Polar Tasks

Description of the system and design elements

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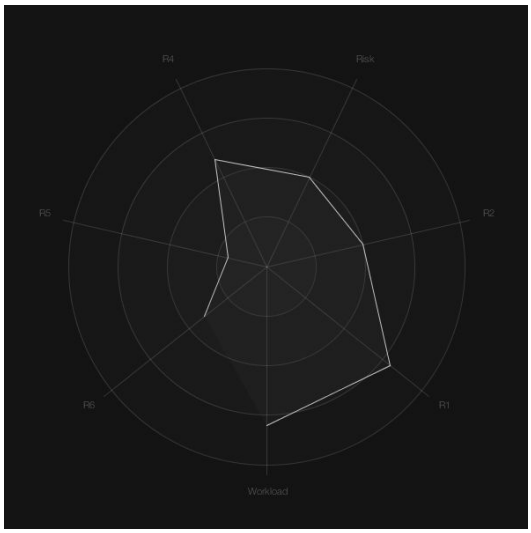
General Description:

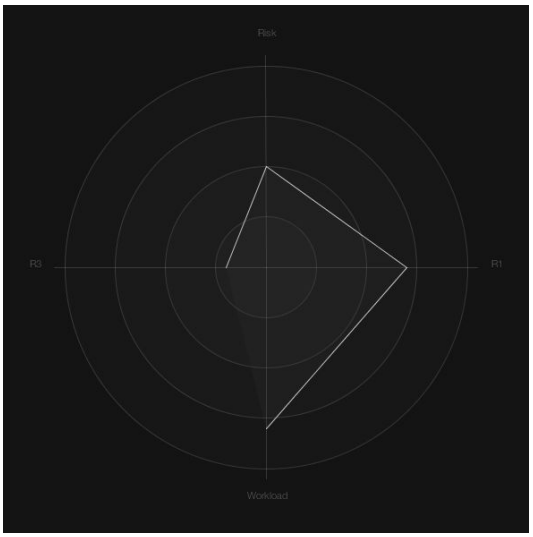
The aim of the project was to develop a data visualization tool for analyzing multiple tasks in the work environment. Tasks are defined with five parameters, namely title, temporal values, riskiness, workload, and multiple resources. Final system should reveal possible resource conflicts in an obvious way.

Elements of the Design:

The parameters of each task structure (difficulty, risk, and resources) are represented with a 2D polar coordinate system for a given time (slices). The number of edges in the slice varies depending on the number of resources associated with the specific task. *Risk* and *Difficulty* parameters are always present in these slices but each task contains a different number of resources.

