct and time control variables of the Earned Value Method are also calculated, as well as delays and advances

These results also can be visualized graphically in the model

Controlling by Gantt chart

- If activities coincide with work units the situation is similar to the management of progress and monitoring of costs
- However, in building and civil works often contracted work units and planning activities are different, which introduces greater complexity, since the elements of the model, the work units and the activities have to be aligned, and integrated or connected software has to be used
- Integrated cost and time management can be based on take-off lines connected to model elements and shared by a matrix of work units and activities
- By introducing progress on activities the software can calculate the impact on the units of work or vice versa and then the result on the related model elements

Thank you

- The result is a natural and practical BIM3D / 4D / 5D process, taking advantage of the possibilities of digitalization without tasks that do not add value to the project

The BIM is not an end in itself, but should serve to improve the project and the work of all the agents