

EBOOK

Generalized Model for Resource Planning HTML5 Gantt Charts



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Why this model for resource planning?

Some time ago, I reported on the way NETRONIC helps its customers develop web applications for scheduling or resource planning by offering custom tailored, [interactive HTML5 Gantt charts](#). Since then, things have evolved outstandingly:

- A lot of great projects with many customers from different fields of application have been realized successfully.
- NETRONIC's cloud based SaaS product [just plan it](#) has been successfully extended.
- The product portfolio of NETRONIC was extended by [new products for Microsoft Dynamics 365 Business Central](#).
- We created a new product for our customers, looking for a HTML5 Gantt component: the [Visual Scheduling Widget](#)

All in all, we have gained a lot of valuable experience, not only with the use of HTML5 techniques, but especially with the implementation of scheduling and planning tasks in graphical user interfaces for web browsers.

At the very beginning of our efforts to develop web applications, the focus was on the realization of pure Gantt functionality. First of all, it was important to have a set of tools for integrating interactive Gantt charts into web applications. But the more projects were implemented together with our customers, the more it became clear that the gap between our level of abstraction and the data and application models of the customers was too wide. So, both worlds had to be brought together to better meet the customers' needs.

We recognized that all applications of our HTML5 Gantt charts for all the different domains – whether project management, production scheduling, supply chain management or others – have one thing in common: **resource planning**. Therefore, we have developed a new data model that generalizes all parts of the different domains that are relevant for visual resource scheduling using interactive Gantt charts.

In addition to the pure data model, we have also created a concept of how to map the members of this data model to interactive graphical representations. This concept and the data model represent our new model for resource planning. Based on this model, we extended our NETRONIC Web Application Framework, which we use internally for instance for developing the custom tailored, interactive HTML5 Gantt chart widgets as well as for developing our own products in the context of Microsoft Dynamics. So, a broad range of our customers benefits from this new model.

Teammates of Resource Planning Data Model

The following list provides a detailed overview of the different types of objects involved in the Resource Planning Data Model and their relationships to each other.

Activities

The term Activities covers all actions that need to be accomplished within a certain period of time to achieve a specific objective. Examples of activities are tasks in project management or jobs and operations in production planning.

Start and end dates of an activity are the two important properties that can be the result of a scheduling process or that are predefined.

Activities can be grouped. For instance, in project management a project might be divided into many tasks and each task consist of a set of subtasks and so on. In production planning, jobs are usually subdivided into further jobs and on the lowest level operations are the base activities. Grouping can be achieved by setting the identifier of a parent activity.

Properties such as progress, special types of constraint dates, and baseline dates are also considered in the data model.

Resources

Resources, such as machines or personnel, are needed to perform the activities. Besides its general availability defined by a calendar, a resource has a capacity and a load. The latter results from the assignment of activities to a resource and is defined by specific curve objects.

As well as activities, resources might be grouped. Departments consisting of groups of individual resources are examples of a three-level nesting (department-> resource group->resource).

Allocations and Allocation Entries

Allocations define the assignments of resources to activities and vice versa. Each allocation refers to a maximum of one activity and a maximum of one resource.

In the simplest case, a resource is allocated by an activity for the entire execution period of the activity. Then the allocation will use the start and end dates of the activity itself. But imagine the

execution time of an activity is subdivided in different time spans. For instance, if the execution time consists of a setup time, a pure runtime, and a teardown time, a resource may only be required for setup and teardown, but not at runtime. For this purpose, an allocation can have an array of allocation entries. Each entry has its own start and end date and represents a time span. In the above case, we will define an entry for the setup time and another one for the teardown time.

Of course, this concept of allocations also allows to model many-to-many relationships between activities and resources by using multiple allocations with the same activities and/or resources involved.

Calendars and Calendar Entries

As mentioned above, calendars are used to define the general availability of a resource without taking into account the specific capacities. Each calendar has an array of calendar entries that determine whether it is a working or a non-working time for a time period specified by a start and an end.

Curves and Curve Point Entries

Curve objects are used to handle time-oriented data such as capacities or loads of resources. They can be simple point curves with an array of curve point entries, each entry defining a point in time and a corresponding value. Or they can be stacked curves that are built by adding multiple curves. In this way, you can, for example, add all capacities of individual resources in a resource group to a total capacity of this resource group.

To make working with curves easier, you only need to define entries for those points at which the curve changes its value.

Links

In addition to grouping, activities can be related to each other in a different way. Think, for example, of chained production operations or of complex networks project management tasks. In this case, an activity can only be started if the directly preceding activity has already been finished. Such a kind of relations can be expressed by link objects.

