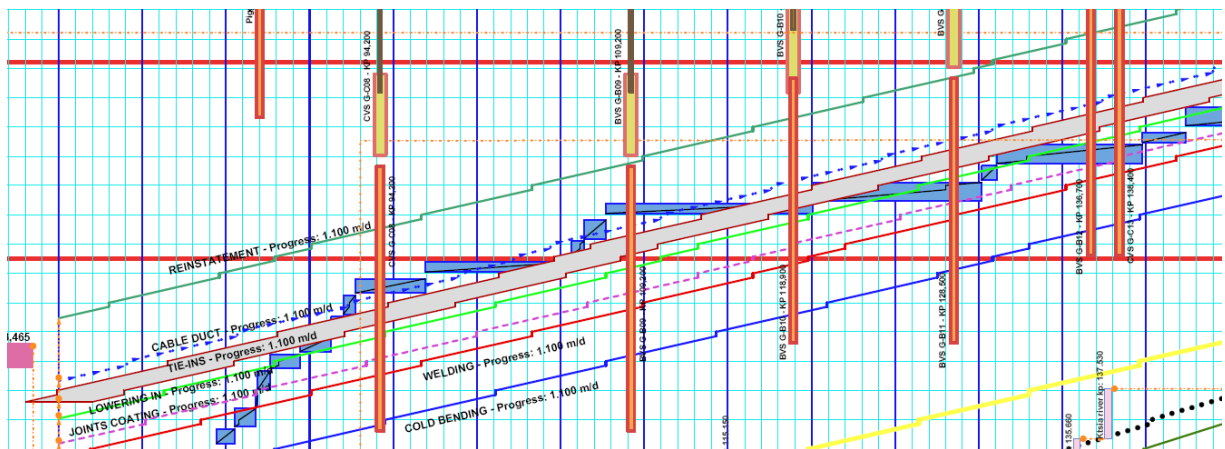# Linear Planning in Pipeline Construction

A case study how to use TILOS in pipeline industry for scheduling and controlling construction works.

Pipeline construction, as with other linear projects; presents construction challenges such as maintaining crew separation, equipment move arounds, permitting, land acquisition and crossings. Ideally, you want to resolve any land and permitting issues before construction begins and then sequentially start your crews using different lags to reduce the total time in construction while preventing one crew catching up to another.

Traditional planning methods

Traditional scheduling tools such as Microsoft Project or Primavera do very little for planning and executing pipeline construction if you want to consider these construction issues. Each task, the start and end date and the physical percent complete are readily displayed using these tools. If we look at Figure 1 (below), we can see that grading is about 18% complete, welding about 13% complete etc. Anyone familiar with these tools can easily extract this sort of information. The issue is that these tools don't show us which part of the project has been completed, where the crews are in relation to each other and what other factors are important to the successful completion of the project.
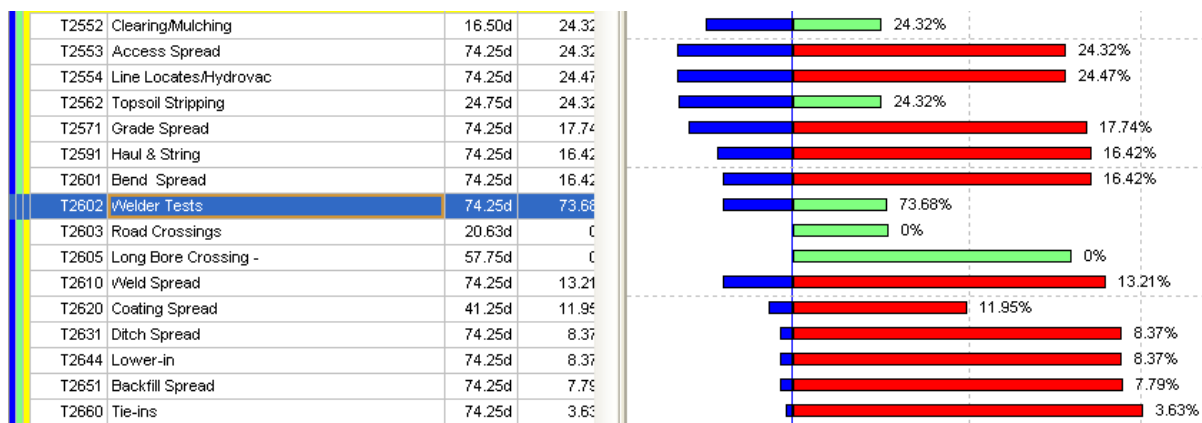

