
AIMMS Tutorial for Professionals - Absentee and Planning Overviews

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Chapter 12

Absentee and Planning Overviews

In this chapter you will construct two end-user pages including Gantt charts and composite tables for the display of model data. A Gantt chart is an advanced page object that is especially useful for displaying scheduling and planning data defined over time.

This chapter

12.1 Gantt charts

A Gantt chart typically contains a number of interrelated *tasks/processes/jobs* viewed against a time scale. Such a chart consists of one or more rows in which horizontal bars are displayed. Each individual bar represents a single task, and the length of the bar gives a visual impression of when and for how long that specific task is to be performed. The rows typically refer to *resources* that are consumed by the individual tasks. It could be that your schedule involves several types of tasks (e.g. maintenance tasks and line usage tasks). In this case, the Gantt chart can be configured using colors and/or text inside bars to indicate what type of task is performed for each resource.

Gantt chart description

You can use several AIMMS identifiers to control the appearance of the Gantt chart. The extensive controls cannot be explained in a single paragraph. You can, however, exercise control over the time scales along the x -axis (see Figure 12.2), and over the position and color of each individual bar.

Controlling appearance

In this chapter you will construct three Gantt charts. The first Gantt chart will be used to plan the vacation periods for each factory on a weekly basis. The second Gantt chart will be used to schedule official holidays on a daily basis. Using these two Gantt charts your end-user will be able to graphically schedule holidays and vacations by merely clicking on the bars inside these charts. The third Gantt chart is not designed for data input, but will be used to display the overall maintenance and line usage output of the model.

Three Gantt charts

12.2 The Absentee Overview page

In this section you will construct the entire page shown in Figure 12.1. The two Gantt charts and the composite tables will be treated in separate subsections.

Viewing the entire page

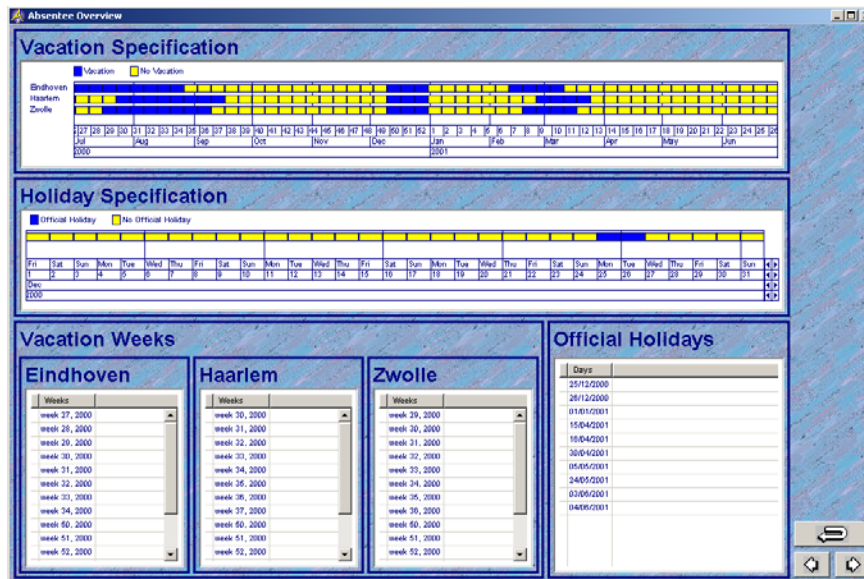


Figure 12.1: The completed *Absentee Overview* page

12.2.1 The vacation Gantt chart

The vacation Gantt chart will contain a single row for each factory. A factory can be viewed as a resource with workers. An amount of the resource is consumed when workers are on vacation. In this Gantt chart there will be two types of colored bars in each row. One bar is to denote that a particular week is scheduled as a 'Vacation', while the other bar denotes the opposite. Part of the Gantt chart you will develop is shown in Figure 12.2.

Row and bar specification

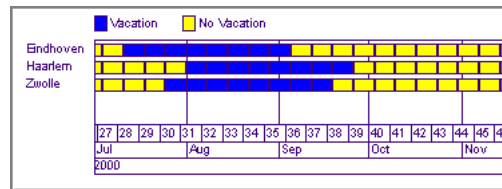


Figure 12.2: Part of the vacation planning Gantt chart

The Gantt chart will display all possible weeks along the *x*-axis. Every bar in this chart is specified by a *start*, indicating the specific week in which it starts, plus a *duration* to indicate the length of the bar. The vacation Gantt chart enables end-users to specify the vacation periods through mouse clicks. To build this facility you need to declare a few identifiers plus a simple procedure to toggle the bars between ‘Vacation’ and ‘No Vacation’. Insert a new declaration section Vacation Gantt Chart Declarations in the Absentee Overview section of your model, and add the following declarations.

*Required
declarations*

```
SET:
  identifier : VacationGanttChartBarTypes
  index      : v
  definition  : data { 'Vacation', 'No Vacation' }

ELEMENT PARAMETER:
  identifier : VacationGanttChartStartingWeek
  index domain : w
  range      : Weeks
  definition  : w

PARAMETER:
  identifier : VacationGanttChartDuration
  index domain : (f,w,v)
```

You can make AIMMS execute a particular procedure whenever an end-user selects a bar in the Gantt chart. In this example you want the procedure to toggle between ‘Vacation’ and ‘No Vacation’. The following single statement achieves this task:

*Toggling the
bars*

```
VacationGanttChartDuration(f,w,v) := 1 - VacationGanttChartDuration(f,w,v);
```

Whenever the corresponding procedure is executed, the value of the duration parameter switches between 0 and 1.

Create a new procedure called ToggleVacationGanttChart(*f,w*) as shown in Figure 12.3. Use the **Argument** wizard to declare *f* as an element parameter in the set Factories and with property ‘Input’. Similarly, declare *w* as an element parameter in the calendar Weeks also with property ‘Input’. Next, enter the statement from the previous paragraph in the **Body** attribute.