Each link is directed and refers to a source and a target activity. In addition to these references, a link has one of the well-known relation types (finish-start, start-start, finish-finish).

Since you can create multiple links with the same source or the same target activity, not only simple activity chains, but also more complex networks of activities can be realized.

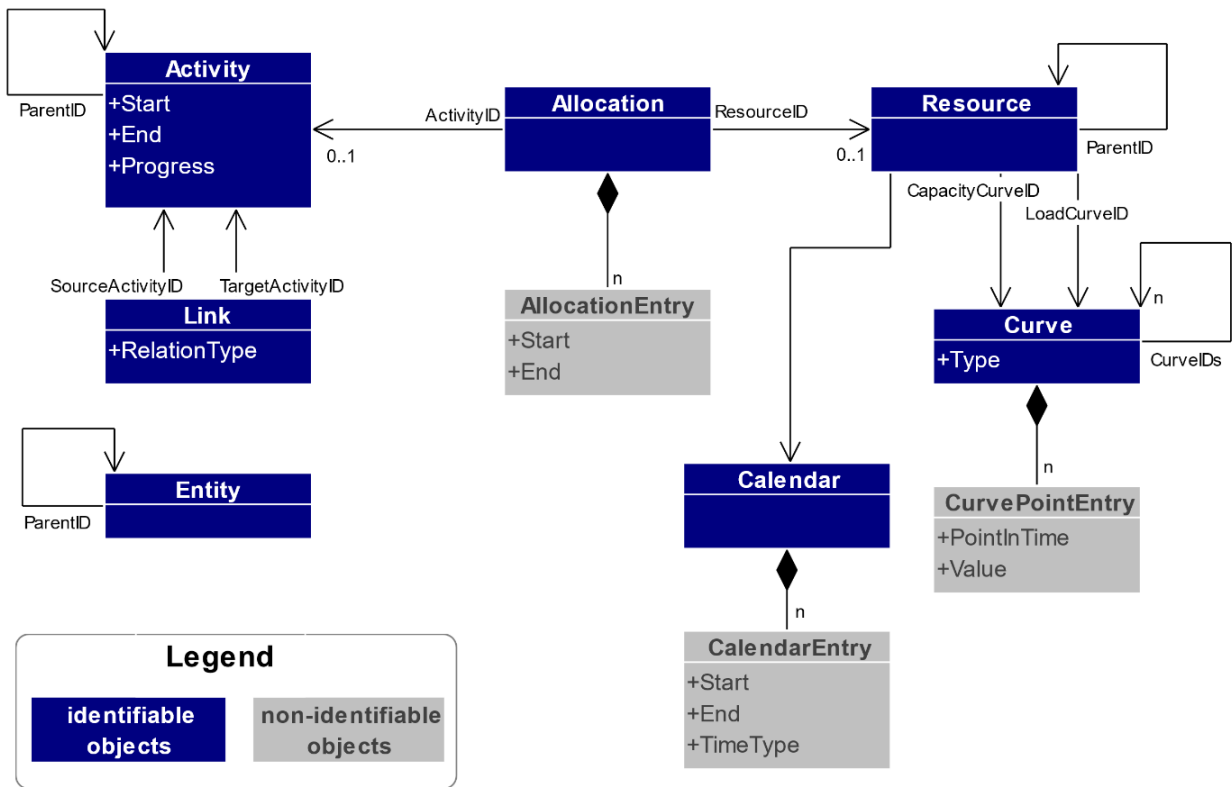
Entities

This kind of objects is used to manage arbitrary sets of any grouped objects. An entity can be an activity, a resource, or any other object. In practice, entries are used, for instance, for lists of backlog orders that have not yet been scheduled or for lists of available resources with suitable skills that can be assigned to a certain activity.

The Model at a glance

The following figure summarizes all object types described above and their relationships. Only those object properties are listed that are essential for understanding the concept of this data model. There are two kinds of objects:

- objects that are identifiable by an identifier and
- objects that are part of an identifiable object, but do not have an identifier of their own.



Map to interactive graphical representations

Having a data model is nice, but what is needed in the end is an interactive chart that allows a user to work with that data in the most intuitive way possible. Therefore, an adequate representation for all members of the data model in form of a Gantt diagram has to be found.

In practice, two types of charts have proven to be very useful and valuable:

- the Activities view and
- the Resources view.

One can imagine them as the two sides of the same coin. Both present the data model from a different perspective with different focus.

