

# BASIC AUTOSCHEDULING ILLUSTRATED

The purpose of this document is to give through illustrations the user an understanding of what to expect when the project plan is autoscheduled.

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## INTRO

Autoschedule is not “auto” in such sense that it would do the calculations automatically every time as soon the user has entered data. There is no options to do so either. In a large plan the calculations may take some time. Secondly the user can try different plan options before selecting the one to be autoscheduled.

Autoschedule attempts to develop a schedule in which all dependencies are satisfied and resources are not overallocated. That means calculating durations for the tasks and their start and finish dates. The durations and sequence of tasks, when dependencies determine it, are usually fairly clear. The uncertainty is in the sequence when there are several tasks available for scheduling at the same time.

### Gantt chart

The Gantt chart is a timescaled view where tasks are displayed graphically as bars. The options allow to display dependencies, baseline etc. OWB cannot display any text eg. task or resource names nor numbers nor dates. It is possible to show vertical lines at some project level dates. The options dialog box is accessed by double clicking the chart area. The timescale unit can be chosen from days to years. Hours are not available. (OWB is not designed for scheduling daily activities)The timescale options dialog box is accessed by double clicking the timescale.

### Rules of prioritization

## EXAMPLES

## Scheduling when no rules apply

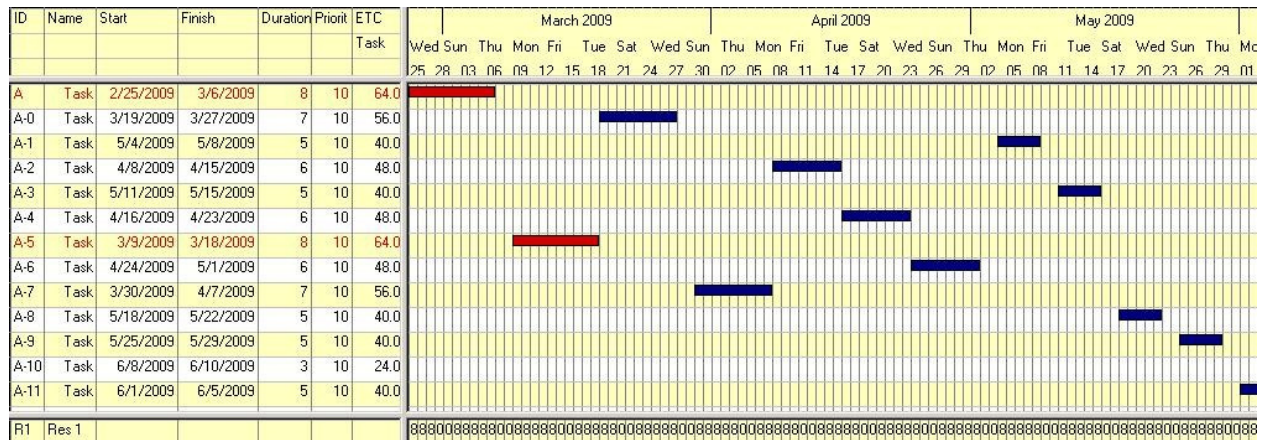
ID	Name	Start	Finish	Duration	Priorit	ETC
						Task
A	Task	2/25/2009	3/6/2009	8	10	
A-0	Task	2/25/2009	3/5/2009	7	10	
A-1	Task	2/25/2009	3/3/2009	5	10	
A-2	Task	2/25/2009	3/4/2009	6	10	
A-3	Task	2/25/2009	3/3/2009	5	10	
A-4	Task	2/25/2009	3/4/2009	6	10	
A-5	Task	2/25/2009	3/6/2009	8	10	
A-6	Task	2/25/2009	3/4/2009	6	10	
A-7	Task	2/25/2009	3/5/2009	7	10	
A-8	Task	2/25/2009	3/3/2009	5	10	
A-9	Task	2/25/2009	3/3/2009	5	10	
A-10	Task	2/25/2009	2/27/2009	3	10	
A-11	Task	2/25/2009	3/3/2009	5	10	
R1	Res 1					

ID	Name	Start	Finish	Duration	Priorit	ETC
						Task
A	Task	2/25/2009	3/6/2009	8	10	
A-0	Task	2/25/2009	3/5/2009	7	10	
A-1	Task	2/25/2009	3/3/2009	5	10	
A-2	Task	2/25/2009	3/4/2009	6	10	
A-3	Task	2/25/2009	3/3/2009	5	10	
A-4	Task	2/25/2009	3/4/2009	6	10	
A-5	Task	2/25/2009	3/6/2009	8	10	
A-6	Task	2/25/2009	3/4/2009	6	10	
A-7	Task	2/25/2009	3/5/2009	7	10	
A-8	Task	2/25/2009	3/3/2009	5	10	
A-9	Task	2/25/2009	3/3/2009	5	10	
A-10	Task	2/25/2009	2/27/2009	3	10	
A-11	Task	2/25/2009	3/3/2009	5	10	
R1	Res 1					

The lowest rule is the WBS sequence. If no higher rule applies then the tasks are scheduled in the WBS sequence from top down.

The next rule is the duration of the tasks. The tasks are scheduled in descending order of duration.

Both of these rules can be illustrated in the same example.

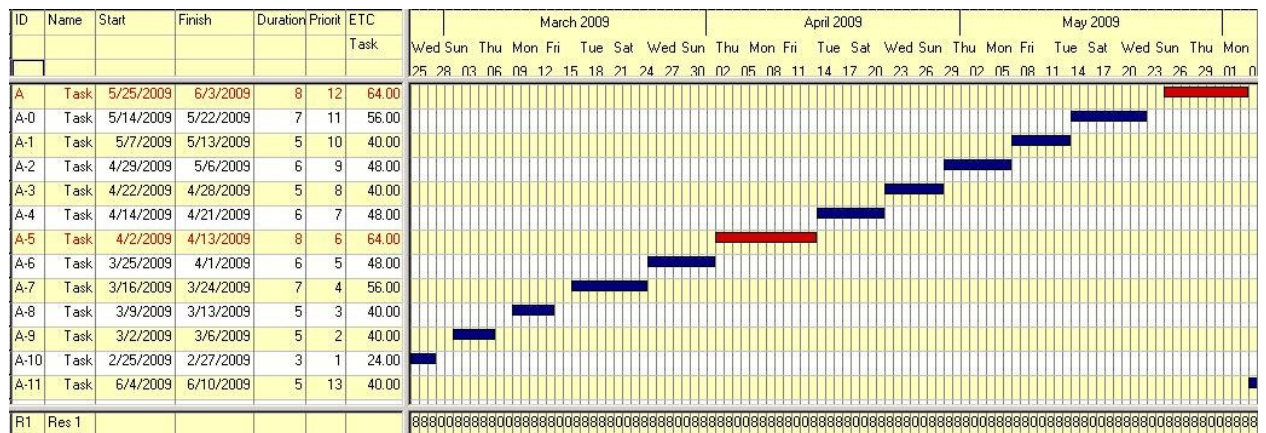


**FIG Sample project schedule based on durations and WBS sequence**

Tasks are Autoscheduled in the descending order of duration (the longest to the left) and then in the order of WBS sequence (the ones higher in the list to the left). No resource overload.