Figure 1. Pipeline Schedule in Primavera

Alternative planning methods

Many field construction managers and field engineers have traditionally created their own version of time distance charts by simply marking daily progress of each crew on the alignment sheets or drawing time distance charts with pen/paper, in Excel or in AutoCAD. These techniques very readily provide a graphical representation of progress, in relation to right-of-way challenges, they are time consuming, cumbersome and don't provide any scheduling functionality.

TILOS (TIme LOcation System) is a linear planning and scheduling software system that provides a very powerful graphical and a fully capable scheduling engine. TILOS was originally developed about 10 years ago in Germany. This system is currently used by more than 250 organizations in Europe, Africa, Australia and North America for railway, tunnel, pipeline and road projects.

TILOS has a cell based structure with at least one main time-distance cell (although there can be more than one) and any number of other cells that contain distance type of information (elevation, alignment sheets, crossing lists, etc.), time cells (resources, spend profiles, profits etc.) and other cells such as calendar and distance scales.   Each TILOS project starts with two views, the project view and a gantt chart. You can define as many views as you need to display your project. In the construction work I am involved in I typically create views for the overall project and then for each section of the project, especially those sections where there are constructability issues (crossings, environmental restrictions, etc.).

The software is based on layers and you can define as many layers as needed for your purposes. This is very similar to CAD or Photoshop systems. For example, in the large pipeline construction projects I am currently involved in I have each crew assigned to a different layer. This allows me to display one or more crews (Figure 2) as required by the project engineers and construction managers. You can also define any number of calendars, task templates (crews), resources as necessary in the software. The key point to understand is that TILOS is very flexible and you can create any number of symbols, layers, views, resources as necessary. TILOS allows you to place the time and distance axes either horizontally or vertically (whatever you prefer) and you can change this orientation with a simple mouse click.
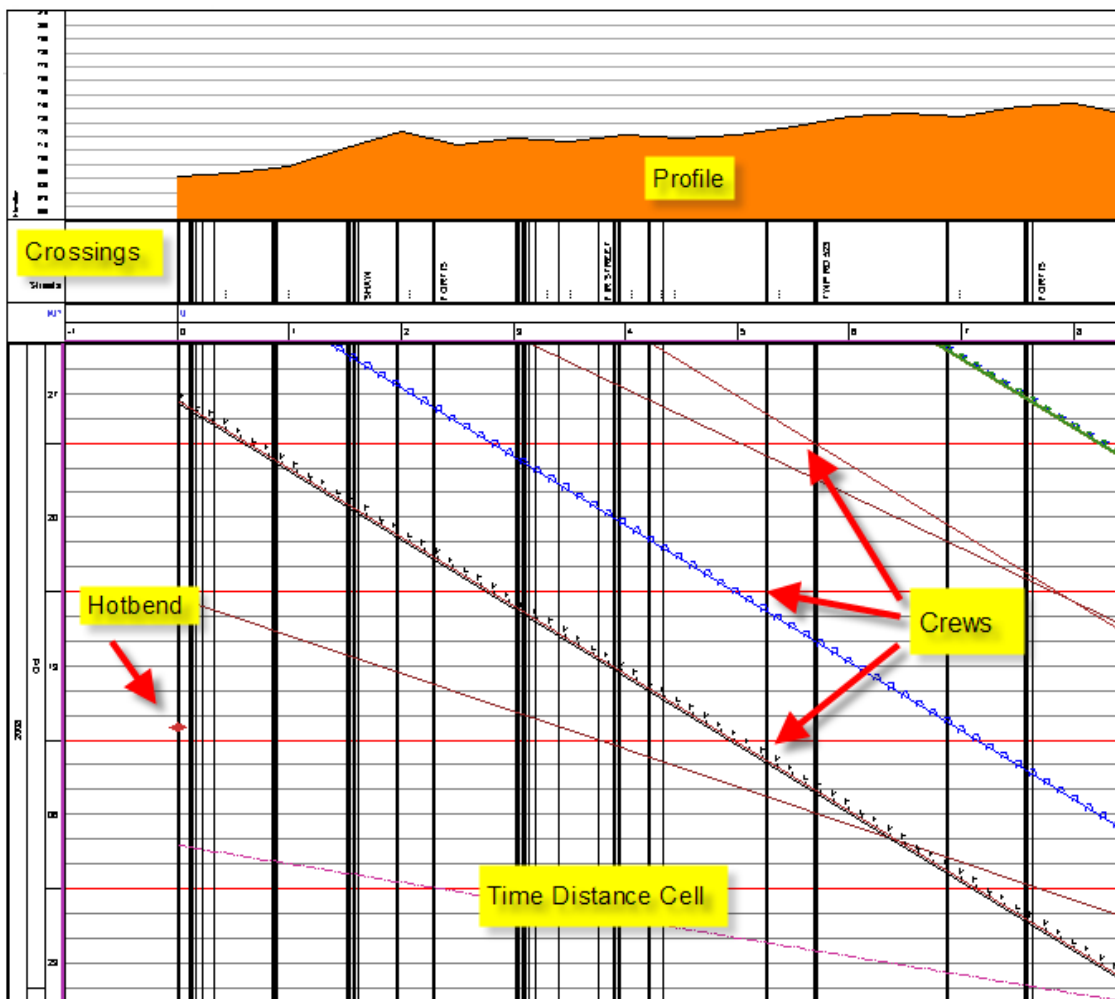