*Declaring the
toggling
procedure*

The duration parameter will be used in three different ways. First, as mentioned previously, it will be used to denote the length of a bar. The value 1 corresponds exactly to the length of the time interval along the x -axis, namely one week. In addition, this parameter will be used as a domain parameter of the Gantt chart, indicating which bars are to be drawn. Finally, the duration parameter will be used to establish the link between the Gantt chart and the set `VacationWeeks(t)` used in the mathematical program.

Using 'Duration' three ways

The procedure to initialize the Gantt chart is as short as the procedure to toggle the duration parameter. Only the following statement is needed in the **Body** attribute:

Gantt chart initialization

```
VacationGanttChartDuration(f,w,'No Vacation') :=
  1 - VacationGanttChartDuration(f,w,'Vacation')
```

With all values at their initial default of zero, this statement will initialize all weeks to 'No Vacation' weeks. Please add a procedure `InitializeVacationGanttChart` as shown in Figure 12.3, and insert the above statement into the **Body** attribute.

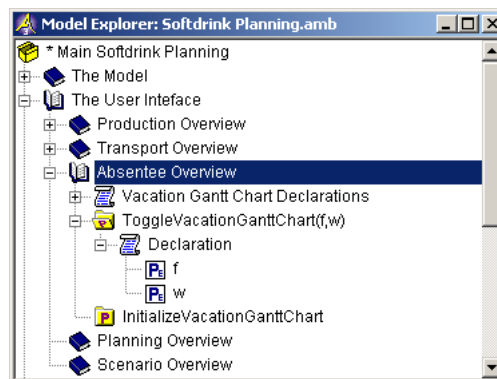

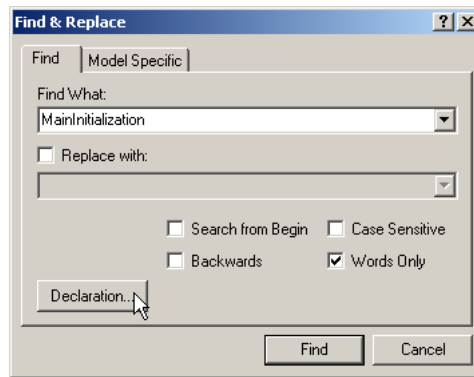


Figure 12.3: The contents of the Absentee Overview section

At this point you should go back to the `MainInitialization` procedure, and add the statement `InitializeVacationGanttChart`; at the end of its **Body** attribute. You can quickly locate this procedure in your model tree by pressing the `Ctrl-F` key combination, or by pressing the **Find** button  on the toolbar (see Figure 12.4).

Adding to Main-Initialization


Figure 12.4: The **Find & Replace** dialog box

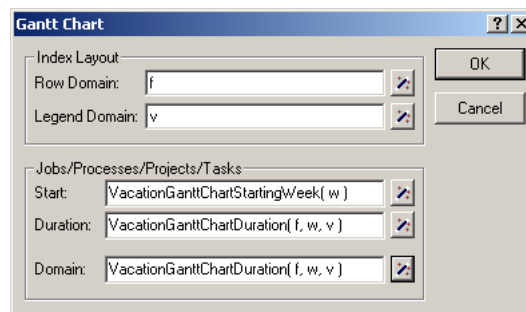
To prevent any initialization error when specifying the Gantt chart, you can now execute the `InitializeVacationGanttChart` procedure by selecting it in the model tree and issuing the **Run Procedure** command from the right-mouse pop-up menu.

Executing the procedure

You are now ready to create the vacation planning Gantt chart on a page by following the steps below:



Creating the Gantt chart object

- ▶ open the *Absentee Overview* page in **Edit** mode,
- ▶ press the **New Gantt Chart** button  on the toolbar,
- ▶ drag a rectangle that matches the desired Gantt chart size on your page, and
- ▶ use the **Wizard** buttons  to complete the **Gantt Chart** dialog box as shown in Figure 12.5.

Figure 12.5: The **Gantt Chart** dialog box for vacation planning

The x -axis of the Gantt chart will initially display the descriptions of the elements in the calendar Weeks. AIMMS can change the labels along the x -axis by mapping the calendar element descriptions to the corresponding moments in time. In this tutorial, the element descriptions contain references to weeks, months and years. To change the time reference along the x -axis in the Gantt chart, you should execute the following steps:

Specifying the x -axis

- ▶ select the Gantt chart,
- ▶ open its **Properties** dialog box,
- ▶ select the **X-axis** tab,
- ▶ select 'Real-time Calendar' as the 'Type of X-axis',
- ▶ check 'Weeks', 'Months' and 'Years' as in Figure 12.6,
- ▶ select 'weeks' as the 'Unit of Measurement',
- ▶ enter "2000-06-26" (with the quotes) as the 'Reference Time',
- ▶ use the **Wizard** button  to select the 'String Parameter' BeginDateOfCalendar as the 'Left Bound',
- ▶ use the **Wizard** button  to select the 'String Parameter' EndDateOfCalendar as the 'Right Bound', and
- ▶ press the *Apply* button.

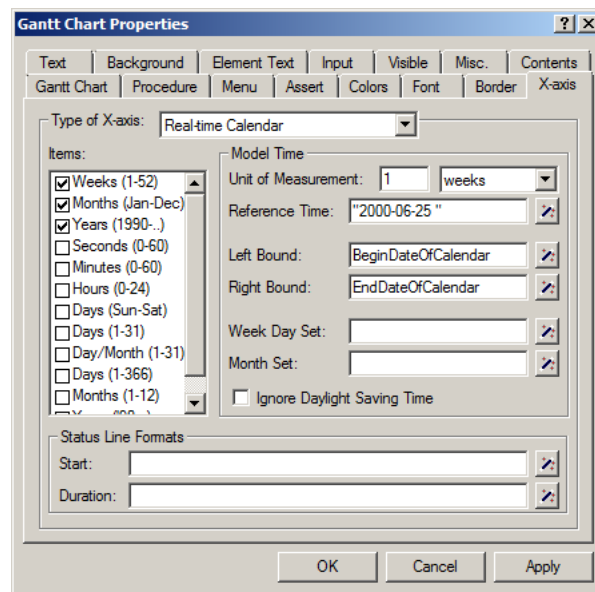


Figure 12.6: The X-axis tab of the **Gantt Chart Properties** dialog box

To implement automatic toggling between the 'Vacation' and 'No Vacation' bar type, you should complete the **Procedure** tab as in Figure 12.7.