### Scheduling based on task priorities

The next higher rule is the task priorities. Priority levels override duration and WBS sequence.



**FIG Sample project schedule based on priorities**

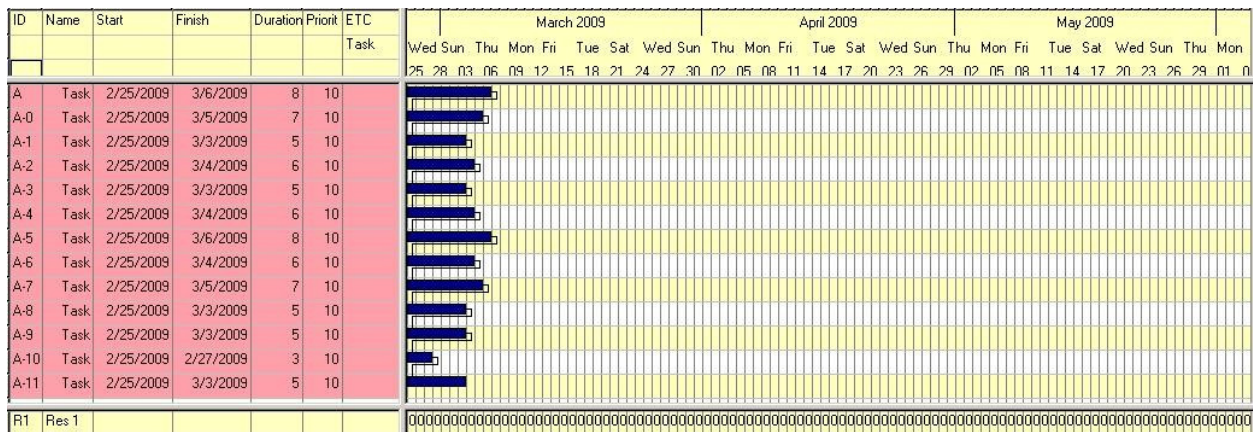
Task are scheduled in the sequence of ascending task priority- lowest number first (to the left).

### Scheduling based on dependencies

Task dependencies come before all prioritization rules in Autoscheduling. Only when dependencies make tasks available for scheduling at the same time are rules taken into consideration.

For this illustration two sample projects are

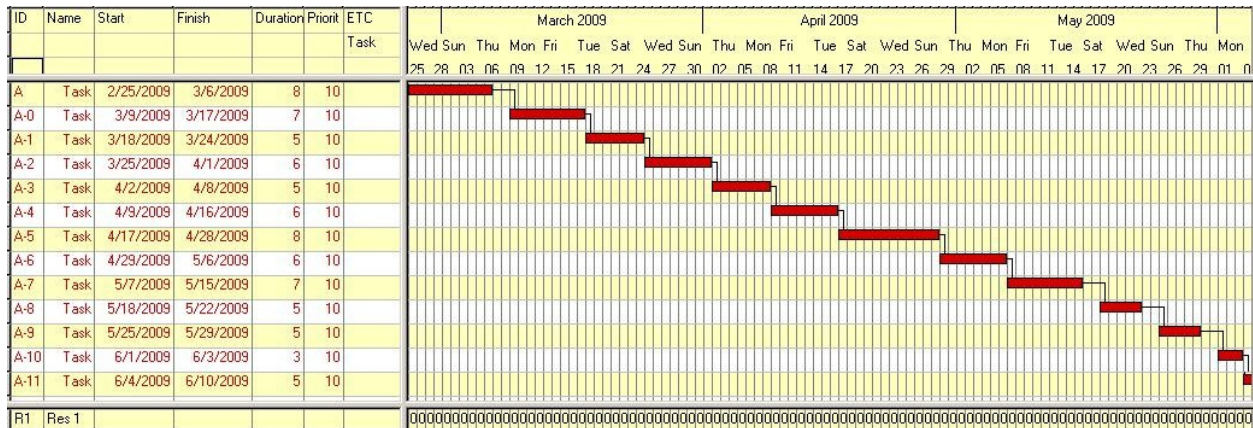




### FIG Sample project unscheduled with dependencies

All tasks are again set to start the same date and have the same priority and the resource is removed. Because all tasks start the same day and the dependencies are defined OWB highlights for dependency violation ie incorrect sequence of tasks.

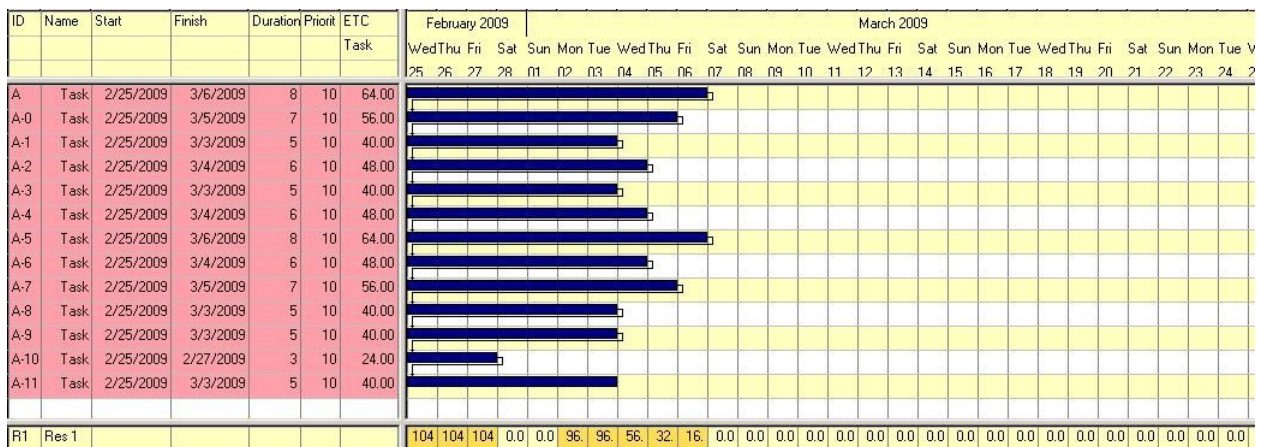
### Scheduling tasks only without resource assignments



### FIG Sample project scheduled with dependencies – no ETC

When there are no resources the only definition is the start and end dates of the tasks. That is the task start at the beginning of the day and finish at the end of the day. The Autoschedule option Start successor the next day has no effect. (You get the same result whether or not you select the option.

