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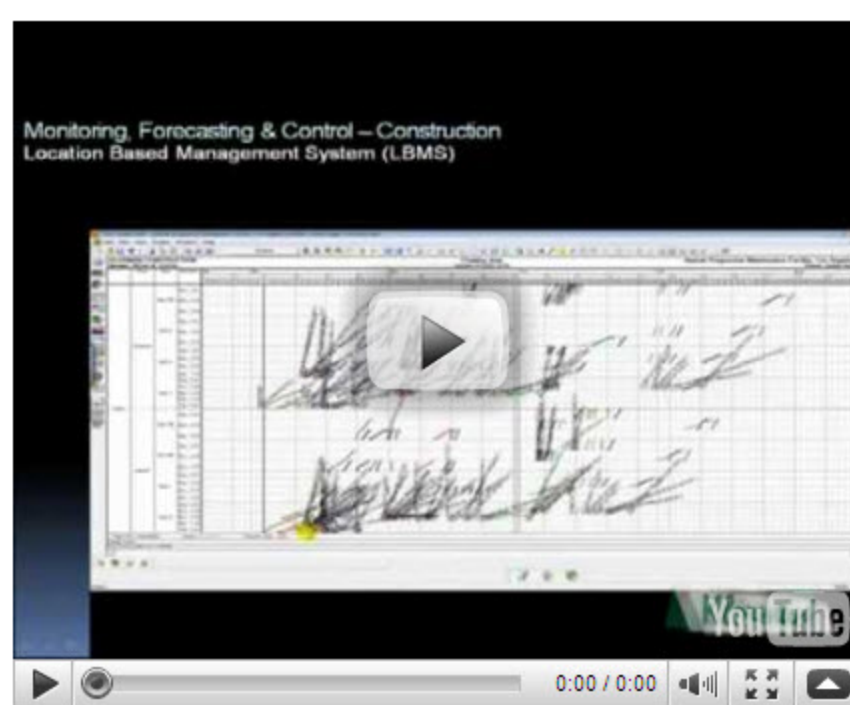
## Vico Guest Blogger Series

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Vico Guest Blogger #2: Klorman Construction Demonstrates Flowline Model-Based Scheduling

Posted by Holly Allison on Fri, Feb 05, 2010 @ 11:47 AM

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We recently gathered at the [AGC BIM Forum](#) in Phoenix for learn best practices with virtual construction. Bill Klorman, President and CEO of [Klorman Construction in California](#), took the time to explain [flowline theory and model-based scheduling utilizing locations, resources, and productivity rates](#) to the audience. Bill was kind enough to share the presentation with our larger Vico Community audience.



Let's look at some monitoring, forecasting, and control of the construction process. This is going to be based on [location-based management systems \(LBMS\)](#). This is an actual project; it is for Amtrak and is a progressive maintenance facility in Los Angeles, California. We're going to show how we can take the model information, move it into our scheduling process, and control and forecast the building.

We'll go ahead and start off with a little fly through. This is a 910 foot long structure. The point here is that structures are built by location. They are not built lineally all the time and it's not by happenstance. So, we'll do a little simulation for you and you can see here the yellow is the work in progress.

We have two different drill rigs putting in these friction piles. We can see there are two different crews putting in the concrete work in the deep pits. We have the grey beams starting to work out to both ends. We have the suspended rail slabs being cast. As we zoom in you can see a little more of the detail. You can see the mat slabs going in. You can see the cast in place wall with the integral piers that will support the steel structures.

But notice the different colors other than the yellow. [These are all separate locations where very specific tasks need to be performed in a specific sequence in order for us to complete the project on time and predictably so we control or reduce risk in missing this schedule or having interruptions.](#) You can see the steel structure started in the middle then the cranes moved to the outside and moved inward.

So, there must be more than a plan. You must be able to monitor, forecast, and control. It must come from your BIM and it must optimize your resources. Now everybody has seen a Gantt chart whether you're using P3, P6, Microsoft Project or any of the other scheduling tools that produce Gantt charts. We can summarize them and we can increase the level of detail. To some extent we can organize them by location. But it's still managing by exception and it's limited to very difficult views. You can see here as we drill down on the detail, you can't see everything on one page. I'm sure you've all experienced this. As we continue to drill down, although we can see the critical path and the logic lines, it becomes very difficult to be able to understand the schedule.