Implementing automatic toggling

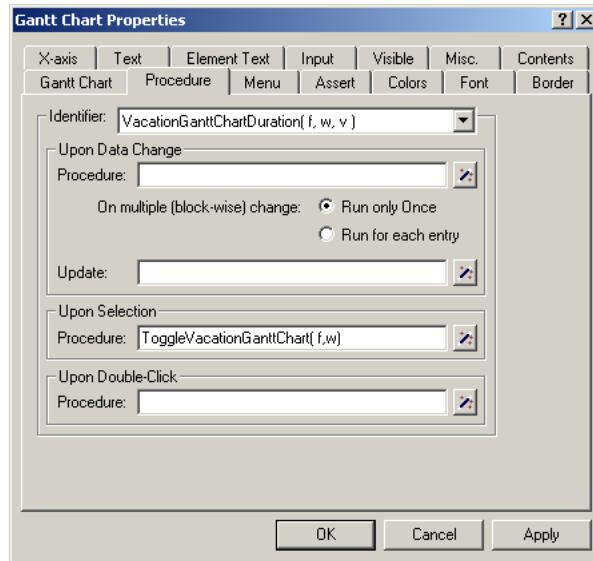



Figure 12.7: The **Procedure** tab of the **Gantt Chart Properties** dialog box

Depending on the size of your Gantt chart, and the size of your screen, the default font used in the Gantt chart might be too large. You are advised to create a new 'Gantt Chart Font' with size 7 instead of the default 8 in the same manner as that shown in Section ??.

Changing the font size

The Gantt chart should now look like the one in Figure 12.8. To test the chart you should put the page in user-mode by pressing the **Page User Mode** button  on the page toolbar. When clicking the mouse on any particular bar, its color should change and the status line at the bottom of the Gantt chart will be adjusted accordingly.

Testing the Gantt chart

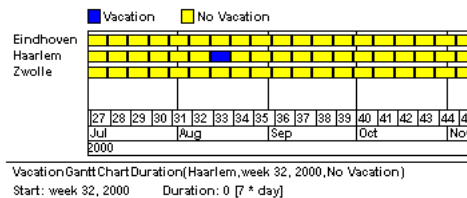


Figure 12.8: The completed vacation Gantt chart

By clicking on a bar of the Gantt chart, the end-user modifies the value of the parameter `VacationGanttChartDuration(f,w,v)`. This change in input data must be passed to the set `VacationWeeks` used in the mathematical program. You can accomplish this data link quite easily by providing the following statement as the **Definition** attribute of this set:

Linking the Gantt chart

```
{ w | VacationGanttChartDuration(f,w,'Vacation') }
```

12.2.2 The holiday Gantt chart

The holiday Gantt chart is similar to the vacation Gantt chart. The main differences are that the holiday Gantt chart is specified in terms of days instead of weeks, and that it contains a single row rather than three.

Similar Gantt charts

The holiday Gantt chart will contain two types of bars. One bar type indicates that a particular day is an official holiday, while the other bar type denotes the opposite. These two bar types will also form the legend as shown in Figure 12.1.

Bar specification

You should now insert a new declaration section named `Holiday Gantt Chart Declarations` inside the section `Absentee Overview`. In the new declaration section the following three identifiers need to be entered:

Required declarations

```
SET:
  identifier : HolidayGanttChartBarTypes
  index      : h
  definition  : data { 'Official Holiday', 'No Official Holiday' }

ELEMENT PARAMETER:
  identifier : HolidayGanttChartStartingDay
  index domain : d
  range      : Days
  definition  : d

PARAMETER:
  identifier : HolidayGanttChartDuration
  index domain : (d,h)
```

Then, introduce a procedure `ToggleHolidayGanttChart(d)` in the same way as the procedure `ToggleVacationGanttChart(f,w)` in the previous subsection. Its argument `d` should be declared as an element parameter in the set `Days` with **Property** attribute 'Input', and its **Body** attribute should contain the following statement:

Toggling procedure

```
HolidayGanttChartDuration(d,h) := 1 - HolidayGanttChartDuration(d,h);
```

Due to the large number of days in the overall planning period, it is impossible to view all individual days in a single Gantt chart. Scroll bars are needed. AIMMS allows you to specify string parameters as the left and right bounds of the Gantt chart. When the string parameters are *updatable* model identifiers the values of these parameters will adjust as you scroll through time. Note that the bound parameters of the vacation Gantt chart in the previous subsection were string parameters with a definition and are therefore not updatable. Their values cannot be changed and, as a result, AIMMS does not show any scroll bars.

Gantt chart boundaries ...

Please add the following two declarations to the Holiday Gantt Chart Declarations section:

... need to be declared

```
STRING PARAMETER:
  identifier : HolidayGanttChartLeftBound

STRING PARAMETER:
  identifier : HolidayGanttChartRightBound
```


Both bound parameters plus the duration parameter need to be initialized in a new procedure `InitializeHolidayGanttChart`. You can place this procedure directly underneath the procedure `ToggleHolidayGanttChart`. The **Body** attribute should be specified as follows:

Gantt chart initialization

```
HolidayGanttChartLeftBound := BeginDateOfCalendar;
HolidayGanttChartRightBound := "2000-08-01";

HolidayGanttChartDuration(d,'No Official Holiday') :=
  1 - HolidayGanttChartDuration(d,'Official Holiday');
```

Note that the duration parameter initialization is identical to the one in the vacation Gantt chart.