### TASK WITH RESOURCES ASSIGNED

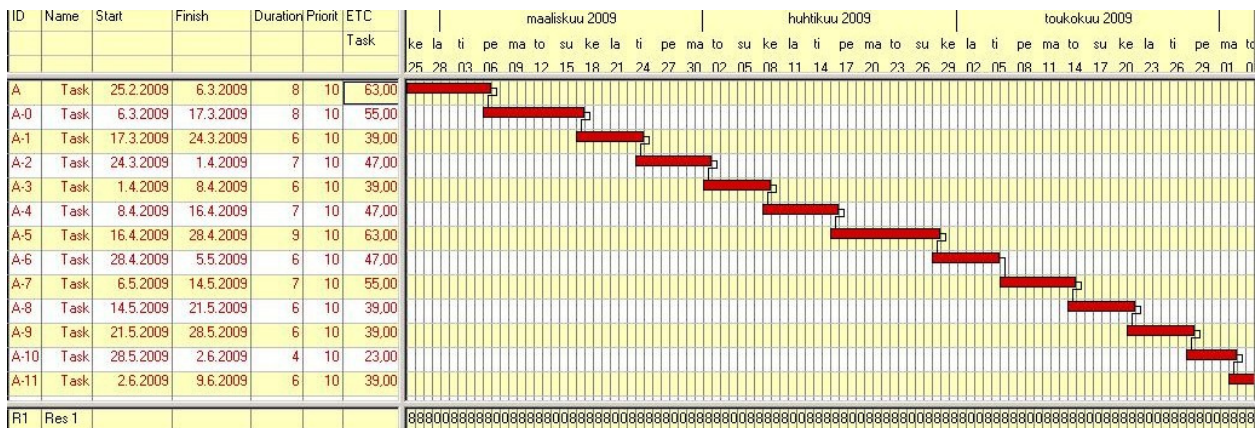


## FIG Sample project unscheduled with dependencies and ETC

When the resource is added to the project, assigned to tasks with ETC, OWB highlights also for the resource overloading.

### Autoscheduling with the successor starting the same day

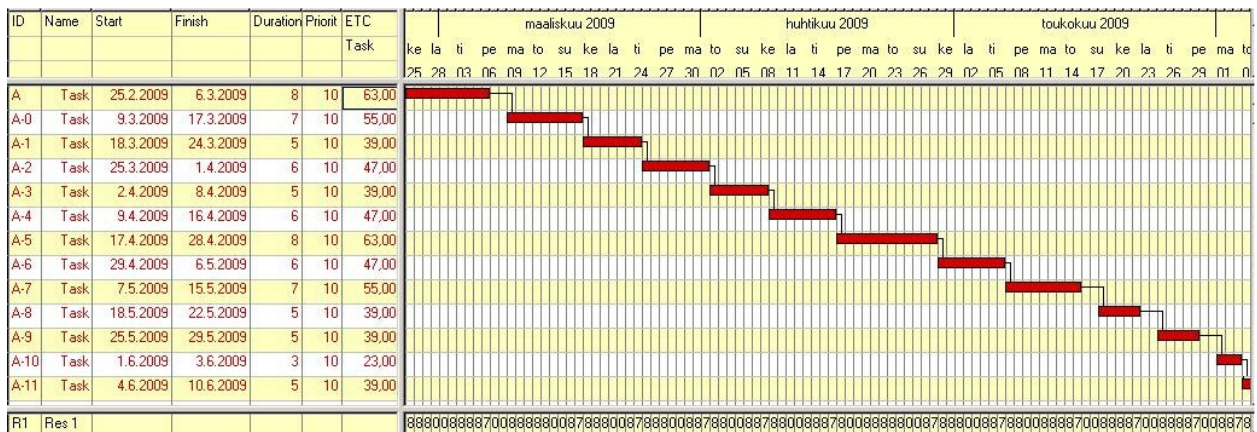
This option will make a difference in the schedule only if tasks finish in the middle of the day and the loading pattern is such that the remaining hours of work will be utilized. Therefore the ETC of each assignment is reduced by one hour and the loading pattern has to be Front. Loading pattern Countour would in most of the cases result the successors to start on the next day anyway. Contour tries to have level work effort on all days and if there is only one hour available on a day work will not be scheduled for that day if there is more work on other days.



## FIG Sample project with dependencies and ETC scheduled successor to start the same day

The resource is assigned to tasks and the work effort is defined with the accuracy of one hour. When the plan is autoscheduled and it not selected to start the successors the next day the successor can start the same day. That is if the predecessor finishes in the middle of the day. Look at task with ID A-1 it starts the same day as the predecessor finishes and the Gantt bars overlap. The successor A-2 starts the next day because A-2 finished at the end of the day (because the resource daily workload in the project is 8 hours).

### Autoscheduling with the successor starting the next day



## FIG Sample project with dependencies and ETC scheduled successor to start the next day

When the option start successor the next day is selected there is no overlap of Gantt bars in any case. The biggest difference is when a



predecessor ends on a Friday, then there is a gap because the successor starts on Monday. Note that with this option the project is one day longer and the finish of the last task is one day later.

## HOLIDAYS

The project plan is always autoscheduled on workdays only and the duration is also given in workdays. The duration in calendar days is respectively longer depending on the number of weekends and holidays. OWB does not display the duration in calendar days. Weekends are by default holidays in OWB calendars. Additionally users can define custom holidays.

As soon as custom holidays are set up they are displayed on the Gantt chart, if the option to display them is on. Custom holidays apply only on projects opened or scheduled after they were defined. Custom holidays apply to all such projects. No work on tasks is scheduled on custom holidays. No work is scheduled on custom holidays

**Calendars**

System Options (applies to all calendars)

Hours per Day: 8.00 Hours per Week: 32.00

Week Start: Monday

Current Calendar: Standard

Calendar Editing

Name: Standard

Based On: <none>

New Delete Print...

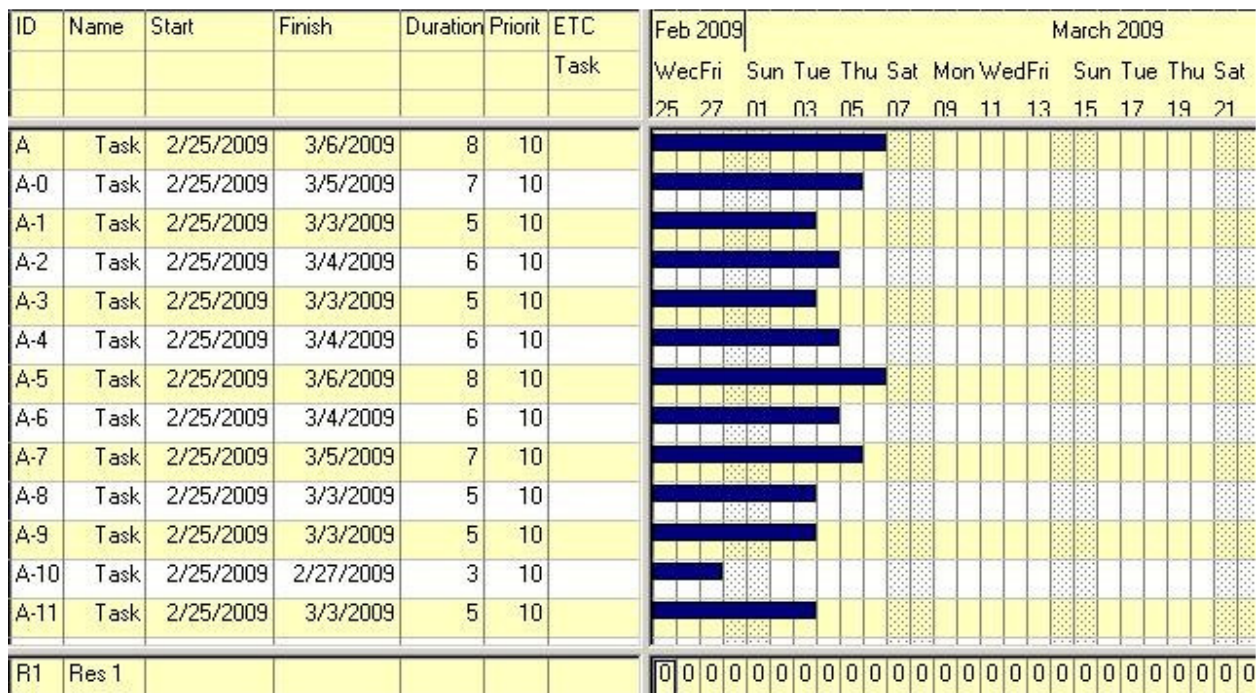
February 2009

Mon	Tue	Wed	Thu	Fri	Sat	Sun
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