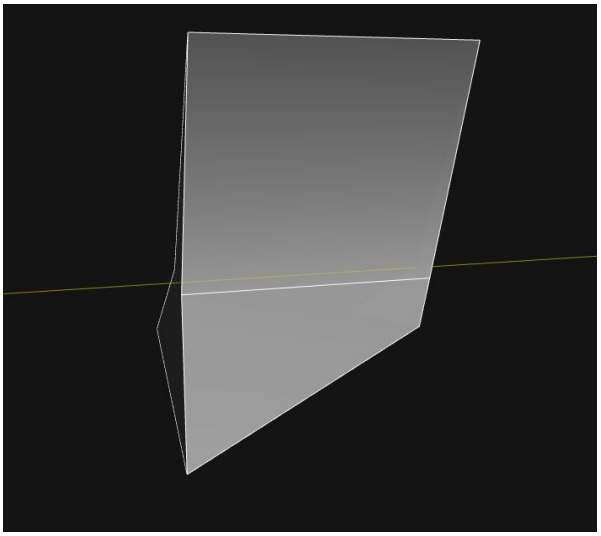


A task with 5 resources

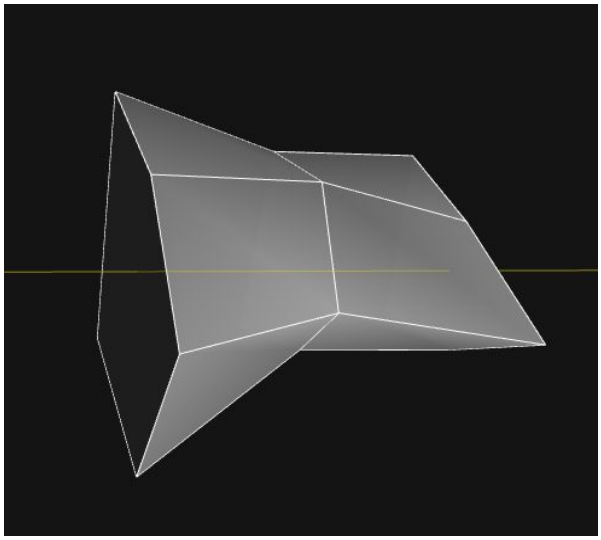


A task with 2 resources

Tasks have a beginning time and an end time, and multiple optional middle timesteps. The resource usage, difficulty, and risk values may or may not change as the time progresses. The 3D task shape is constructed by interpolating bridges between consecutive task slices.



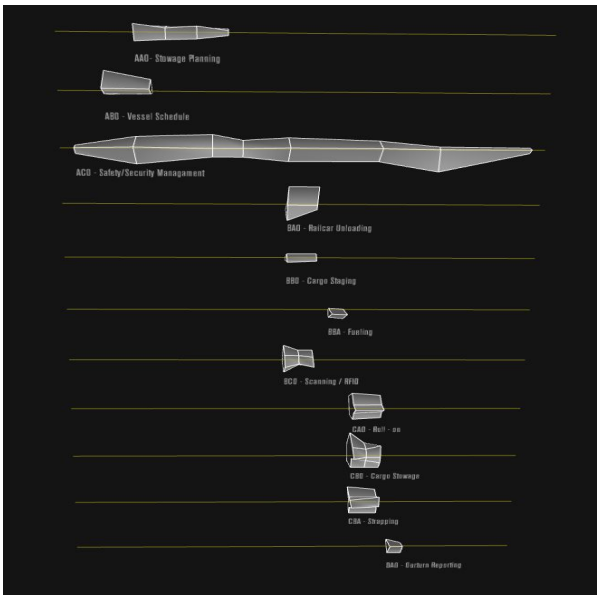
A task with beginning and end slices only



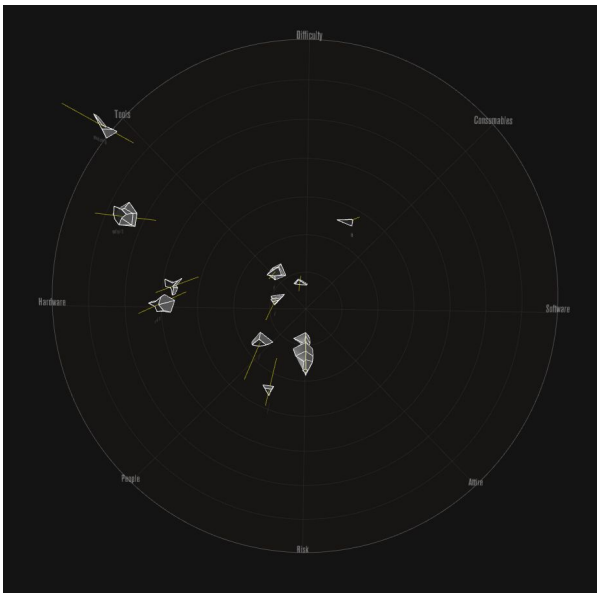
A task with beginning, middle and an end slices

As for the global placement of multiple tasks, the X axis is reserved to denote time, meaning that if two tasks need to be performed concurrently, the YZ plane (the timer) intersects both tasks at the same time. If they are sequential, the timer does not intersect both items at the same time. In order to interact with the time, either time animation can be toggled using **Space** key, or the bottom slider can be utilized for fine-tuning.

The YZ-axis is reserved to display the dominant factor of a task, which could be either difficulty, risk, or one of the resources. As the time slider moves, the dominance factor is recalculated considering the value of current slice.

