

## SWIFT – Schedule Workload Integrated Forecasting Tool



**Maintenance availability scheduling for Fleet assets is a complex task that involves balancing demands of Cost, Schedule and Readiness.**

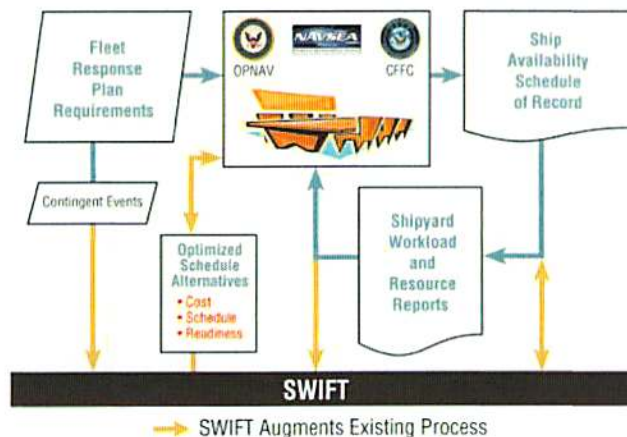
**SWIFT is an executive-level decision analysis tool that:**

- Complements and maximizes use of existing tools and processes;
- Provides complete and accurate real-time impact analysis;
- Prioritizes solutions within multiple constraints;
- Enables optimization across multiple trade spaces



**SWIFT provides significant benefits to the Navy's scheduling process:**

- Performs in minutes analyses which previously required days or weeks;
- Decision makers are provided with independent, objective, data-driven support;
- Current business rules, user-defined criteria and priorities are enforced;
- The trade space between cost, schedule and readiness is quantified;
- The potential for sharing workload and resources across multiple work sites is identified;
- Accurate forecasts of future resource needs are provided;
- Mitigation of impacts due to contingent events is facilitated



ASSETT Inc. has developed and demonstrated a novel and efficient solution to a complex resource-constrained project scheduling problem (RCPS) that includes multiple shipyards, hundreds of ships, thousands of skilled shipyard workers, and complicated resource constraints on dry docks, workforce overtime, and operational deadlines. The solution is being made available online via the web for executive users in the Navy's Fleet Maintenance Enterprise.

The user-friendly interface is tailored to provide the selection of multiple constraint values and objective functions with user-familiar terminology and displays. Intelligent feedback is provided to help users resolve infeasibilities. Real-time graphical displays show the effects of the optimal solution on the baseline schedule cost, workload and overtime required for different skills in the shipyards.

### Optimization Within a Specified Trade Space

- Constrain the variation allowed in one or more of the primary objectives (cost, schedule or readiness)
- Determine the changes to the current planned availabilities that allow the constraints and objectives to be met
- Determine the impact to unconstrained objectives

INFORMATION				
Metric	Units	Baseline	Alternative	Delta
Total Schedule Churn	days	0	3,288	3,288
Total Labor Cost	\$M	3,680.70	3,493.40	-187.30
Total Overtime Cost	\$M	1,700.90	1,518.70	-184.20
Avg. Availability	units	6.48	6.48	0.00
Total Workload	RD	4,380,480.0	4,048,171.0	-334,309.0
Total Workforce	RD	3,778,608.0	3,778,608.0	0.0
Resource Imbalance	RD	601,875.0	267,565.0	-334,310.0
Average Overtime	%	19.1	10.1	-9.0

Inflation Rate: 5% Save

#### Optimization Parameters

##### Constraints

Total Monthly Average % Overtime	10		Limit of Avail. Movement (Days)	180	Minimum Number of Surgeable Units	1
Total Monthly Maximum % Overtime	30	Class1	180			
Limit on Monthly Additional RDs	2,500	Class2	180			
Limit on Total Additional RDs	100,000	Class3	180			
Limit on Movable Workload RDs	750,000	Class4	180			

##### Objective Functions

Level Workload Vs Workforce	<input type="radio"/>		
Minimize Additional Resources	<input type="radio"/>		
Minimize Total Cost	<input checked="" type="radio"/>	Limit on Total Cost (\$M)	25,000
Minimize Schedule Churn	<input type="radio"/>	Limit on Schedule Churn (RDs)	500
Maximize FRP Ao in an Interval	<input type="radio"/>	Limit on CVR FRP Ao	2

##### Parameters

Optimization Window  
 Starting Fiscal Year: 2010    Duration (RDs): 36    Extension (RDs): 24  
 FRP Ao Interval  
 Starting Fiscal Year: 2010    Interval Duration (RDs): 24