Figure 2. TILOS Time Distance Cell showing crossing and hot bend location

Once you set up your initial view you simply choose the task symbol representing the work you want to show (for example grading), place your cursor on the main area of your screen and drag out the line representing the work. You can adjust the start/end time and start/end distance either with your cursor or by typing in the values in the dialog box on your screen. TILOS calculates the work rate automatically for you as you draw or modify the crew line. If you have assigned resources to a crew

then TILOS can display the spend profiles in a time cell. These profiles are automatically recalculated as you change the productivity rates, start / end times, etc. so you can easily see the cost impact of these modifications.

The process is repeated for each crew/task that you want to schedule. Once you have added all your crews you can then create logic by connecting each task with a start-start, finish-finish or other type of relationship. You can also specify a lag between tasks or specify the distance that you want the crews to be apart. TILOS will maintain this minimum distance or lag when you make adjustments and reschedule your project.

TILOS also enables you to apply speed, work or work-rate profiles to each crew. For example I recently used TILOS to calculate duration and cost of logging and clearing along a northern route. Based on an Excel file that contained timber types and productivity rates/timber type, I was able to apply these productivity rates to the tasks I had drawn on the time distance chart. TILOS then calculated the duration required for each different timber type and applied this profile to the logging and clearing tasks. The next phase of this project will be to analyze the cost advantage of adding multiple crews along the route. TILOS easily does this by letting you break a crew into two or more sections with a simple right mouse click.