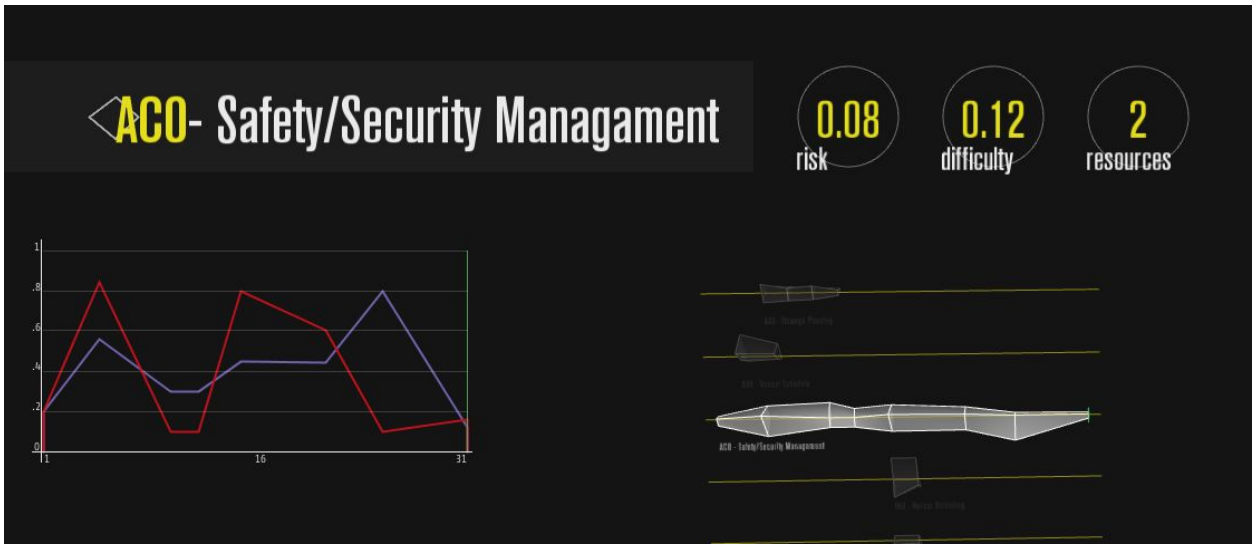


X-axis // time

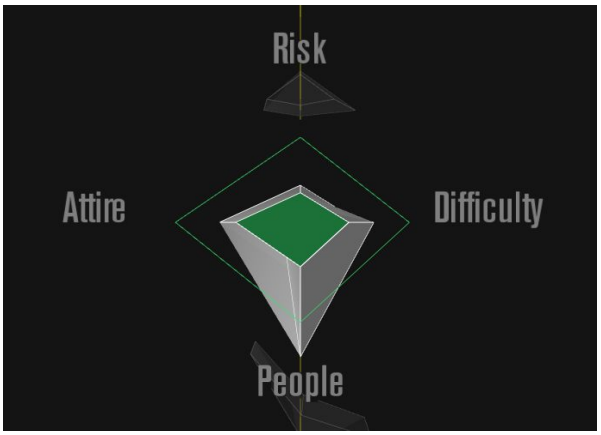


YZ-plane // dominance factor

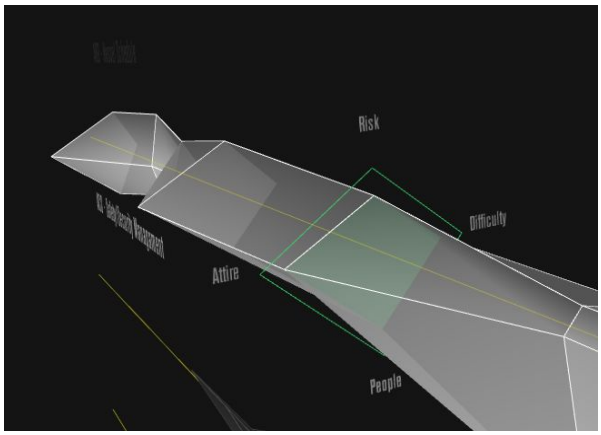
Double-clicking on any of the tasks will reveal information about that task and desaturates rest of the shapes. Upon selection of a task, its title, risk, difficulty, and number of resources parameters are immediately displayed on the screen. In addition to these, a graph showing the changes in resource usage over time will be displayed. Using the **1** key, appearance of the graph can be alternated.



Triple-clicking on a task not only selects it for further inspection but also rotates the camera to focus task from YZ direction. With the help of green slice inspector, one can understand which resources are employed and how much they are used. In the selection mode, mouse wheel moves slice inspector back and forth between consecutive slices.