At this point you should go back to the `MainInitialization` procedure, and add the statement `InitializeHolidayGanttChart`; at the end of its **Body** attribute. As shown previously, you can quickly locate this procedure in your model tree by pressing the `Ctrl-F` key combination or by pressing the **Find** button  on the toolbar

Adding to Main-Initialization

To prevent any initialization error while specifying the Gantt chart, you should now execute the `InitializeHolidayGanttChart` procedure by selecting it in the model tree and issuing the **Run Procedure** command from the right-mouse pop-up menu.

Executing the procedure

Figure 12.9 shows part of the model tree that contains the declarations associated with the holiday Gantt chart. *Model tree*

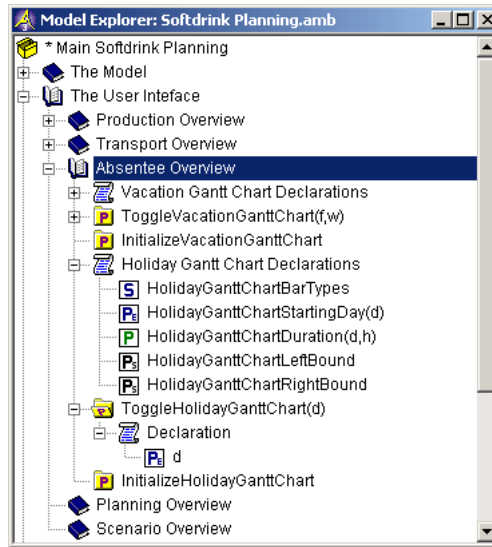



Figure 12.9: The contents of the Absentee Overview section

You are now ready to actually create the holiday specification Gantt chart underneath the vacation specification Gantt chart following the steps below:

Creating the holiday chart

- ▶ open the *Absentee Overview* page in **Edit** mode,
- ▶ press the **New Gantt Chart** button  on the toolbar,
- ▶ drag a rectangle that matches the desired Gantt chart size on your page, and
- ▶ use the **Wizard** buttons  to complete the **Gantt Chart** dialog box as shown in Figure 12.10.

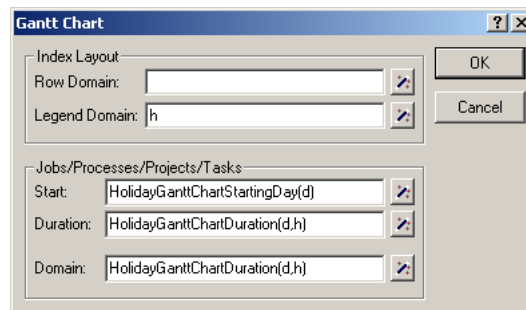





Figure 12.10: The **Gantt Chart** dialog box for holiday planning

The x -axis of the Gantt chart will initially display the descriptions of the elements in the calendar 'Days'. To change the reference of time to days, months and years along the x -axis in the Gantt chart, execute the following steps:

Specifying the x -axis

- ▶ select the Gantt chart,
- ▶ open its **Properties** dialog box,
- ▶ select the **X-axis** tab,
- ▶ select 'Real-time Calendar' as the 'Type of X-axis',
- ▶ check 'Days (Sun-Sat)', 'Days (1-31)', 'Months' and 'Years' as illustrated in Figure 12.11,
- ▶ select 'days' as the 'Unit of Measurement',
- ▶ use the **Wizard** button  to select the 'String Parameter' BeginDateOfCalendar as the 'Reference Time',
- ▶ use the **Wizard** button  to select the 'String Parameter' HolidayGanttChartLeftBound as the 'Left Bound',
- ▶ use the **Wizard** button  to select the 'String Parameter' HolidayGanttChartRightBound as the 'Right Bound', and
- ▶ press the **Apply** button.

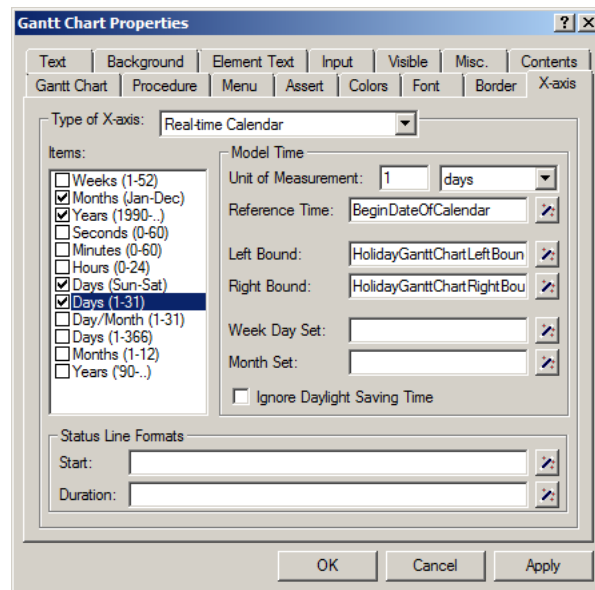


Figure 12.11: The **X-axis** tab of the **Gantt Chart Properties** dialog box

Once you have followed the instructions in the previous two paragraphs, your screen should resemble the picture shown in Figure 12.12.

Viewing the holiday chart

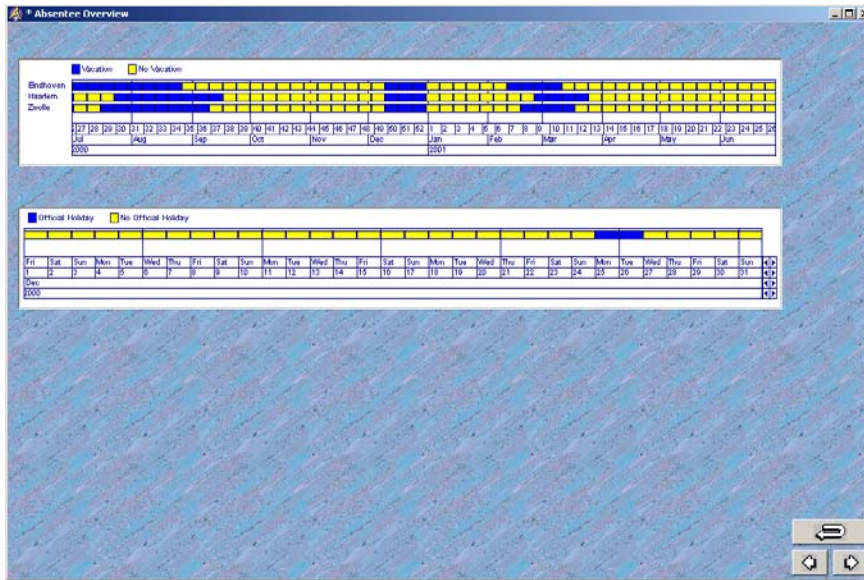


Figure 12.12: The holiday and vacation specification page

To implement automatic toggling between the 'Official Holiday' and 'No Official Holiday' bar types, you should complete the **Procedure** tab as in Figure 12.13.