Workday Holiday Reset Reset All

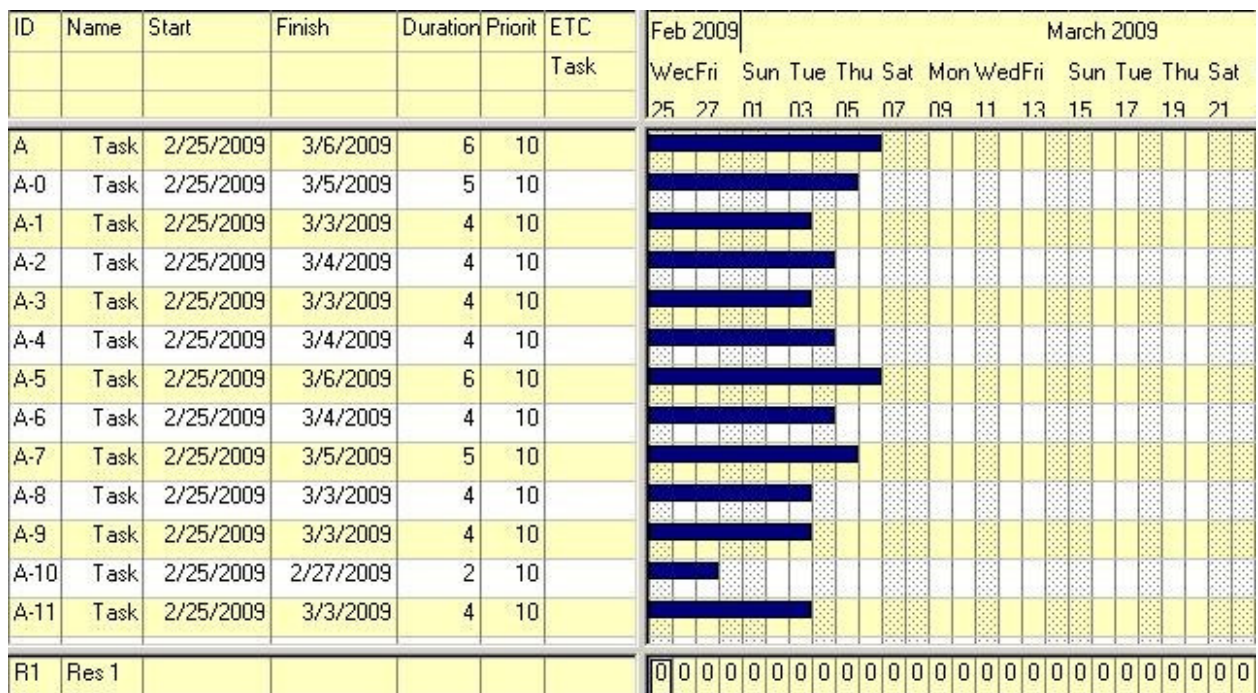
### FIG Project calendar after Wednesdays are set holidays

The same sample projects as before are used. First the effect of custom holidays is illustrated with the project with no resources assigned



**FIG Sample project with no ETC and dependencies before scheduling**

This is the same project that was used before.  
As soon as Wednesdays are defined as Holidays the project plan changes.



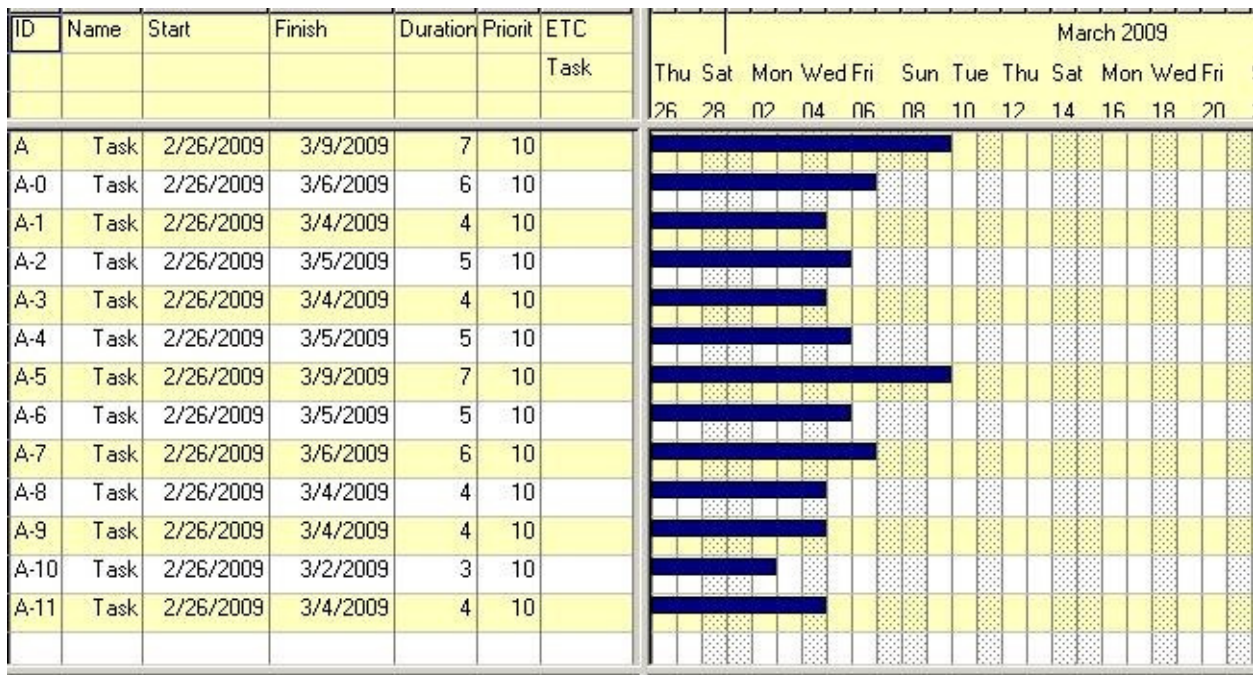
**FIG Sample project with no ETC and dependencies after Wednesdays are define as holidays**

The start and finish dates of the tasks do not change (task length in calendar days) but the duration is recalculated based on the current workdays. Next the plan is autoscheduled.