Focused view after triple-click



Slice inspector on one of the intermediate slices

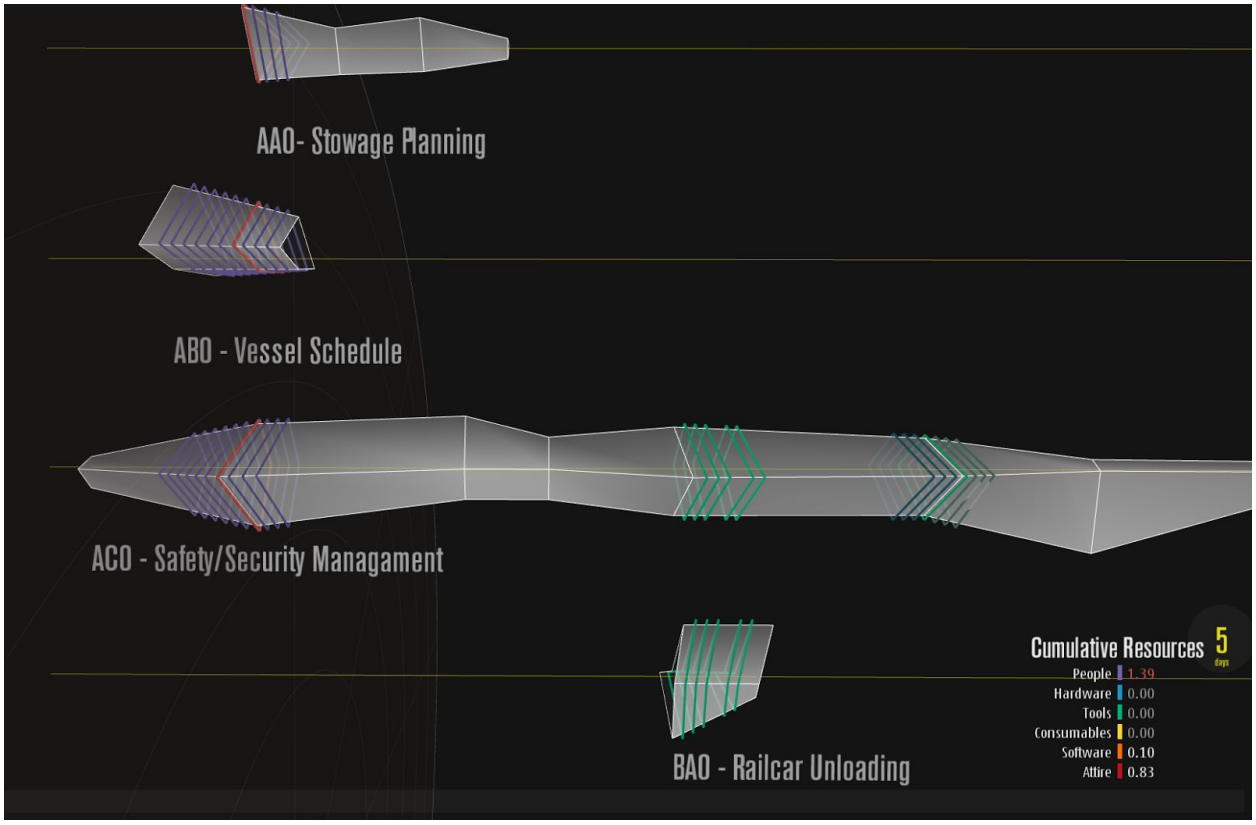
The bottom right side of the visualization provides feedback on multiple things; (1) the current value of the timer in terms of days, (2) cumulative resource usage at the particular time, (3) color legend for different resources. The conflict on the usage of resources can easily be monitored from this panel since once a resource gets overused, the corresponding number is highlighted red to alarm the resource conflict.

Day 0. Simulation hasn't started. None of the resources are in use.