Implementing automatic toggling

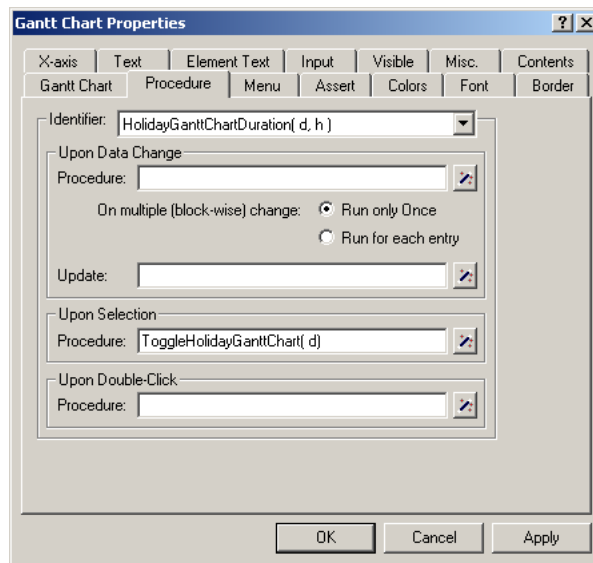


Figure 12.13: The **Procedure** tab of the **Gantt Chart Properties** dialog box

By clicking on a bar of the Gantt chart, the end-user modifies the value of the parameter `HolidayGanttChartDuration(d,h)`. This change in input data must be passed to the set `OfficialHolidays`, declared in Chapter ??, and used inside the mathematical program. You can accomplish this data link quite easily by using the following statement as the **Definition** attribute of the set `OfficialHolidays`:

*Linking the
Gantt chart*

```
{ d | HolidayGanttChartDuration(d,'Official Holiday' ) }
```


12.2.3 Completing the page

You still need to add four more tables to your current page before it resembles the one shown in Figure 12.1. These tables provide a clear summary of the vacation and holiday information as specified in the two Gantt charts.

*Adding four
more tables*

A composite table in AIMMS can contain several identifiers provided that they share the same index domain. The first such table that you will create however, contains only a single identifier, namely the set to display all vacation weeks for the 'Eindhoven' factory. To create this table you should perform the following actions:

*Creating a first
composite table*

- ▶ make sure the page is in **Edit** mode,
- ▶ press the **New Composite Table** button ,
- ▶ draw a rectangle on the page,
- ▶ select the set `VacationWeeks` on the first tab of the **Identifier** wizard box, and
- ▶ select 'Eindhoven' as the 'Fixed Element' of the index `f` as shown in Figure 12.14

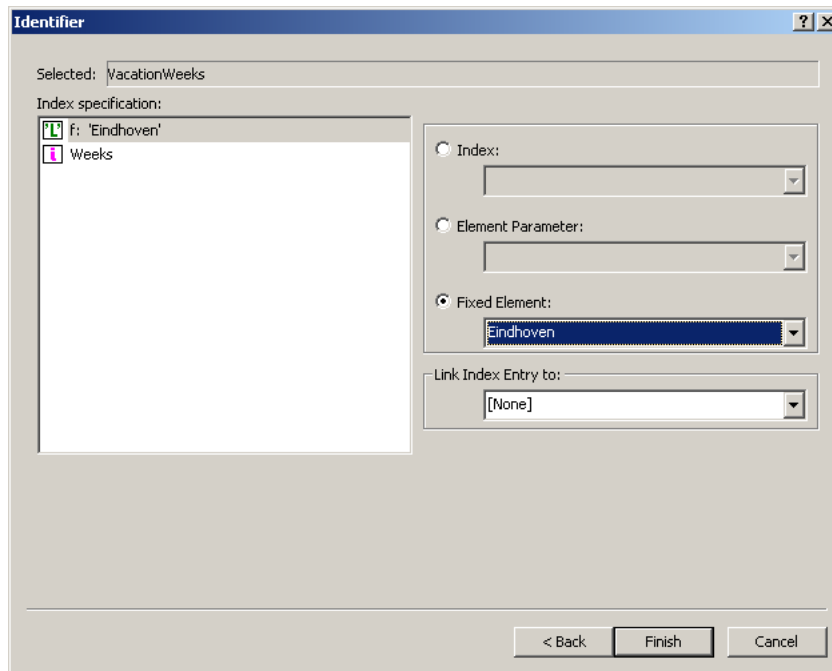


Figure 12.14: The contents of the identifier wizard box

Having created your first composite table, you can immediately verify its correct response to changes in the vacation Gantt chart. Simply click somewhere in the 'Eindhoven' row of the vacation Gantt chart, and the contents of the table should adjust immediately.

Checking the table

To create two similar composite tables for the factory in 'Haarlem' and the factory in 'Zwolle', you can either follow the same steps, or create the tables using copy-and-paste facilities. The latter option requires the following actions:

Copying and Pasting

- ▶ copy and paste the composite table for 'Eindhoven',
- ▶ open the **Properties** dialog box of the copied composite table,
- ▶ go to the **Contents** tab,
- ▶ select the domain identifier `VacationWeeks('Eindhoven',Weeks)`,
- ▶ press the **Modify** button,
- ▶ press the **Next** button in the **Identifier** wizard ,
- ▶ change the 'Fixed Element' from 'Eindhoven' to 'Haarlem' (or 'Zwolle'),
- ▶ press the **Finish** button, and
- ▶ press the **OK** button.