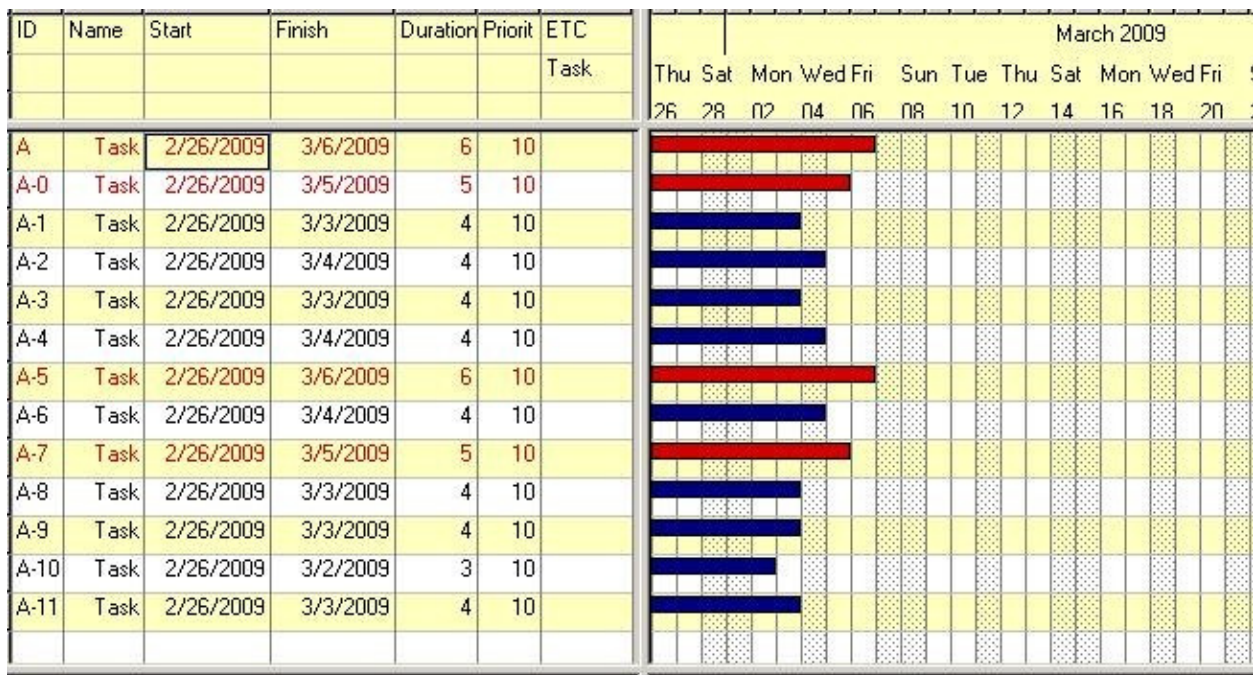








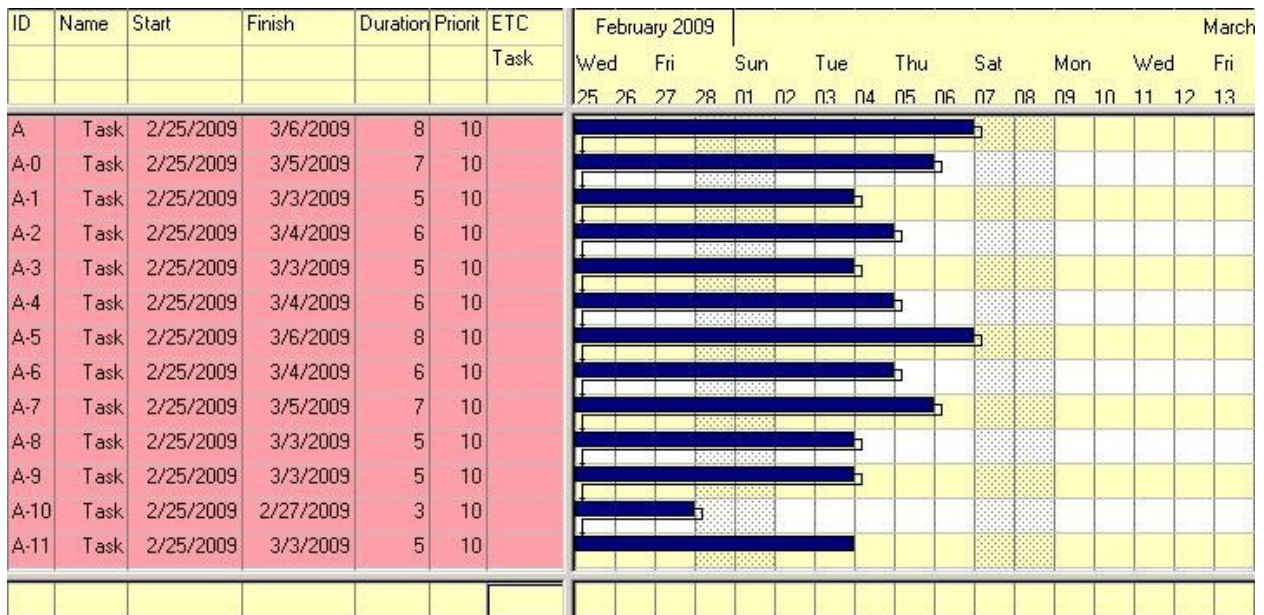
**FIG Sample project after Wednesdays have been defined as holidays.**



**FIG Sample project after scheduling**

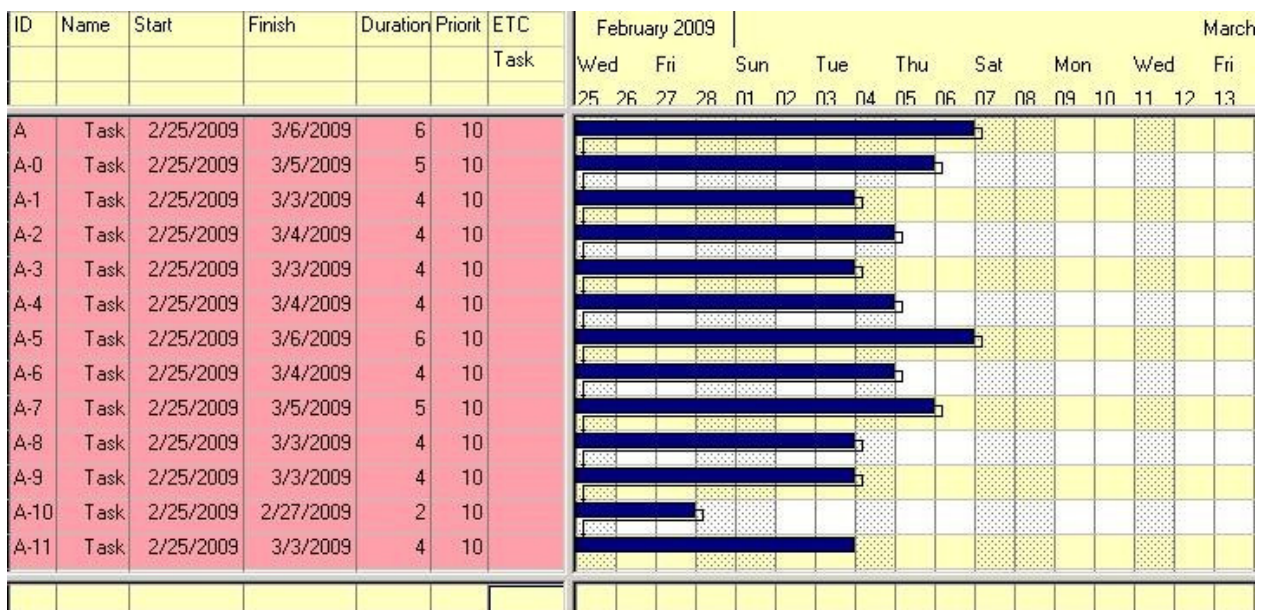
In this second illustration the durations in calendar and workdays are not the same as in the previous illustration.

