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FUNCTIONAL DEFINITION DOCUMENT

NETRONIC

Visual Scheduling Widget - Standard Edition

(VSW SE)

Version: 8.2 | State of July 4, 2024

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1   Scope of Document

The purpose of this document is to outline the functional definition of the NETRONIC Visual Scheduling Widget, Standard Edition that Boyum IT has developed. This widget is based on HTML5/JavaScript technology and will be called VSW SE for short.

The Functional Definition Document (FDD) is complemented by the Interface Definition Document (IDD), in which Boyum IT will specify the API of the VSW SE. The IDD will specify all options to customize the widget, all methods to modify the data, and all callback functions that VSW SE will call in response to user interaction. In addition, a separate document explains the structure of our Resource Planning Model and its objects. VSW SE expects the data to obey this model in its structure.

2   Purpose of VSW SE

Boyum IT provides the VSW SE as a widget. It is explicitly mentioned that this is not a ready-to-use application like for instance the standard Visual Production Scheduler add-in developed by Boyum IT for Dynamics 365 Business Central.

The widget can also be used in the form of a jQuery UI widget. In this case, the application is responsible for including the jQuery and jQuery UI libraries.

3   Terminology

In this document the terminology of Boyum IT's data model is used. Following the core terms of this data model are defined:

- **Activity**: Activities cover all actions that need to be accomplished within a certain period of time to achieve a specific objective.
- **Resource**: Resources – such as machines or personnel – are the ones that are needed to perform the activities. Besides its general availability defined by a calendar, a resource has a capacity and a load.
- **Allocation**: Allocations define the assignments of resources to activities and vice versa.
- **Allocation entry**: If an activity consists of a setup time, a pure runtime, and a teardown time, then a resource may only be required for setup and teardown, but not at runtime. For this purpose, the developer has to split allocations and additionally can use more than one allocation entry. Each entry has its own start and end date and represents a time span.
- **Entity**: Entities are special objects to hold any data, such as backlog data. They are displayed in a separate table on the right side of the widget.
- **Link**: Links are used to visualize temporal dependencies between activities or allocations. They can have one of the well-known relationship types (i.e., finish-start, start-start, finish-finish).

4 Technology & Architecture

4.1 Technology

The VSW SE is using the NETRONIC Web Application Framework (NWAF), which enables Boyum IT to effectively develop visual scheduling applications based on HTML5/JavaScript technology. This technological foundation has two implications:

- The usage of HTML5/JavaScript technology allows using the VSW SE in (theoretically any) device that has a web browser installed. As a Gantt chart by its nature always requires a comparably large screen with high resolution, it is not recommended to use the VSW SE with a smartphone client despite the general technological feasibility to do so.
- The technology used by Boyum IT is "touch enabled", but not "touch optimized". This means that the VSW SE can get used on tablet PCs. However, not each native touch gestures will get supported.

Boyum IT will not deliver a stand-alone application. The VSW SE will come with an API, which allows a web application to control the widget. This interface can be used to provide data to the VSW SE, to customize it, and to get calls from it to callback functions triggered by user interactions. Handling these data within the VSW SE for visualization and interaction on it is the development work that is provided by Boyum IT.

4.2 Architecture

The general architecture of the VSW SE is based on the following principles:

1. Other than in Boyum IT's standard developer controls (such as VARCHART XGantt), Boyum IT will not manage data within the Gantt chart. All data management functions as well as the corresponding business logic happen within the customer application.
2. Nearly each mouse interaction on a graphical object (such as a Gantt chart bar or a resource row) in the VSW SE triggers a bi-directional communication between the VSW SE and the application (see "callbacks" and "Options/Methods" in the graph below).
3. This bi-directional communication starts with a call of application-specific callback functions. Within these functions, the application can modify the data objects and update them in the VSW SE by method calls.
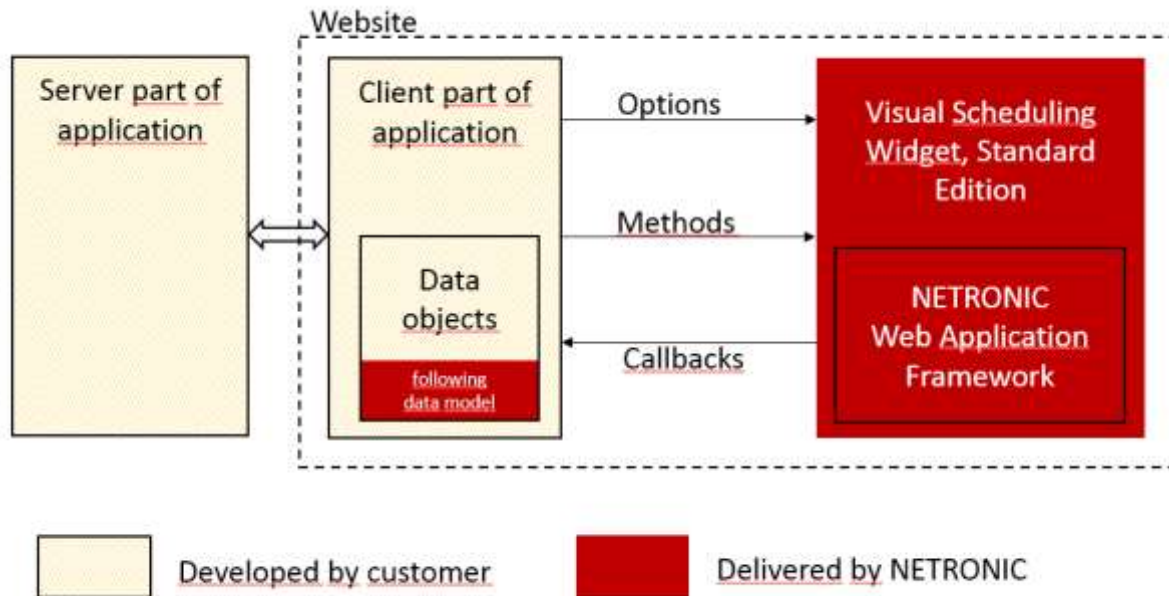
All parts of the data objects that must follow our Resource Planning Data Model, the options, the methods, and the callbacks are part of the application programming interface (API) and can be accessed by the application on client side.

4.3   Technological requirements

The VSW SE is developed based on HTML5/JavaScript program code. It can be performed using the latest three versions of the following browsers on current OS versions at the delivery date of VSW SE:

- Google Chrome (Windows)
- Microsoft Edge (Windows)
- Mozilla Firefox (Windows)
- Apple Safari (iOS, macOS)

In case of automatic software updates of these browsers, Boyum IT will update its base technology accordingly. However, Boyum IT cannot guarantee an any-time availability for any browser version. Boyum IT recommends using Google Chrome, as this browser has by far the best performance results at the time of writing this FDD.

5   Visualization

In general, the VSW SE can show four alternative Gantt Views: two Resource centric, an Activity centric, and a Load centric view. All views and their elements are described below.

5.1   Resources View

5.1.1   Overview

The Resources View can consist out of several elements for visualizing the respective data:

1. Resources table

2. Timescale
3. Top view area (optional)
4. Diagram area
5. World view (optional)
6. Entities table (optional)

This general structure is outlined below:

1. Resources table	2. Timescale	6. Entities table (optional)
	3. Top view area (optional)	
	4. Diagram area	
5. World view (optional)		

Each building block of this view is defined as follows.

5.1.2 Resources table

The table area lists the resources. If a resource is sub-ordinated to another resource, it will be shown in an indented way in the table. The super-ordinated resource then also shows a symbol to collapse/ expand all its sub-ordinated resources. In case that a super-ordinated resource will get collapsed, the sub-ordinated resources will no longer get displayed. This enables a flexible nesting and grouping of different types of resources (e.g., employees to locations, replacement cars to garages, etc.). It is possible to show more than one table column.

5.1.3 Timescale

5.1.3.1 Time range

The time range defines the date range that is shown in the current display of the VSW SE. This time range will be provided to the VSE as parameters from the application.

5.1.3.2 Timescale resolution

The horizontal resolution of the timescale can be adjusted by mouse wheel so that users can zoom in and zoom out of the displayed data in a seamless manner.

5.1.4 Top view area (optional)

This area can be displayed by option. Like the regular diagram area, it can host resources with their allocations and can be scrolled vertically independently of the regular area. Allocation bars of both areas can be moved between both areas via drag & drop. This area is useful for instance to manage

unassigned allocations. The height of the top view area cannot be changed interactively but via the API.

