

# WORLD PIPELINES®

Volume 12 Number 02 - February 2012

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Figure 1. Crossing the Waupisoo River.

# Scheduled

# FOR

Hubert Geier,  
Managing Director,  
Linear Project,  
Germany, explains  
the advantages  
of linear  
scheduling for  
pipeline projects.

# SUCCESS

**T**raditional planning and scheduling software for the construction industry is dominated by Primavera and Microsoft Project. Both solutions enable a planner to develop a series of activities that are logically connected, to provide a sequence of events from project start to finish. While these tools are designed for the construction of buildings and other facilities (power generating stations, refineries, etc.), they are not adequate for the constructability issues and demands of building a

linear project such as a pipeline, high voltage power lines, rail system or roadway.

The Gantt chart, with tasks grouped and sorted in different ways, is the most common approach these programmes use to present schedules. Using traditional planning software, the project execution can only be represented by increasing the number of tasks to split the work of a crew into many small parts to reflect the constructability issues (i.e., reverse lays, environmental restrictions) of the project. The end result is

large schedules that do not readily provide an overview of the interaction between site and schedule.

The difference in a linear project, such as a pipeline, is that the work is highly repetitive, with the crews moving along a defined right-of-way (ROW). Changing site conditions, environmental and regulatory constraints impact the production methods, work rate and the logistics of building the pipeline along the length of the project. The planner always needs to be aware of these conditions when planning

the tasks and resource usage, as well as the sequencing and direction of the work.

This article introduces TILOS, a linear planning and management tool that through the use of march charts (also known as time distance diagrams), enables a pipeline planner to integrate the schedule with the site data and logistical constraints. Rather than presenting the plan as a series of Gantt bars, this approach allows the planner to integrate and print as much detail as required about the schedule on

a single page. This detail can include elevation profiles, environmental windows, environmental windows, crossings and crew movement and direction of travel.

The key is the use of two axes: the time and the location axis in a 2D grid. In Figure 2, the location axis is horizontal and the time axis is vertical, but this can be changed on demand. Each task is defined by the start and end co-ordinates in both time and location. The line between these points defines the task and describes when the crew is at a specific location. The slope of the line indicates the speed of each crew in the different segments. The steeper the slope, the slower the crew is moving. Furthermore, the sequence of tasks in pipeline construction is strongly determined by the production processes, one crew cannot overtake the other. Using TILOS, any lines that cross immediately indicate clashes.

Activities such as horizontal directional drills, road bores or mainline block valves are typically shown as rectangles because the crews are working in one location. Environmental constraints and hydrotest segments are also typically represented by rectangles, as these are clearly defined in time and distance.

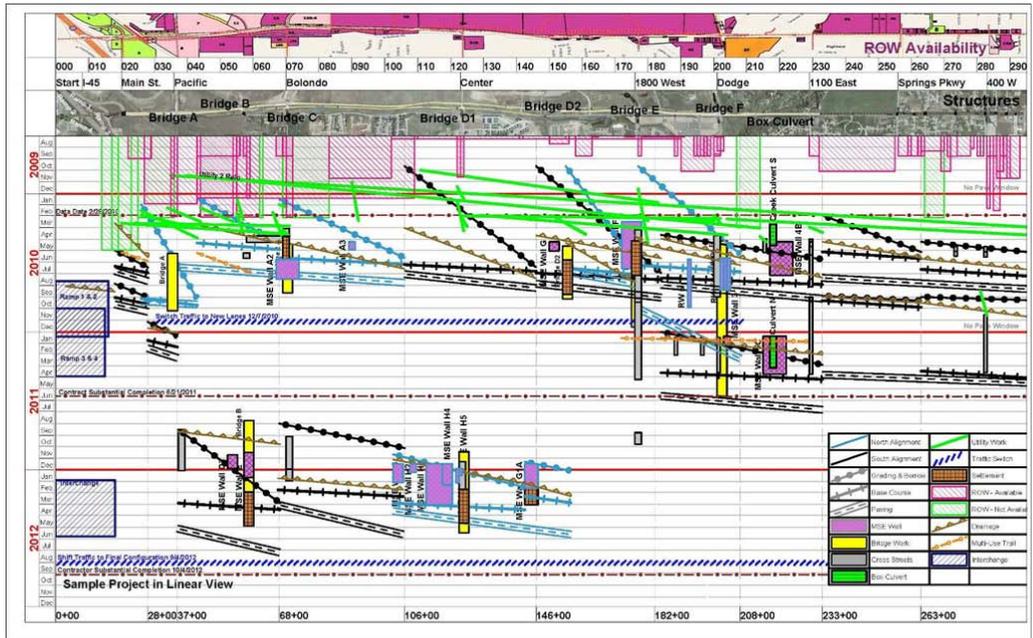


Figure 2. An example of a TILOS 1 page time-distance plan.