Recording actual progress in the field

Once you have created your plan you can then baseline and progress against the baseline (Figure 3). As you already know, the great advantage of linear scheduling is that you can visually see where your crews have completed the assigned work.
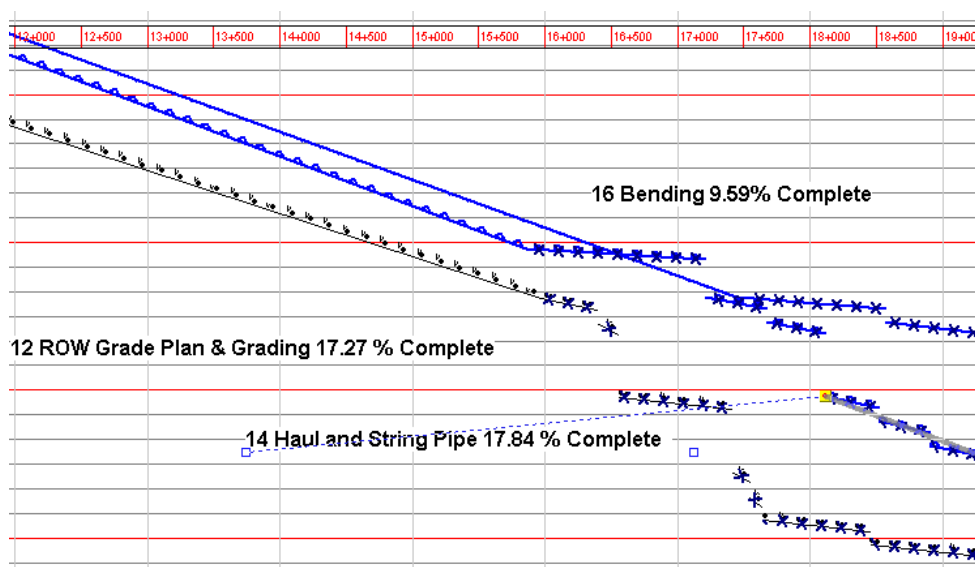

Figure 3. Progressing against a baseline

Summary

Traditional scheduling tools like Microsoft Project or Primavera will tell you that a task is 40% complete, but have no way of displaying which 40% has been completed and when a particular section was completed. It is very difficult to accurately describe move arounds, permitting and environmental issues in a way that is obvious. TILOS has been used in the U.S. for claims mitigation in a pipeline construction project as it clearly showed the number of moves that were required during the life of the project.

TILOS offers many other views, from the traditional Gantt chart to a bar chart (Figure 4) that displays the completed sections of the project based on the progress you have applied.
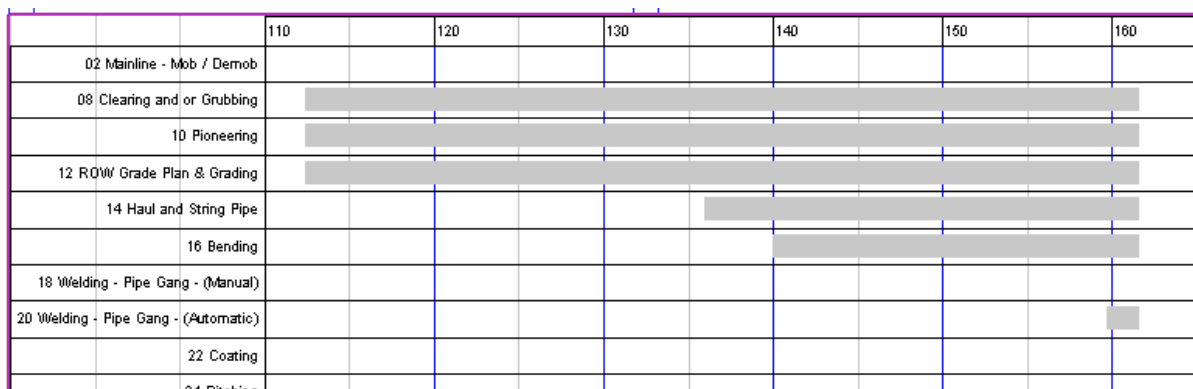

Figure 4. Bar Chart showing completed locations by crew

This overview is not intended to provide an exhaustive list of the capabilities of TILOS, but rather to show you that the very flexibility of the software provides you with endless opportunities to plan and execute your project. TILOS enables you to define your pipeline project, with all the challenges, in a single display.