You can create the fourth composite table in the same way as you created the first table. This new table should contain the set Official Holidays.

Creating the fourth table

The page on your screen does not yet look like the one shown in Figure 12.15. If you like, you can enhance your page by, for instance, aligning the data objects, adding text objects and rectangles, and changing font sizes and colors.

Enhancing the page

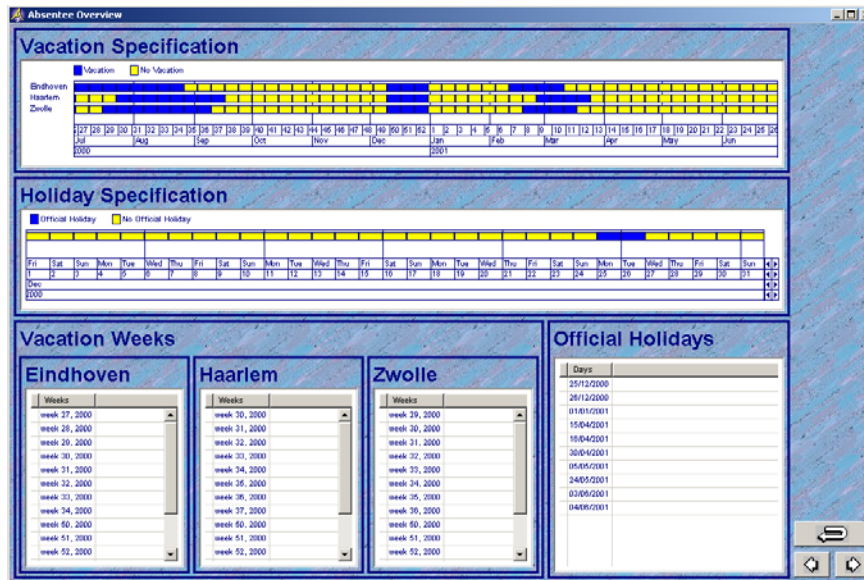
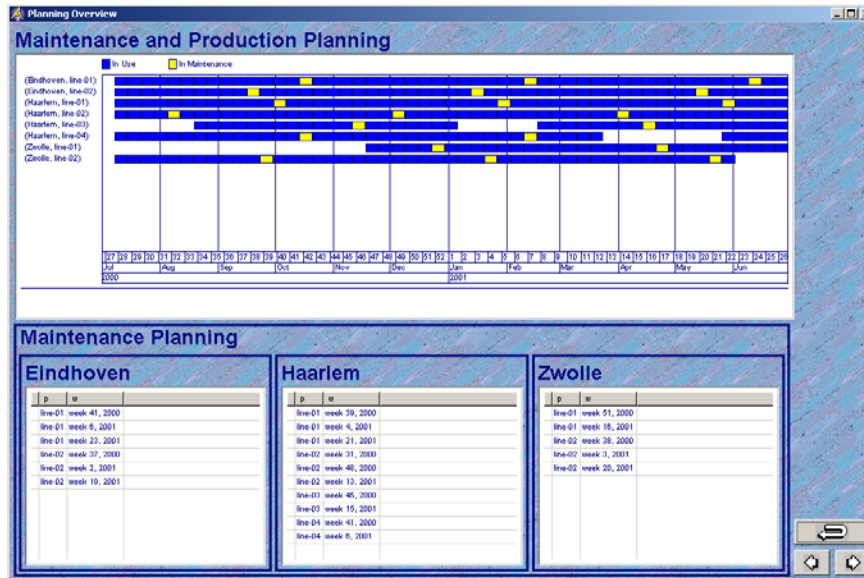


Figure 12.15: The completed *Absentee Overview* page

12.3 The Planning Overview page

In this section the entire page as shown in Figure 12.16 will be constructed. The Gantt chart and the tables will be treated in separate subsections.

Viewing the entire page

Figure 12.16: The completed *Planning Overview* page

12.3.1 The planning Gantt chart

The planning overview page should display a Gantt chart that summarizes the planning and maintenance schedule for each combination of factory and production line. Therefore, each such combination will be a row of the Gantt chart. In each row there will be two types of bars. One type of bar denotes that the corresponding production line is 'In Use', while the other type denotes that the line is 'In Maintenance'. These two bar types will form the legend in the Gantt chart.

Row and bar specification

The planning Gantt chart contains one new feature compared to the Gantt charts discussed earlier. In the description of each row there is a reference to two elements instead of one, namely a factory and a production line. As a result, a compound set rather than a simple set is needed to specify each row description. Please insert a new declaration section Planning Gantt Chart Declarations in the Planning Overview section, and enter the following declarations:

Required declarations

```

SET:
  identifier : PlanningGanttChartRows
  subset of  : (Factories, ProductionLines)
  index     : r
  definition : { (f,p) | p in FactoryProductionLines(f) }

SET:
  identifier : PlanningGanttChartBarTypes
  index     : b
  definition : data { 'In Use', 'In Maintenance' }

ELEMENT PARAMETER:
  identifier : PlanningGanttChartStartingWeek
  index domain : w
  range      : Weeks
  definition  : w

PARAMETER:
  identifier : PlanningGanttChartDuration
  index domain : (r,w,b)

```

After each step in the rolling horizon procedure the zero-one parameters `OverallLineUsagePlanning(f,p,w)` and `OverallMaintenancePlanning(f,p,w)` are both updated to contain the planning information of the first week of the planning horizon as produced by the mathematical program. It is precisely this 'first week' information that is needed to update the corresponding 'duration' parameter used in redrawing the planning Gantt chart. Once the duration parameter has been updated, AIMMS will automatically refresh the Gantt chart on the *Planning Overview* page.