5.1.5 Diagram area

5.1.5.1 Visualization of resource calendars

The background of the diagram area visualizes for each resource the working times (white) and non-working times (grey). This background calendar visualization cannot get changed interactively; it is just meant to display the general resources availability/ unavailability.

5.1.5.2 Visualization of resource allocations

The diagram area also shows the allocation of orders to resources as bars. The start and end date of a bar represents the time span in which the resource is allocated to that specific activity. If a resource has multiple allocations at the same time, the respective bars are shown one below the other.

Each bar can get a text to be displayed on it. The length of the bar determines the length of the text displayed (the text gets truncated at the end of the bar).

Allocation objects contain so-called entries that can be used to define phases (like startup time, runtime, teardown time). Each allocation entry gets a start time and an end time and can have a freely definable color. The entries are shown as sections within the allocation bar. An application can define the display of the bar (text and colors) flexibly and by their own via the respective data objects defined in the IDD.

Dependent allocations (predecessor/ successor) and their links will be shown as a curved arrow line between the predecessor and the successor. An application can control which links will be shown when.

5.1.5.3 Curves/histograms

For each resource, a histogram can be shown that visualizes both the capacity and the load of that resource. The histogram is displayed in the same row in the diagram in which the resource itself is shown. It can get expanded/collapsed by the user via a click on a symbol in the table area. The histogram will be applied to the same time area that is valid for the entire diagram area and its scroll and zoom behavior corresponds with the time scale. The histogram can include two type of curves.

1) Capacity curve
   The capacity curve is shown as line and visualizes the total capacity of a resource at a given time.
2) Load curve
   The load curve visualizes the utilization of this total capacity at a given time and is shown as filled area between the zero-line and the respective utilization.

The values of these curves are set independently from the resources' allocations. This means that they are not automatically calculated based on the resources' allocations. This enables the customer application to show these curves independent from the shown allocation and hence e.g. the "correct" allocation in case that some allocations had been filtered out.

In case the load curve exceeds the capacity curve, an overload exists. The overload area can get visualized by an own, independent color.

5.1.6   World view (optional)

This view can be displayed by option. It gives a rough overview of the entire chart (except the entities table) and symbolizes the current visible area of the chart by a rectangle. Scrolling or resizing the chart causes the rectangle to move and change accordingly. In addition, the rectangle can also be moved interactively, which changes the visible area accordingly.

5.1.7   Entities table (optional)

It is possible to show an additional table on the right side by option. This table will be filled using entity objects. If an entity is sub-ordinated to another entity, it will be shown in an indented way in the table. The super-ordinated entity then also shows a symbol to collapse/expand all its sub-ordinated entities. In case that a super-ordinated entity will get collapsed, the sub-ordinated entity will no longer get displayed. It is possible to drag and drop single entities from the table into the diagram area. This table can be used to show backlog activities. It is possible to show more than one table column.

5.1.8   Tooltips

It is possible to show a set of information that will get displayed when the user hovers with the mouse over a graphical element (tooltip text). A graphical element in case of the VSE is defined as

- Resource in the left table area
- Bar in the diagram area
- Links in the diagram area
- Curves in the diagram area
- Entities in the right table area

An application can define the different information sets per graphical element by its own and will be enabled to change these information sets later independent from Boyum IT.

5.2   Activities View

5.2.1   Overview

The Activities View consists out of several elements for visualizing the respective data:

1. Activities table
2. Timescale
3. Top view area (optional)
4. Diagram area
5. World view (optional)
6. Entities table (optional)

1. Activities table	2. Timescale	6. Entities table (optional)
	3. Top view area (optional)	

	4. Diagram area	
	5. World view	

Each building block of this view is defined as follows.

5.2.2 Activities Table

This table lists the activities. One activity can be the parent activity of other child activities. The super-ordinated activity is marked by a symbol in the table, which can be used to expand/collapse the underlying activities. If an activity is sub-ordinated to another activity, it will be shown in an indented way in the table. It is possible to show more than one table column.

5.2.3 Timescale

The timescale is exactly as specified in the Resources View.

5.2.4 Top View Area

This area can be displayed by option. Like the regular diagram area, it can host activities and can be scrolled vertically independently of the regular area. Activity bars of both areas can be moved between both areas via drag & drop. This area is useful for instance to manage unplanned activities. The height of the top view area cannot be changed interactively but via the API.