Next custom holidays on Wednesdays is illustrated with the project that has additionally dependencies between the task.



**FIG Sample project with no ETC defined before scheduling**

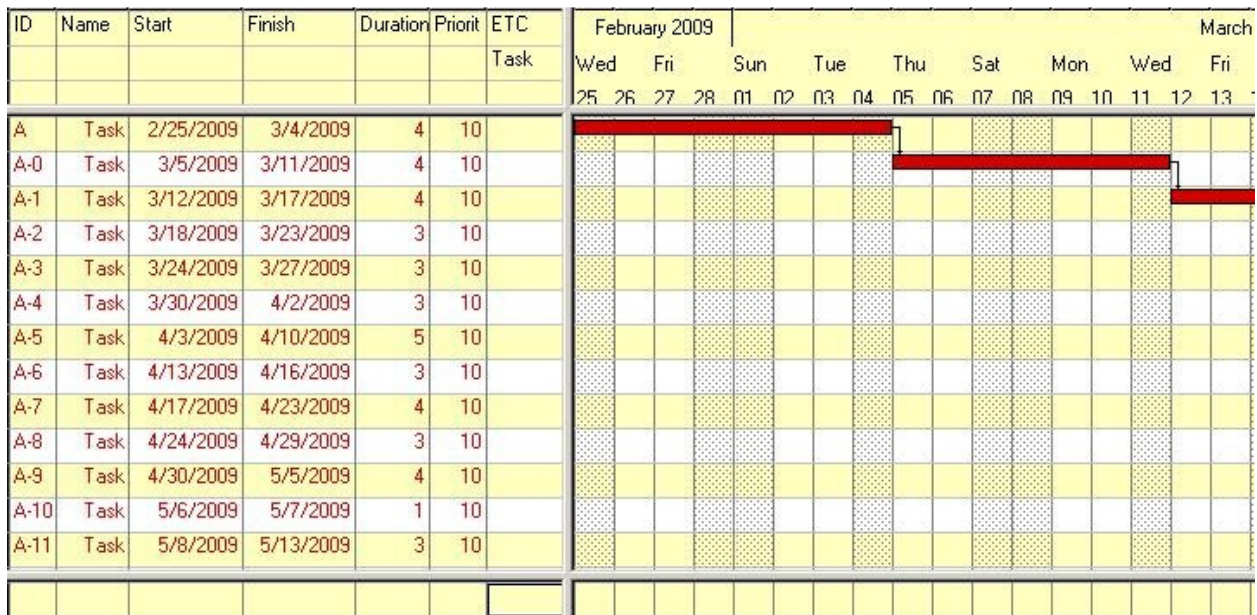
Again as soon as Wednesdays are defined as Holidays the project plan changes.



**FIG Sample project with no ETC defined before scheduling after Wednesdays are made holidays**

The start and end dates of the tasks have not changed, but the duration in workdays was recalculated. Next the plan is autoscheduled.

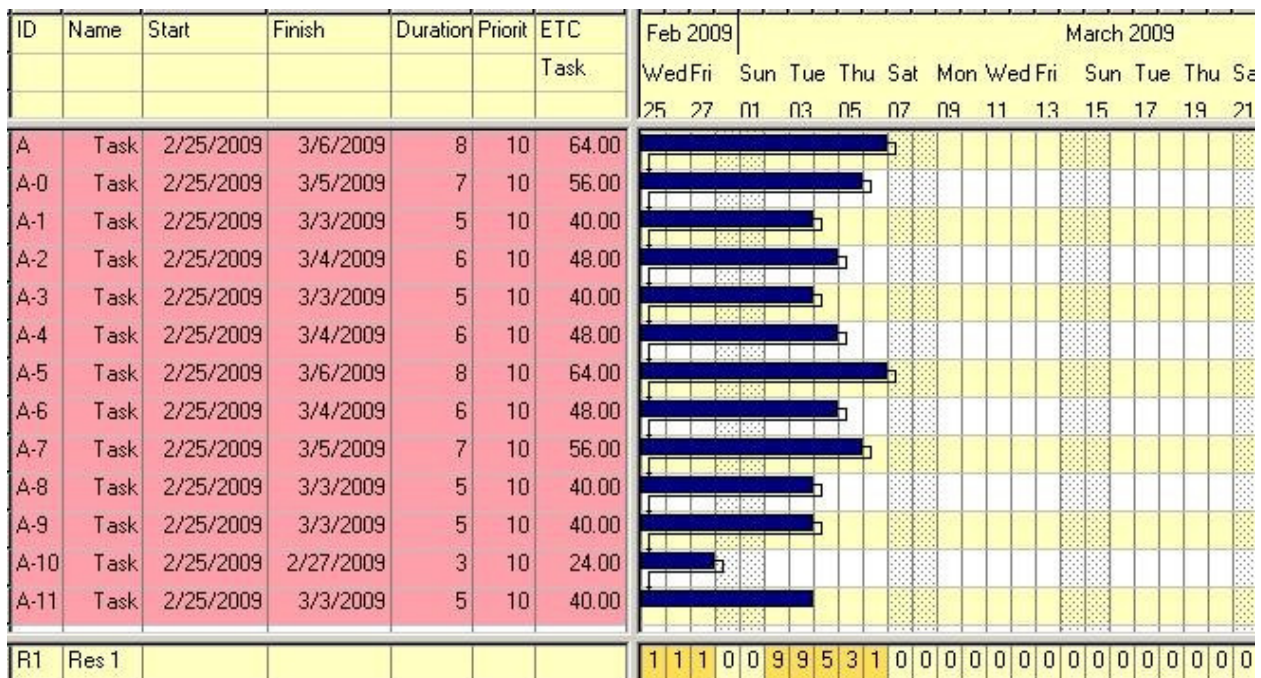




**FIG Sample project with no ETC defined scheduled when Wednesdays are holidays**

The duration in workdays is changed again. The duration in calendar days is changed to what was the initial value in workdays.

**OWB DOES NOT AUTOSCHEDULE PROJECT PLAN CORRECTLY AND CONSISTENTLY WHEN THERE ARE NO RESOURCES ASSIGNED TO TASKS AND THERE ARE CUSTOM HOLIDAYS.**



**FIG Sample project before scheduling**

Again as soon as Wednesdays are defined as Holidays the project plan changes.



[illegible]



The holidays on project calendar are applied also on resource calendars. Therefore the resource effort under the Gantt chart is 0 hours on Wednesdays.