*Refreshing the
planning Gantt
chart*

You should now insert a new procedure `UpdatePlanningGanttChart(iw)` in the Planning Overview section of the model (as shown in Figure 12.17). Its argument `iw` should be declared as an element parameter in the set `Weeks` with **Property** attribute 'Input'. Its **Body** attribute should contain the following statements:

*Update
procedure*

```

PlanningGanttChartDuration(f,p,iw,'In Use') := 1 onlyif
  (OverallLineUsagePlanning(f,p,iw) and not OverallMaintenancePlanning(f,p,iw));

PlanningGanttChartDuration(f,p,iw,'In Maintenance') := 1 onlyif
  OverallMaintenancePlanning(f,p,iw);

```

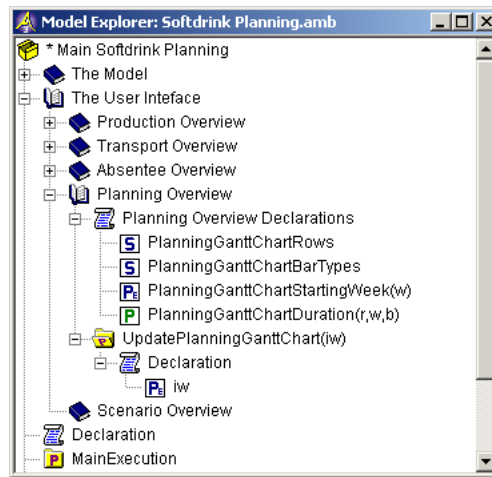
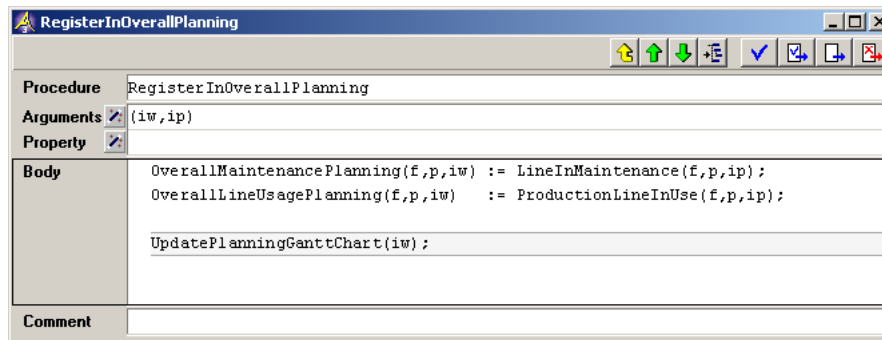


Figure 12.17: The Planning Overview section of the model tree

The above `UpdatePlanningGanttChart(iw)` procedure needs to be run after each step of the rolling horizon process. Due to its link with the parameters `OverallLineUsagePlanning(f,p,w)` and `OverallMaintenancePlanning(f,p,w)`, it is logical to insert the procedure call as the last statement inside the procedure `RegisterInOverallPlanning(iw,ip)` as shown in Figure 12.18.

Inserting the update procedure

Figure 12.18: The **Body** attribute of the procedure `RegisterInOverallPlanning`

You are now ready to create the maintenance planning Gantt chart on the *Planning Overview* page by following the steps outlined below.

Creating the planning chart

- ▶ open the *Planning Overview* page in **Edit** mode,
- ▶ press the **New Gantt Chart** button  on the toolbar,
- ▶ drag a rectangle that matches the desired Gantt chart size on your page, and

- ▶ use the **Wizard** buttons  to complete the **Gantt Chart** dialog box as shown in Figure 12.19.

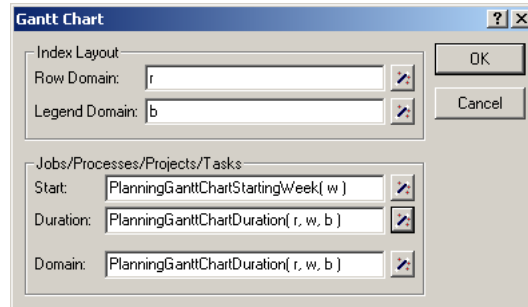


Figure 12.19: The **Gantt Chart** dialog box for the maintenance planning Gantt chart

The x -axis of the planning Gantt chart should be the same as in the vacation specification Gantt chart discussed earlier, namely with references to weeks, months and years. To change the current time reference along the x -axis of the Gantt chart, you should execute the following steps:

Specifying the x -axis

- ▶ select the Gantt chart,
- ▶ open its **Properties** dialog box,
- ▶ select the **X-axis** tab,
- ▶ select 'Real-time Calendar' as the 'Type of X-axis',
- ▶ check 'Weeks', 'Months' and 'Years' as in Figure 12.20,
- ▶ enter "2000-06-26" (with the quotes) as the 'Reference Time',
- ▶ select BeginDateOfCalendar as the 'Left Bound',
- ▶ select EndDateOfCalendar as the 'Right Bound', and
- ▶ press the **Apply** button.

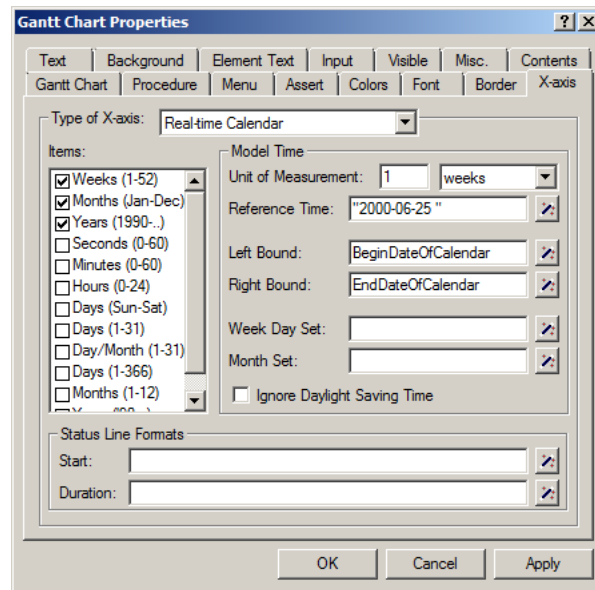


Figure 12.20: The X-axis tab of the **Gantt Chart Properties** dialog box

12.3.2 Completing the page

Once you have finished the planning overview Gantt chart, all that is left to do is to add the three composite tables shown in Figure 12.21. Add the three tables displaying the identifiers

Adding three tables

- OverallMaintenancePlanning('Eindhoven', p, w),
- OverallMaintenancePlanning('Haarlem', p, w), and
- OverallMaintenancePlanning('Zwolle', p, w)

in the same way that you added such tables on the *Absentee Overview* page.