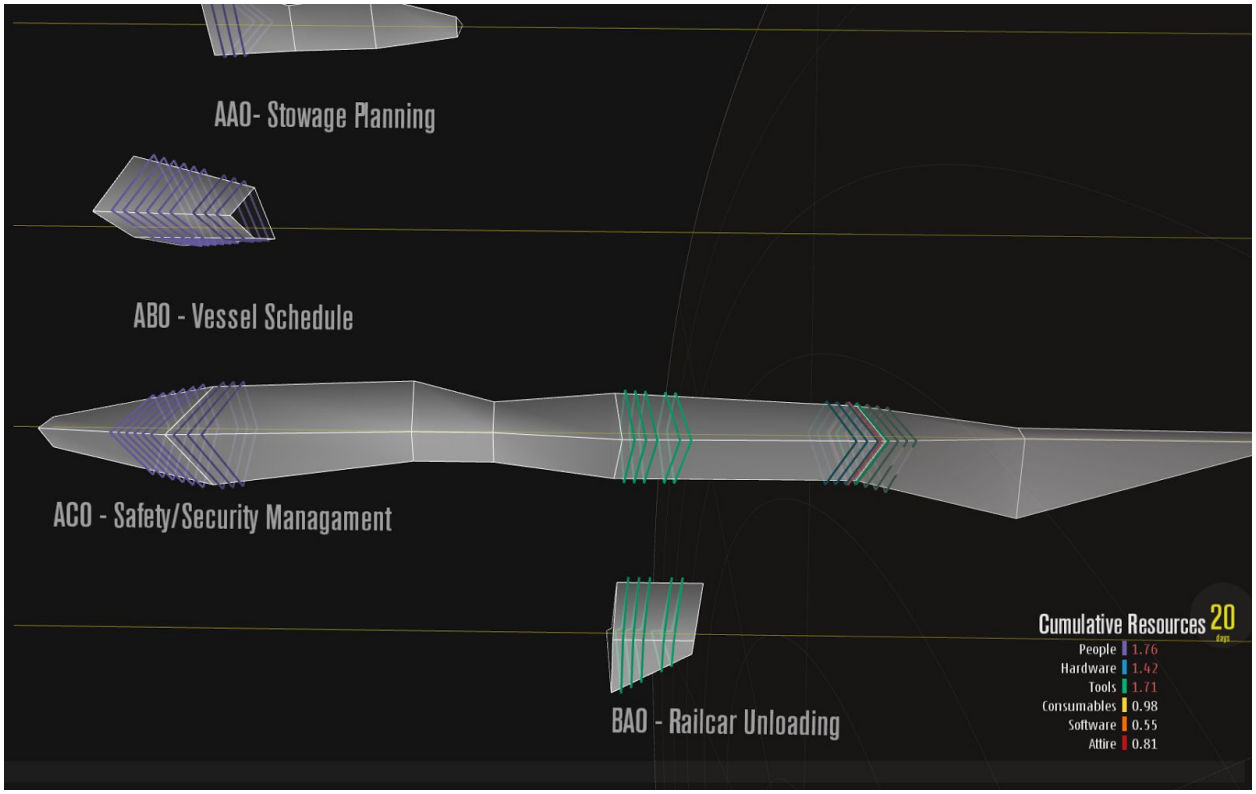
5th day. Software and Attire are used, but People is conflicting.

20th day. People, Hardware, and Tools are conflicting. Consumables are about to conflict.

Another quick way to see all conflicts without moving the timer around is to press **R** key so show an overlay of all conflicting resources. In this view, tasks are highlighted where the conflict occurs with rings. The color of the rings is calculated taking into consideration the conflicting resources. For example, for 5th day, since only People is conflicting, the ring colored with purple, but for the 20th day, the color of the ring is calculated with the cumulative usages of People, Hardware, and Tools as weights.