**FIG Resource calendar where holidays on Wednesdays are derived from project calendar.**

ID	Name	Start	Finish	Duration	Priorit	ETC	March 2009															
						Task	Thu 26	Sat 28	Mon 02	Wed 04	Fri 06	Sun 08	Tue 10	Thu 12	Sat 14	Mon 16	Wed 18	Fri 20	Sun 22			
A	Task	2/26/2009	3/10/2009	9	10	64.00																
A-0	Task	3/12/2009	3/23/2009	8	10	56.00																
A-1	Task	3/24/2009	3/31/2009	6	10	40.00																
A-2	Task	4/2/2009	4/10/2009	7	10	48.00																
A-3	Task	4/13/2009	4/20/2009	6	10	40.00																
A-4	Task	4/21/2009	4/30/2009	8	10	48.00																
A-5	Task	5/1/2009	5/14/2009	10	10	64.00																
A-6	Task	5/15/2009	5/25/2009	7	10	48.00																
A-7	Task	5/26/2009	6/5/2009	9	10	56.00																
A-8	Task	6/8/2009	6/15/2009	6	10	40.00																
A-9	Task	6/16/2009	6/23/2009	6	10	40.00																
A-10	Task	6/25/2009	6/29/2009	3	10	24.00																
A-11	Task	6/30/2009	7/7/2009	6	10	40.00																
R1	Res 1						8	8	0	0	8	8	0	0	8	8	0	0	8	8	0	0

**FIG Sample project with resources assigned scheduled when Wednesdays are holidays on resource calendar only.**

The resulting schedule is the same as when the holidays are on project calendar, except that the duration in workdays is calculated using the project calendar.

**WHEN THERE ARE RESOURCES ASSIGNED TO TASKS AND THERE ARE CUSTOM HOLIDAYS IN RESOURCE CALENDAR OWB DOES AUTOSCHEDULING CORRECTLY AS EXPECTED.**

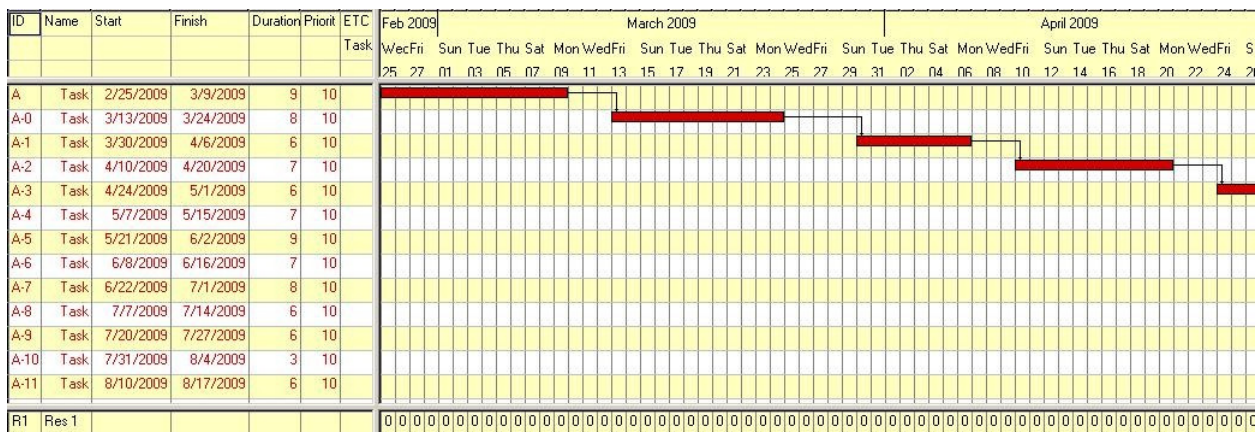
The Discontinuous option breaks the bars in the Gantt chart, when there is no resource effort on the task on a workday.

## LAG

### Standard lag

Lag is the predetermined amount of time between the start and/or finish time of two tasks in a project plan. That means of course that dependencies have to be defined. Lag can be positive or negative.

The test project with dependencies is modified to have a 3 day lag between the tasks.



**FIG Sample project with dependencies and 3 day lag scheduled.**

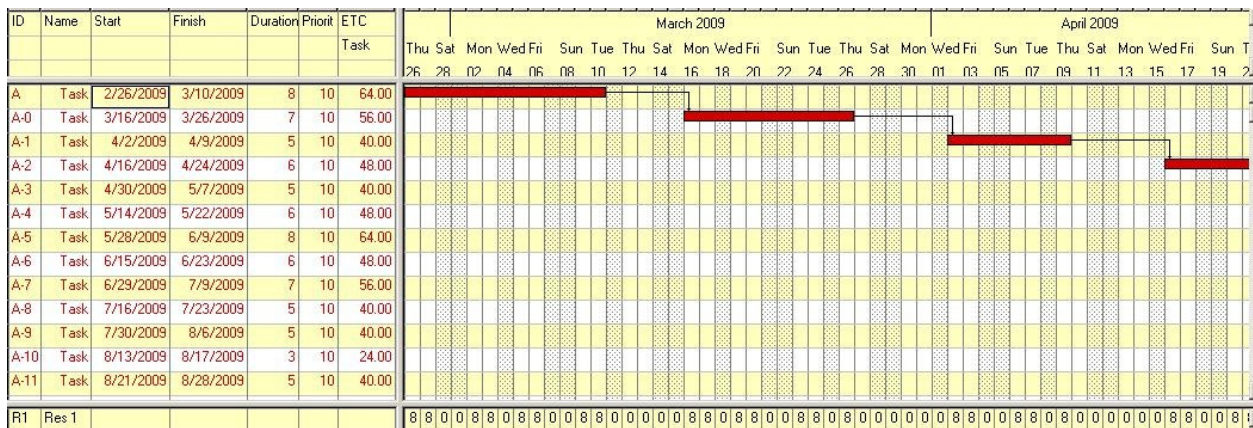
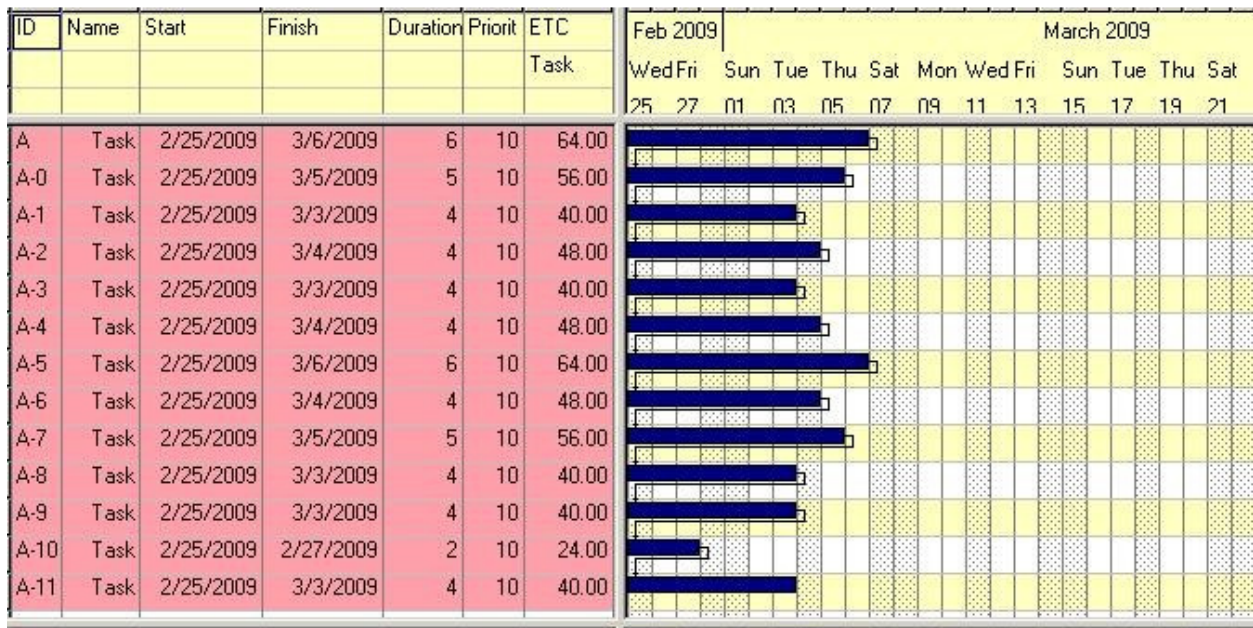
The sample project behaves as expected in scheduling and successors are started three days after the predecessor is finished.