Solution Gap Tolerance Level: 1 %

Lowest Resources Level Optimized: Total + Prod and Supp    S&B Code

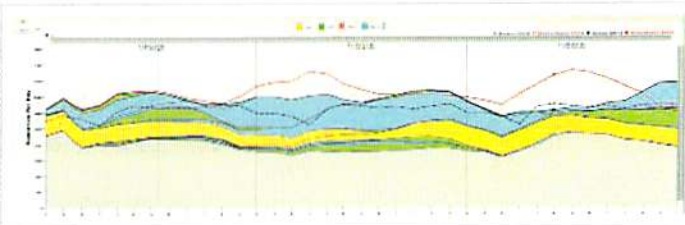
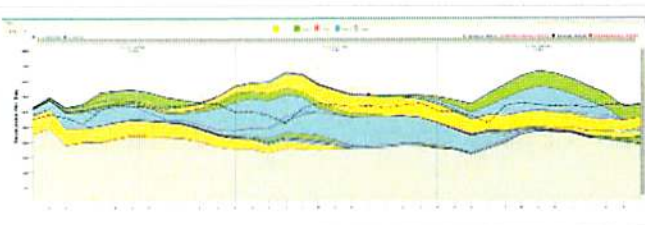
Workload Time Interval: Monthly    Weekly

Class Operating Interval Enforcement:  Off     On

Dry Dock Conflicts Allowed:  None     In Shadow

Var + 20 %  
Var - 20 %

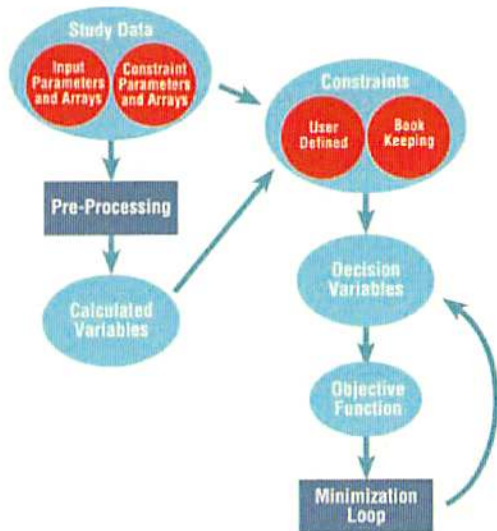
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SWIFT uses a commercial off-the-shelf optimization engine to optimally solve a Mixed Integer Programming (MIP) formulation of large resource-constrained scheduling problems in reasonable amounts of time to support online, interactive users using actual shipyard data.

**Optimization Problem Formulation includes:**

- A metric that measures the value of different potential solutions (objective function);
- A set of decision variables that represent the factors controlled by the decision-maker;
- A set of data that describes the system;
- A set of relationships between the decision variables and the data that constrains the system.



**Examples of Optimization Objectives:**

**Minimize the cost of shipyard resources to meet specified availability completion dates or deadlines.**

- Establish penalties for overtime and/or obtaining additional resources.

**Minimize the number of missed completion deadlines while staying within the constrained shipyard resource profile.**

- Establish penalties for late completion of critical availabilities.

**Maximize the number of platforms within the established readiness construct.**

- Establish penalties for reducing surge capacities beyond certain levels.

**Applied constraints are derived from current business rules:**

**Resource Based**

- Overtime must not exceed a given percentage in any month.
- Dry dock of a certain size and configuration must be available.
- Need for resources in excess of the available force must be limited.

**Time Based**

- Availability must start or finish within a specified date range.
- Scheduled start and/or finish date must not change.
- Total duration of an availability must not exceed a specified length.

**Policy Based**

- Certain availabilities must be in a yard near a ship's home port.
- Certain availabilities must have a greater priority.

**Operationally Based**

- Surge capacity must not be reduced beyond a certain level.

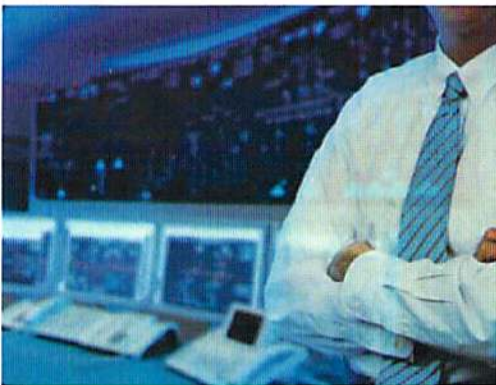
**Cost Based**

- Total cost of all projects must not exceed a specified amount.



U.S. Navy photo by Michael F. Laley

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- Information Management/Reduced Manning
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- Schedule Analysis and Workload Forecasting

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