But if we use a flowline or line of balance base you can see not only the entire project on one screen but we can see the layout of the locations in the building. We have the overall project, we have the zone or areas... in this case it's a train project so we have inbound and outbound. Train people like to talk about spots so we have spots for the areas. And then, as opposed to floors (because the building has so many elevation changes in each spot), we elected to use our fourth level of hierarchy elevations. We can see how it's optimized and we can also see there are areas of wide space which may need to be considered for accelerating some of the work. Or where it's getting close... is this a possible interruption? Do we need to reconsider buffers or lags to reduce any risk and ensure the schedule can be delivered?

Let's drill in on a little more detail. And granted, when you look at this, it looks like chaos or somebody threw a bunch of spaghetti on the screen. But as we drill in you'll see that there's a huge amount of information in this. [Unlike a typical CPM or Gantt schedule, we not only know the location but on the specific day what trades are working in what area on the job.](#)

Now here we see what could be a conflict or interruption but when we look at it closer we see that it's forming walls and the rebar for walls. We made a conscious decision to model them as two items instead of three which would have been first, side, rebar and then close. So let's go ahead and see how we got this information. This information comes from our target bill of quantities. Now, these quantities are all pulled directly from the model and not only do we know our total footage and our unit of measure, but very importantly we know our consumption rate and we know our resources. In this case: carpenters, laborers, cement masons, and equipment. And we can see where this occurs in each area of the project. As you can see in the picture in the right hand corner you can see the amount of elevation control in this building.

So let's go back to our flowline schedule and look at one particular set of activities. We're going to look at the cast in place walls. Now let's go ahead and drill into a little more detail. As we do, we notice there's a potential interruption. As we look into this I don't think we want this pouring to go on at this time. You'll notice the little numbers here. That represents the crew; in this case we've assigned one crew in order to get this production rate. Now if we decide to go faster we can only either change the production factor, the gang (which in this case to go from one to six) or the consumption. It's kind of hard to imagine that we could increase the consumption from what we figured one crew could do to about six times that amount in order to get the work to be completed from six days to two and a half days. So the odds are we'll go back and add more crews to this as opposed to just changing the consumption rate. And you can see the logic lines and critical path lines. But let's look at something else that's extremely advantageous in this type of scheduling process.

Let's move from our planning phase to our control phase. I'll explain the red dot's to you in a minute... they're called alarms. But let's drill back down to where we've been in the schedule. Now you can see things that you don't get to see in typical CPM schedules. You noticed the little dotted lines, that is our actual progress. The solid lines are our planned progress (what we expected to do). But because we have some history on the job now we can see that up here we fell off. And as of this day, if we continue at this pace, we can see just how much the forecast is going to push us out. Now that's what makes these alarms very interesting. So from today, knowing exactly what area and what location, we can see that there's an alarm. And these alarms, if you notice, are almost six full weeks in advance. We're being notified that because of a predecessor's late start we have a problem. Now we go back and research it and find that the drill rig broke and that's what the problem is.

Now we can do a few things... We can go and go in and we can edit the control plan (mind you this is different than a planning mode or a detail task) and we can do one of four things. We can either change consumption or change the crew size or make some work go faster or go slower to optimize it. But again as we drill back out you can see the entire project both actual plan and forecast all on one page.

So it's important to understand that your BIM needs to drive quantity and resources and using a [location-based schedule](#) with five-layered logic makes it predictable and controllable.

To learn more about this subject, please utilize the following resources:

- ~ Olli Seppanen's blog on [flowline theory, location-based management systems, and model-based scheduling](#)
- ~ [BIM 401: Model-Based Scheduling](#)
- ~ [Scheduling Strategies in a Hard Bid](#)
- ~ [A 30-day evaluation of Vico Control](#)

Tags: [4D BIM](#), [model-based scheduling](#), [vico control](#), [flowline](#), [location-based scheduling](#), [location-based management system](#)

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