### Lag and custom holidays

The conclusion on custom holidays was that a project without resource assignments cannot be autoscheduled when there are custom holidays. That is not going to change when there is lag, so there is no point to illustrate that situation.

Lag and custom holidays is illustrated only with a sample project where there are resources assigned and ETC defined.





## APPENDIX: THEORY BEHIND AUTOSCHEDULE

### Steps of Autoschedule

Autoschedule is done in several steps in order to achieve the desired schedule. The following is an overview of the steps. The steps are described more precisely and in detail in the manuals and various training materials

At first the task **durations** are calculated based on the assigned resource effort (ETC) and resource daily availability. If there is no resource effort or the duration is set to be fixed this is skipped and the current task durations are used.

Taking into consideration the dependencies between tasks defines their network. **The first schedule** is calculated using the calculated durations with a forward pass taking. There is no limit to the number of tasks starting at the same time, because at this point the resource availability is considered to be unlimited. Therefore there is no need to prioritize the task yet. In the first forward pass Autoschedule tries to schedule all task as early as possible (**Early Start and Early Finish**). If there are assignments with fixed loading pattern or tasks locked for scheduling or to be omitted from scheduling they retain their current schedule. This gives the **Earliest Finish** for the project.

The Earliest Finish for the project is used as a bounce back date which is used when the backward pass calculation is made. The backward pass calculates the Late Start and Late Finish for each task.

The two sets of dates establish the **float** of each task and the chains of those tasks which have no float determine the **critical path**. Some times there is more than one critical path in the project. For example the administrative tasks and holidays can be included in the plan for clarity and reporting even if their progress is irrelevant to the project. These tasks may be planned for the whole duration of the project and therefore they naturally lie on the critical path. OWB can accommodate this with the Critical Path subnet option in project properties on scheduling tab. However, a small number of subnets in the project plan is quite different from no dependencies at all. That is something where Autoscheduling can produce unexpected results if any.

At this point resources may be overallocated and this is where the calculation stops if Resources Constraints is not selected in Autoschedule options.

In the final schedule calculation the resource availability is taken into consideration when scheduling tasks that are available to be scheduled at the same time so that no resource overload will occur. The critical path is refined to **resource critical path**.

## Rules

The tasks are rescheduled according to resource availability and the critical path is recalculated accordingly. The work effort is distributed across the duration of tasks according to the selected loading pattern.

All of the resource availability is used on the critical path tasks first. (Usually that results in resources working on one task at a time)  
Any remaining resource availability is used in the order of prioritization.

## Priorities

Tasks, that are available to be scheduled at the same time, are prioritized in the following order:

- Tasks that use a fixed loading pattern (non critical)
- Tasks locked for scheduling (non critical)
- Tasks with start and finish constraints
- Priority (0-36 see note below)
- Started tasks
- Tasks with the lowest float FIRST then in ascending order of float.
- When the tasks have no dependencies, they are scheduled in the descending order of duration
- "top-down" according to WBS order.

N.B. Autoschedule assumes that a predecessor task has a priority at least equal to its successor. In some cases, dependency relationships override individual task priority during the scheduling process.

## Constraints for task scheduling

You can set other task scheduling constraints that impact Autoschedule on the Advanced tab of the Task Properties dialog box. These scheduling constraints can override priority during Autoschedule but cannot override tasks that are locked for scheduling. Scheduling constraints that you can specify for tasks include:

## Autoschedule options

This refers to the options in the Autoschedule launch dialog box



Warning: Prior to Autoscheduling the task start dates are changed to the date you enter, except in the following cases:

- The task's Status is 'Started' or 'Completed'.
- The task has a 'Must Start On' constraint.
- The task is marked as Locked for Scheduling.
- The task has resource assignments with fixed loading patterns before the entered start date.

In the Ignore Tasks Starting Before text box, enter a date if you want Autoschedule to bypass tasks that start before the date you enter (partial autoschedule)

In the Ignore Tasks Starting After text box, enter a date if you want Autoschedule to bypass tasks that start after the date you enter (partial autoschedule).

Select the Resource Constraints check box if you want Autoschedule to take resource availability into account when scheduling the project. Note: If you clear the Resource Constraints check box, Autoschedule treats resources as if they had unlimited availability. Each task is scheduled against the resources total availability, not against the resources remaining availability which takes other task assignments into consideration. This results in the shortest possible schedule, but it may also cause resources to be overcommitted.

## RESCHEDULING

After the project has been started and work has been performed the progress may differ from what was planned. Then rescheduling is necessary to update plan. Rescheduling will help the project manager to better establish where the original plan is not met and plan corrective action accordingly. Work already performed will not be rescheduled only the remaining work (ETC).

When the plan of an ongoing project is Autoscheduled then the same and some additional rules apply:

Autoschedule will not reschedule:

- The start date of started tasks
- The end date of started tasks when task duration is Fixed

Autoschedule does not reschedule tasks that are:

- Locked (Lock for Scheduling option selected)
- Completed
- Tracked solely by percent complete

There are options for

- Schedule Assignments on Locked Tasks
- Honor Constraints on Started Tasks

Please refer to the manual regarding to their use

Autoschedule will reschedule tasks according to remaining resource availability.

Autoschedule will reschedule started tasks FIRST.

(Started tasks are scheduled ahead of other tasks with the same priority.)

Tasks are scheduled to minimize the critical path (subject to priority) and to use availability as early in the project as possible without overcommitting resources.

Cost resources do not constrain the schedule.

A fixed loading pattern will determine the task schedule, regardless of constraints and possible resource overallocation.

The duration of a fixed duration task is not changed.

Autoschedule will not over allocate resources to meet a finish constraint, unless the Schedule From Finish Date option is selected.

Tasks are scheduled at a daily level.

#### REVISIONS

v.03 March 2 2009

Completely revised with additional topics and examples, but still a draft.

The content of these pages is presented as personal views only and not as any sort of advice or instruction.