5.2.5 Diagram area

The diagram area shows activities as graphical objects. There are three different activity types resulting in three different visualizations:

Summary bar. The summary bar is typically used to visually embrace all subordinated activities. It spans the period from a given start date to a given finish data and will not be calculated automatically.

Rectangle. Activities are shown as rectangular bars. The time between the start and end date of a bar represent the duration of the activity. Each bar can have a text displayed on it. Also, each bar can have a freely defined color. The flexible creation of the bar display (text and color) can be done by an application via the respective data objects. The length of the bar determines the length of the text displayed: the text gets cropped at the end of the bar. It is also possible to define a percentage of complete for each activity, and to have an additional visualization of it.

Diamond. A diamond (often called milestone) is shown as a point of time symbol.

Activity objects can contain so-called entries that can be used to define phases (like startup time, runtime, teardown time). Each activity entry gets a start time and an end time and can have a freely definable color. The entries are shown as sections within the activity bar.

An application can define the display of the bar (text and colors) flexibly and by their own via the respective data objects defined in the IDD.

Dependencies between activities are shown as links between the bars.

5.2.6   World view (optional)

The world view is exactly as specified in the Resources View.

5.2.7   Entities table (optional)

The entities table is exactly as specified in the Resources View. It contains the same data, i.e., there is no different data set specific to the entities table in the Activities View.

5.2.8   Tooltips

It is possible to show a set of information that will get displayed when the user hovers with the mouse over a graphical element (tooltip text). A graphical element in case of the VSW SE is defined as

- Activity in the table area
- Bar in the diagram area

5.3   Loads View

5.3.1   Overview

The Loads View can consist out of several elements for visualizing the respective data:

1. Resources table
2. Timescale
3. Top view area (optional)
4. Diagram area

This general structure is outlined below:

	2. Timescale
	4. Top view area (optional)
1. Resources table	4. Diagram area

5.3.2   Differentiation from the Resources View

The Loads View contains basically the same elements as the Resources View. However, instead of bars, only curves/histograms are displayed in the diagram area there. And the curves cannot be hidden. Also, the world view and the entities table are here not available. This view is useful to get an overview of the resource load.

5.4   Skilled Resources View

5.4.1   Overview

The Skilled Resources View is very similar to the Resources View and can consist out of several elements for visualizing the respective data:

1. Skills and resources table
2. Timescale
3. Diagram area
4. World view
5. Entities table

This general structure is outlined below:

1. Skills and resources table	2. Timescale	5. Entities table (optional)
	3. Diagram area	
	4. World view (optional)	

5.4.2   Difference to the Resources View

The Skilled Resources View contains basically the same elements as the Resources View. However, here the resources are grouped by skills, which are displayed as rows on the highest hierarchy level. The associated resources are shown in rows of the next hierarchy level. Since resources can have more than one skill, they show up more than once in this view.

Like how resources can have skills, allocations can have them as well. However, each allocation can have only one of them. This allows you to determine which skill of a resource is required or claimed for processing an activity.

In the diagram area, each resource row shows all allocations associated with the corresponding resource. That is, those allocations that have no skill assigned to them are also displayed. To make them visually distinguishable from the allocations with skill, their design can be altered so that they are less noticeable.

5.5   Structuring data

5.5.1   Building hierarchies

A hierarchy is something like the basic method for structuring data. Activities, resources and entities can be structured in this way by using a property containing the ID of the parent of the corresponding VSW SE objects. In this manner, for example, orders can be structured according to orders or resources

can be structured according to locations, departments, and resource types. VSW SE shows data structured in this way in the form of collapsible table rows with indentations of the row contents according to the hierarchy levels.

Hierarchies are not available in the Skilled Resources View.

5.5.2 Grouping of hierarchy levels

In addition to building a hierarchy, the rows of each level can be grouped by using one or more criteria derived from property values within the row objects.

Grouping is not available in the Skilled Resources View.

6 Interaction functionality

The Resources View of the VSW SE visualizes allocations of resources and allows the user to change these allocations interactively via drag & drop. The same applies to the activities in the Activities View. In the following chapters the supported graphical user interactions are described.