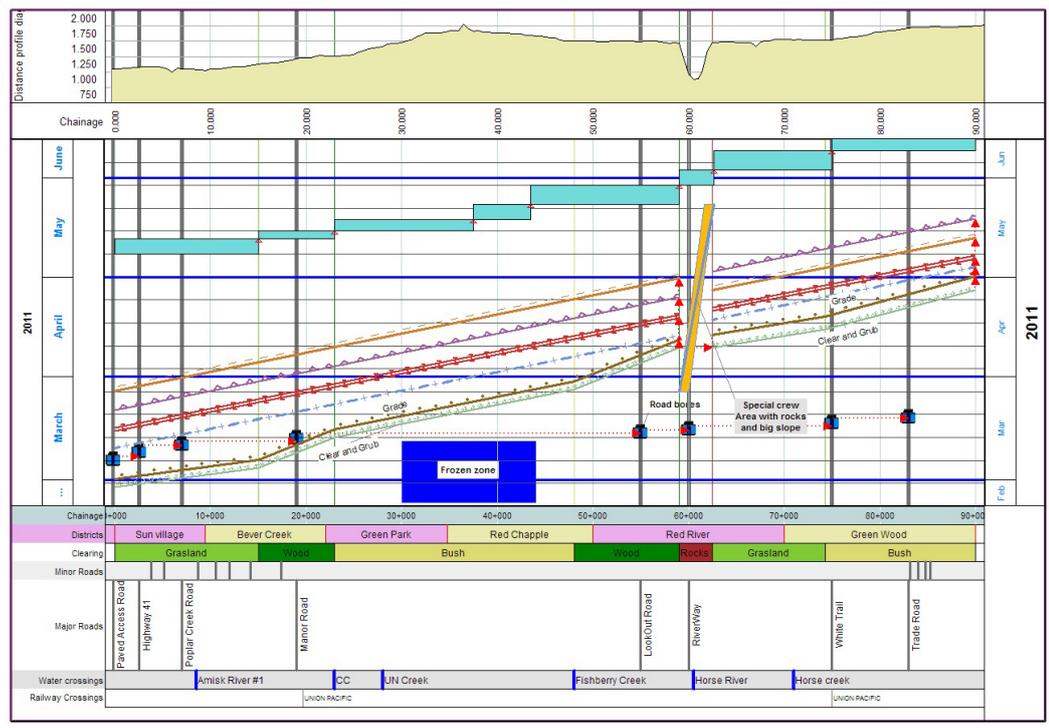


Figure 3. Linear schedule with ribbons.

## Connecting alignment sheets with the schedule

In the pipeline industry, detailed information about the ROW is documented in the alignment sheets that are typically prepared with CAD systems. This information includes: elevation, crossings, pipe thickness and type, pipe weight requirements, environmental restrictions, land permitting, and municipal districts that the pipeline is traversing.

This type of information is added in a TILOS view as a ribbon along the distance axis that represents the ROW. These ribbons can contain graphs that are generated using TILOS profile data, which are easily imported from Excel or other data files. Thus, a time distance diagram looks similar to an alignment sheet but also has an extra ROW that displays the schedule in a march chart form.

Figure 3 shows the main crew movements as different coloured lines. The road bores and the hydrotest tasks are shown as rectangles. The area between KP 59+000 and 62+600 (where the pipeline is crossing a valley) is represented in the overview plan by just a single summary task. This section is performed by a special crew and is detailed in another time distance diagram using a different scale to show more details.

Environmental restrictions and land tracks that have not been acquired are monitored as rectangles to indicate that there is no access to these areas. Each crew line touching these objects represents a clash and the planner is notified of these events during a reschedule in TILOS. In Figure 3, the blue rectangle indicates a weather restriction that the planner has had to consider in developing the project execution strategy.

Figure 4 shows a portion of the entire schedule discussed earlier. In this view, a filter has been applied to display only the clearing activity. The different clearing work rates (here m/d) along the ROW are indicated by the changing slope of the task line and the differential work rate is generated



Figure 4. Clearing crew with a variable work rate.



Figure 5. Satellite view with pipeline route, crossings and progress situation.

using the 'clearing' profile and is shown as a table. The table also represents the land coverage showing each type as a different colour. The work rate in the last column adjusts the work rate of the clearing task for that segment.

## Integrating GPS data

The integration of maps and satellite can further enhance the time distance diagram. If GPS co-ordinates are available, the ROW can be drawn as a route on a map and the pictures can be added to the TILOS view. Locations of crossings, camps, stockpiles and access roads to the ROW are important components of the planning process. All of these can be readily identified and located in TILOS using GPS data during planning.