The page on your screen does not yet look like the one shown in Figure 12.21. If you like, you can enhance your page by, for instance, aligning the data objects, adding text objects and rectangles, and changing font sizes and colors.

Enhancing your page

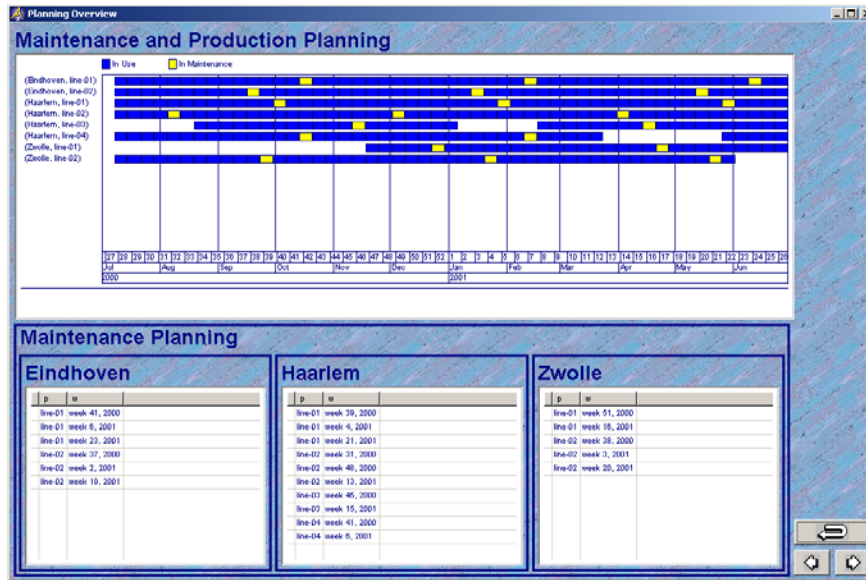
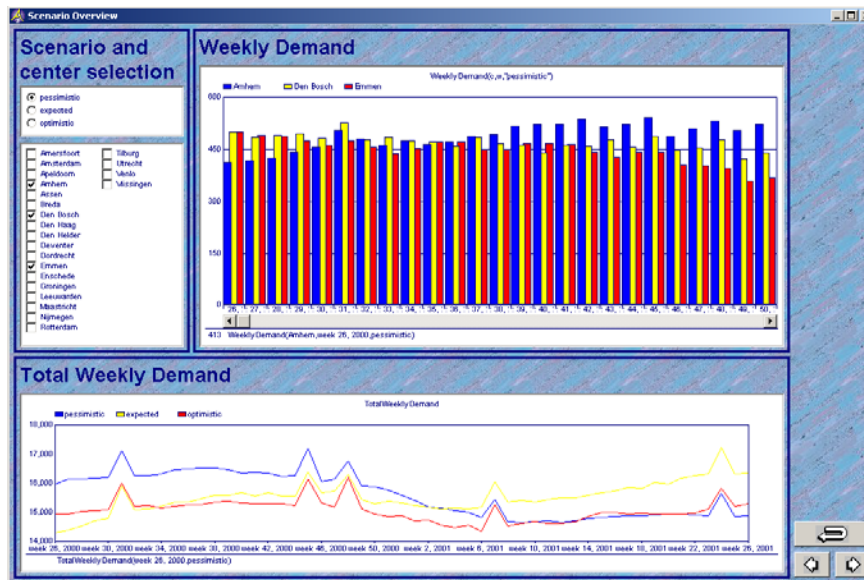


Figure 12.21: The completed *Planning Overview* page

12.4 The Scenario Overview page

Rather than create this page you will import it in its entirety as shown in Figure 12.22.

Viewing the entire page

Figure 12.22: The completed *Scenario Overview* page

Before importing the *Scenario Overview* page, you will need to import some model declarations that are used on this page. To import these model declarations you should execute the following steps:

Importing model declarations

- ▶ select the Scenario Overview model section in the model tree,
- ▶ from the **Edit** menu, select the **Import** command,
- ▶ select the file 'Scenario Overview.amb' from the 'Sections' subdirectory in the **File Selection** dialog box,
- ▶ press the **Open** button, and
- ▶ press the **OK** button to confirm the import.

To import the completed *Scenario Overview* page, you should execute the following steps:

Importing the page

- ▶ press the **F9** key to open the **Page Manager**,
- ▶ select the **Page Tree**,
- ▶ select the **Import** command from the **Edit** menu,
- ▶ select the file 'Pages\Scenario Overview.pag' from the **File Open** dialog box,
- ▶ press the **Open** button, and
- ▶ press the **Import** button in the **Import Page File** dialog box (see Figure 12.23)

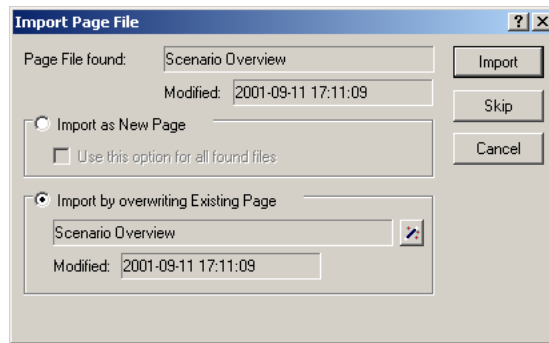


Figure 12.23: The **Import Page File** dialog box