6.1 Selection

6.1.1 Click

The user can select a resource, an allocation, an activity, or an entity.
This also triggers the callback o*nSelectionChanged* which passes the ID of the selected object. This allows an application to react to this selection within the customer application accordingly by e.g. displaying additional information in another window.

6.1.2 Double click

The user can also double click on a resource, an allocation, an activity, a link or an entity. This triggers the callback *onDoubleClicked* accordingly including of the respective ID of the double-clicked object. An application then can react to these events, for example by opening a dialog for editing the selected objects.

6.1.3 Multi selection

The user can also select multiple resource allocations of resource with a left mouse click. This can be done either by CTRL + left mouse click or by pulling up a selection rectangle. Then all allocations get highlighted and the respective callback is triggered.

6.1.4 Right-click / context menu

The user can get enabled to open a context menu upon the right click on resource, an allocation, an activity, a link or an entity. The respective fitting context menus can be freely defined and associated with these elements by an application. If the user opens a context menu and selects an item, the callback *onShowContextMenu* gets triggered. This event passes the object type and the ID of the respective object to the application.

6.2 Movements: Change of allocations and activities

6.2.1 Allowed interactive changes

The following interactive changes of allocations are allowed:

- Vertical movements = change of allocation from one resource to another (see above Visualization of resource allocations)
- Horizontal movements = change of start and date dates of an allocation
- Change of length of bar = change of duration of an allocation

The following interactive changes of activities are allowed:
- Horizontal movements = change of start and date dates of an activity
- Change of length of bar = change of duration of an activity

All movements can get done with time-spot accuracy (on minutes- or even on seconds-level).

6.2.2 Processing of interactive changes

Once the user completed a movement, the VSW SE triggers the callback *onDrop* and passes the respectively changed data to the application. This callback is a request to change the data accordingly. An application can then react to this request with its own business logic, which then decides if the user's request gets approved, rejected or modified. In that way, the application can trigger an update call to the VSW SE which will then carry out the confirmed changes.

6.2.3 Dragging of multiple bars

In both the Activities View and the Resources View, it is possible to drag multiple bars at the same time. While in the Activities View the bars ca be dragged horizontally only, in the Resources View they can be also dragged vertically. In the latter case, however, all allocation bars will end up on the same resource, even if they were previously assigned to different resources.

6.3 Drag & drop of table rows

In all views it is possible to enable vertical drag & drop for table rows. This also applies to the rows of the entity table.

This way, the user can restructure the hierarchy of activities, resources or entities by dragging a table row vertically. As with interactive bar movements, the widget does not restructure or change the data itself. However, it informs the application of the user's intended changes by the callback *onDrop* so that the application can make the necessary changes to the business logic and update the data of the widget (see also 6.2.2 Processing of interactive changes).

6.4 Drag & drop of entities

If the entities table is activated the user can schedule unscheduled activities by interaction. This is done by dragging a selected row of the entity table into the diagram area. This can be used for instance to assign unassigned backlog activities to resources.

6.5 Creation of objects

Boyum IT will not provide any functionality to allow the interactive and visual creation of a new object including the respective resource allocation. Boyum IT recommends that an application implements this functionality by context menu items or by buttons, which will be shown in the same windows that contains the VSW SE instance.

6.6 Deletion of objects

Boyum IT will not provide any functionality to allow the deletion of objects by user interaction within the VSW SE. An application needs to implement this functionality by providing context menu items or buttons.

7 API

Changes to the VSW SE can not only be executed via the user interactions specified in chapter 5.3. In addition to this, they can also get triggered via program code calling API functions.

There are additional functions to the add/update/remove functions related to the data objects, which can get applied to load and change data in the VSW SE. These additional functions can get used to

- reduce the diagram area to a certain time interval,
- scroll horizontally to a specific time within the time area,
- scroll horizontally and vertically to a specific allocation/activity in the diagram area,
- blend out all non-working periods, which all displayed resources have in common.

8 Printing

As accessing hardware – printers in this case – in the web browser is a particular challenge, VSW SE enables printing by generating PDF documents. This solution allows to use one of the many available apps for viewing and printing PDF documents. In addition to the common options such as paper size, orientation, margins, etc., users can also choose between different print modes. These offer the splitting of a chart on several sheets, crop marks, and the repetition of the table and timescale on each sheet.