TILOS is able to slice the task data to any time period or distance section. By mapping the KP values of the tasks to the GPS co-ordinates of the ROW, each task can be shown in the map view as well. Setting time filters, snap shots of the progress can be shown. Furthermore, it allows a simulation of the construction process by moving the time stepwise forward and adding the built section for the time periods.

## Reporting and controlling

During project execution, the time distance diagram is a valuable tool as it provides all the necessary information about stockpile sites, restricted access, crew locations, and access roads to plan the daily construction.

Daily progress is typically recorded in worksheets that are then entered into Excel or a company-owned reporting system. This progress data is easily imported into TILOS using its extended import facilities and allows the construction team to monitor the progress along the ROW. While traditional project management systems report on a % completed for

each task, TILOS also records the location and date where the work has been executed. Recording both the time and location of completed activities quickly identifies where move arounds and work stoppages have occurred.

Finally, a good progress overview can be achieved using the distance-based Gantt chart in TILOS. This is a unique feature that show bars along a distance axis (not using a time axis that is typical of Gantt charts). By grouping the task by crew and filtering for only performed sections, the distance Gantt chart clearly displays the sections that each crew has completed. Other information can also include earned value analysis on a crew or project basis. This includes: % completed

to date, % complete planned, completed quantity, remaining quantity, earned value and schedule variance. A distance Gantt chart is shown in Figure 5.

TILOS calculates the expected end date using the actual work rate to date. After rescheduling, any remaining work can be easily planned using a new work rate required to recover the baseline end date if necessary.

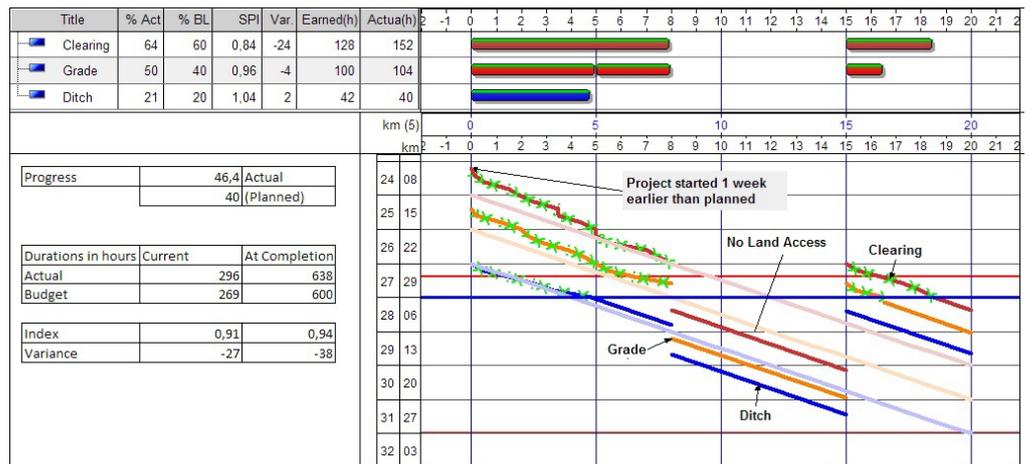


Figure 6. Progress in a march chart and distance Gantt chart.

### Integration concepts

Compiling all this information into the plan does not necessarily mean that a lot of effort is required. Most of the information is already available and can be imported into TILOS during the planning phase.

In TILOS, most graphs are not simply pictures but are generated based on grid data that can be easily imported. Spreadsheets, the most common tool used by engineers for calculation and management, are easily imported into the software by using the clipboard or importing XML data.

The TILOS template strategy allows a planner to setup a project in a minimum amount of time. The layout of the view, including ribbons, and the standard task templates with predefined work rates can be predefined and saved as a TILOS template. New projects are then created based on this template. Setting the execution time and the distance axis values adjusts all the views in the project automatically.

The planning starts by importing site data such as crossings, county list and elevation to generate the ribbons for the view. Activities can be added by drawing them directly on the view or importing them from Excel or another project management system.

### Portfolio management

In many large organisations, TILOS is used to plan and control individual projects because of its comprehensive schedule presentation. In these organisations, TILOS is used to push

data to the company portfolio management tools, such as Oracle's Primavera using the API integration tools developed for TILOS. The software exchange module can import the whole project including WBS structures and resource usage into Primavera Project management. For MS Project, a similar integration is available using a VBA application that can build the whole project from scratch.

### Summary

This article has shown a new approach to the traditional planning methodology. By visually developing the project, while incorporating all known constraints and constructability issues, the planner can readily develop a feasible execution plan. Using the layer-based cell system in TILOS, as much detail as required by the planner and project team can be incorporated into a TILOS view. Company tailored templates reduce the work efforts and costs for planning by providing more precision during the early planning phase.

Many owner organisations now require a march chart submission as part of the bid package so that the contractor can demonstrate an understanding of the constructability issues and constraints and to prove that the work can be completed in the required timeframe. 