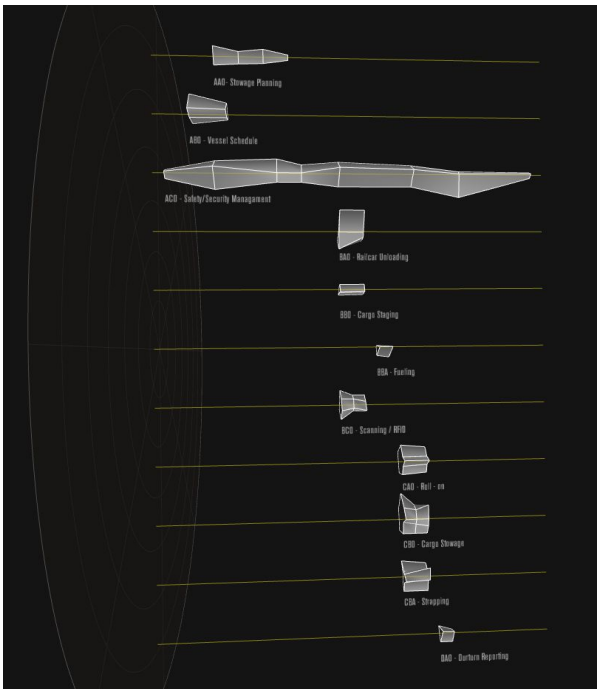


Timer (red ring) is currently on 5th day



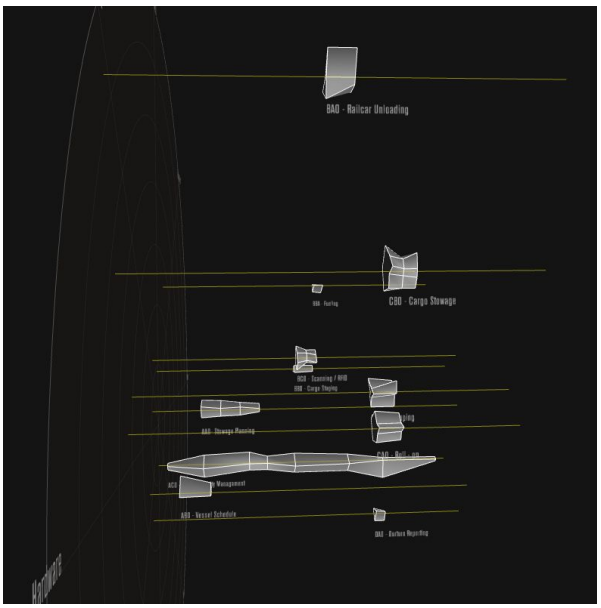
Timer (red ring) is currently on 20th day

Apart from these, spatial placement of tasks can be changed using **T** key, which results in toggling between a nice line-up and dominance factor placement mentioned above.

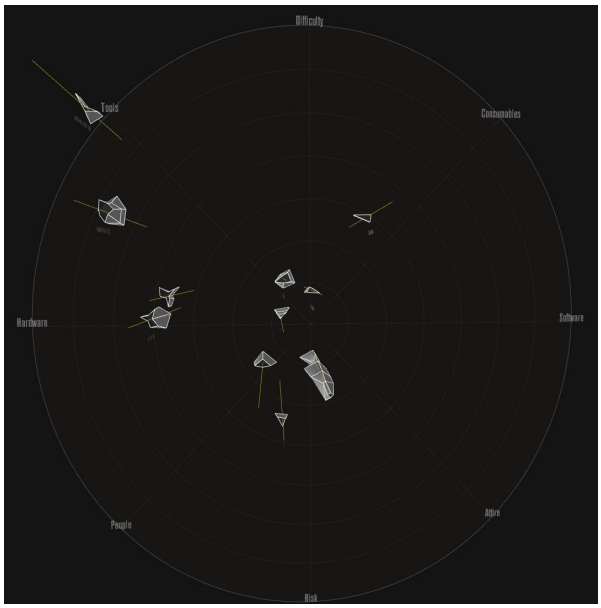


(a)

(b)



(c)



(d)

The line-up placement in (a) time view and (b) side-view. The dominance factor placement in (c) time view and (d) side view.

Note: The data of tasks are loaded from a CSV file on program startup. If the data is updated during program execution, **L** key reloads tasks and updates current visualization.

Each line in the *data.csv* is one time-slice of one task. The header and sample lines can be found below:

```
task_title,time_stamp,start_flag,end_flag,risk,difficulty,r_hardware,r_software,r_people,r_con
sumables,r_attire,r_tools
AAO - Stowage Planning,5,1,0,0.4,0.7,,,0.3,,,
AAO - Stowage Planning,7,0,0,0.2,0.65,,,0.25,,,
AAO - Stowage Planning,9,0,0,0.3,0.5,,,0.22,,,
AAO - Stowage Planning,11,0,1,0.1,0.4,,,0.1,,,
```

In this example, the task *AAO* globally starts on day 5 and ends on day 11, with two more intermediate reporting steps on day 7 and 9. It uses *Hardware*, *Software*, and *People* as its resources with different utilization levels for each time-slice.