In order to be able to specify all desired aspects of the mapping of the data model to interactive, graphical representations, many additional properties have been added to each object type of the data model. These properties – they are marked by the prefix “pm_”, which stands for “presentation model” – can be used to control the following aspects of the presentation:

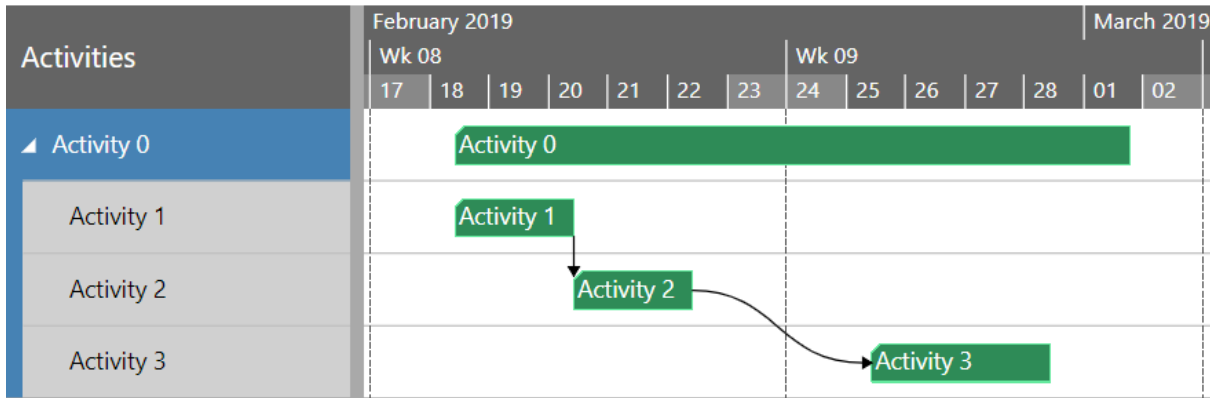
- colors of graphical elements such as bars, table rows, lines, texts, timescale, calendar grids, ...
- collapse status of rows/groups (expanded, collapsed)
- possible interactions (whether a bar can be moved or resized, whether a row can be collapsed or not, which elements are selectable, snapping targets, etc.)
- design of expanded and of collapsed rows (whether and how child elements should be displayed)
- visualization of special properties such as constraint dates, status, symbols, etc.

Many of these properties can be set both as default values and as individual values for individual objects. For further details, please refer to the Interface Definition Document – IDD for short – of the respective widget.

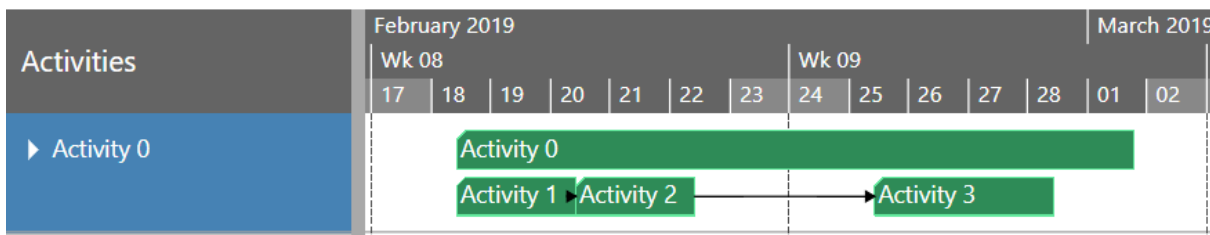
The Activities view

In this view, activities are listed in the table area of the Gantt diagram. In the simplest case, each activity has its own row. In the diagram area, the start and end dates of the activities are represented by bars. Resources and allocations are not of interest in this view type.

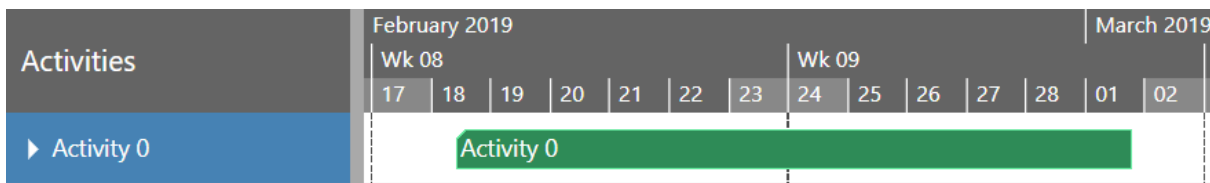
If activities are grouped, then the parent activities can be expanded:



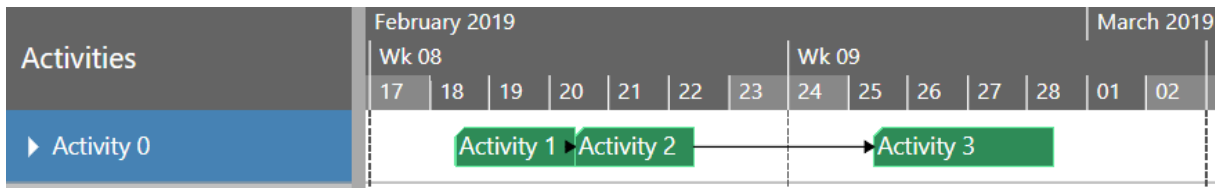
Or the parent activity can be interactively collapsed:



In the collapsed state, the parent activity itself and all child activities are positioned in one row. But this is only one possible way we provide to display collapsed rows. Alternatively, you can choose a different design and decide to show the parent activity only:



Or instead of the parent only the children are to be seen:

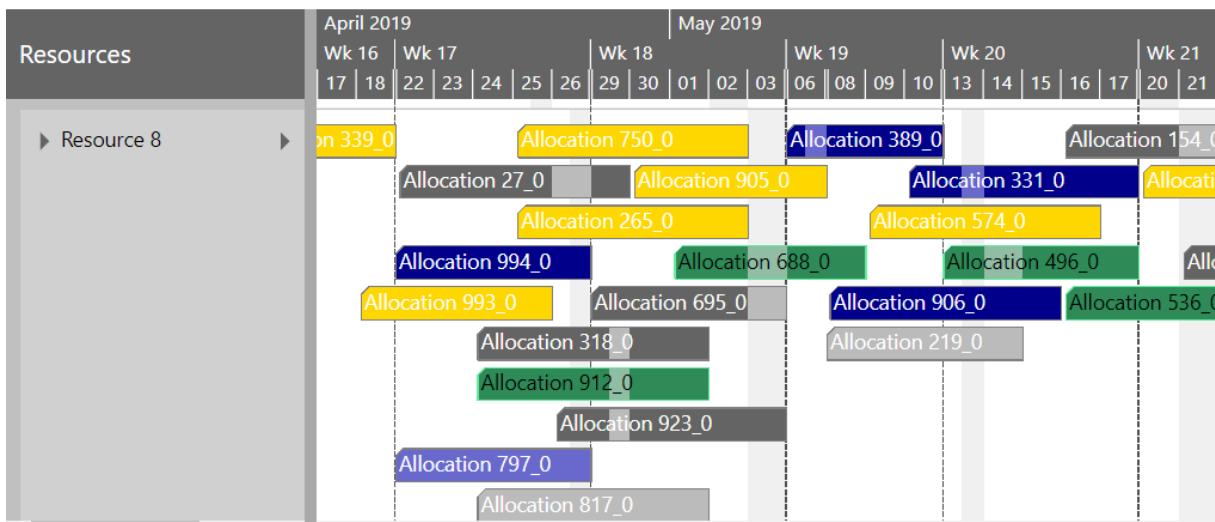


In any case, the concrete design for collapsed activities can be defined individually for each activity as well as globally by default settings.

Link objects are mapped to arrows between activity bars. The relation type of a link is expressed by the layout of the arrow, which can begin and end at the beginning or the end of a bar depending on the type.

The Resources view

Analogous to the activities view, the resources view lists all resources in the table area of the Gantt diagram. In the diagram area the allocations and their entries are displayed. The calendar entries for non-working times of a resource are visualized by slightly grayed vertical strips.



There are multiple designs for visualizing allocations.

- An allocation can be represented by a single bar:



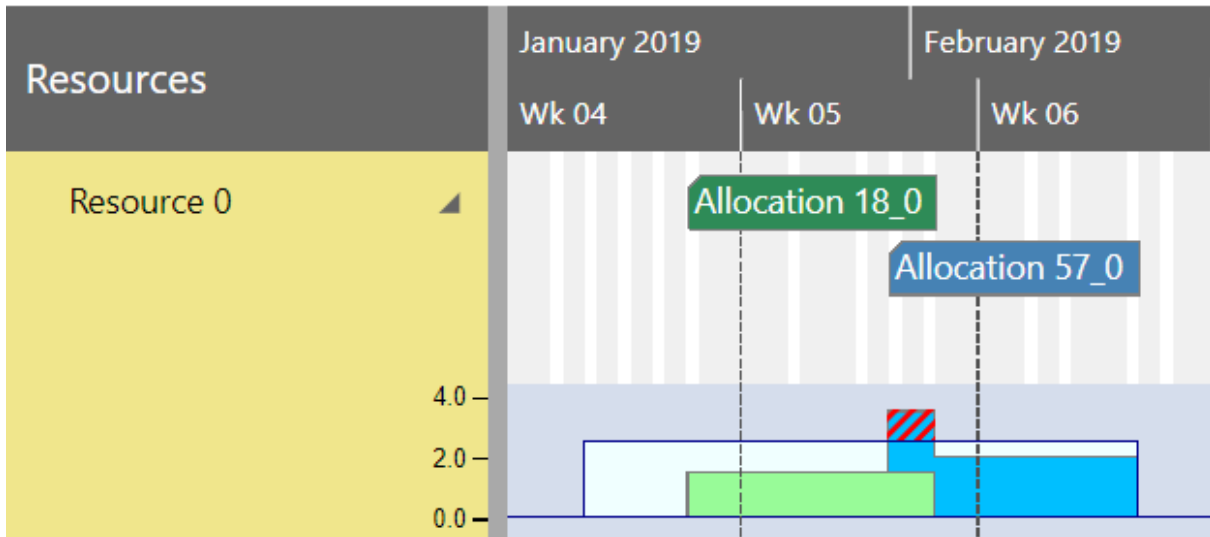
- If it has more than only one entry, then each entry can be displayed as a separate bar:



- Or the entries are shown together with the allocation itself:



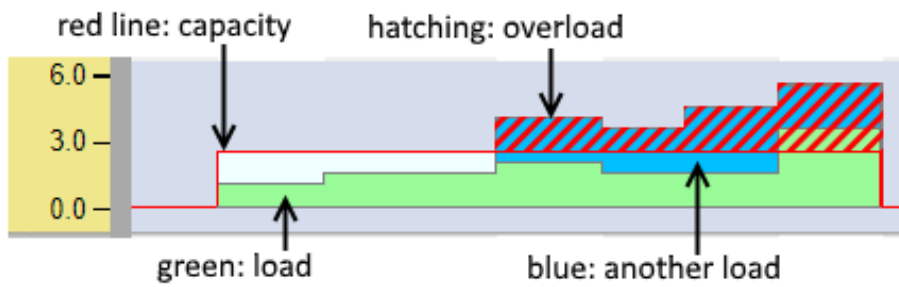
For displaying curves there is a curve area inside each resource row a curve area, which can be interactively expanded and collapsed.



A curve object is displayed as a stepped line, possibly with the colored area below the line. Each curve entry defines a data point of that stepped line.

With stacked curves, not only the stack as a whole is visible, but also the single members of the curve stack.

The following figure shows two curve objects, each of them representing the load of a resource caused by an allocation. They are stacked on top of each other and visually distinguishable by two colors. An additional curve object defines the capacity of the resource and is displayed by a line. The area where the stacked curve exceeds the capacity line is highlighted by hatching:



Of course, this is only one possible sample for the use of curves. A lot of further applications for curves are conceivable and you can use curves to express any other semantics.

Last but not least, there is an additional view type – the loads view – that is a derivative of the resources view with the curve diagram areas only and without any bars. It is a valuable tool when only the capacities and loads of the resources are of interest, but not the allocations in detail.

The Entities table

The entities objects are displayed in a special table – the entities table – that can be displayed on the right side of the Gantt diagram.

Outlook

I explained in detail our generalized model for resource planning we use when developing jQuery UI Widgets for our customers. It is universal enough to map most resource planning models from practice to powerful interactive HTML5 Gantt charts. And by the way, this model is also internally used at NETRONIC with NETRONIC's new products: the Visual Scheduling Suite 2.0 and the new [Visual Scheduling Add-in Developer Toolbox for Dynamics 365 Business Central](#). As you can see, the generalized model is a fundamental building block not only for the development of tailor-made widgets for our customers, but also for NETRONIC's own products.

Although the current state of the model has proven to be very powerful and flexible, we have a lot of ideas – inspired by requirements from our customers' real world, among others – to further improve the user experience.

And that's where you come in:

- If you come to the conclusion is this is exactly the model you are looking for, take your chance and contact us.
- If you say: Ok, that all all looking pretty good, but I need it a bit different here and there, don't worry and contact us anyway. We are looking forward to every new challenge and we are always trying to improve ourselves and our support for our customers.

In any case, we are absolutely determined to help you bring great Gantt functionality into your web application.