

# **Navy Manpower and Personnel Modeling, Simulation and Optimization Tools**

## **Brief to MORs**

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# Report Documentation Page

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# Background

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- Navy communities include enlisted ratings (e.g., electronics technicians) and officer designators (e.g., surface warfare officers)
- Navy community managers are responsible for the development, both in the short- and long-term of their communities
  - They need to understand the effects of a wide variety of policies and procedures
- Navy community managers need a variety of decision support tools to facilitate their work

# Issues

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- **During the past 30 years there have been many decision support tools have been developed for Navy community managers**
- **They have largely fallen by the way-side for a variety of reasons:**
  - **They do not address community manager needs**
  - **Difficult to use**
  - **Lack of transparency**
- **ONR is sponsoring research to remedy this situation**

# **Approach & Research Team**

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- **A wide variety of skills are required to produce an operational decision support system, and ONR has constructed a research team accordingly**
  - **SPAWAR, San Diego – user requirements**
  - **NPRST – domain expertise and access to data**
  - **CNA – domain expertise and modeling**
  - **Icosystem – systems engineering and modeling**

# Methods

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- We intend to build upon existing knowledge and on-going research
- Current CNA research - developing a simulation model for enlisted personnel on Virginia class submarines
- Current Icosystem research
  - **S**imulation **T**oolset for **E**xperimental **E**nvironment **R**esearch
  - **I**ntegrated **M**anpower and **P**ersonnel **A**gent-Based **C**omputer **T**ool

# Simulating MPT&E and measuring FIT

- FIT measures unit manning
  - FIT is the overarching objective of the Navy MPT&E system
- ONR sponsored CNA research, aimed at improving FIT
- Build a model that simulates the MPT&E process
  - Simulate the flow of personnel through the MPT&E production line
  - Follows industry approach of simulating production lines to understand complex dynamics, bottle necks, inefficiencies, etc.
  - Analyze impacts of MPT&E initiatives on FIT
- Focus on Virginia class submarines

# Simulation model overview

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- A top down approach
  - **Start with flows at a macro level and develop more detail over time**
- Address the numerous processes that apply to personnel and guide their movements in the Navy
  - **Recruiting, Training, Distribution, Retention, Advancement**
- The model will be able to explore policy changes and their impact on metrics such as:
  - **FIT, MPT&E budgets (recruiting, training, retention, PCS costs), NEC utilization, School capacity, etc.**

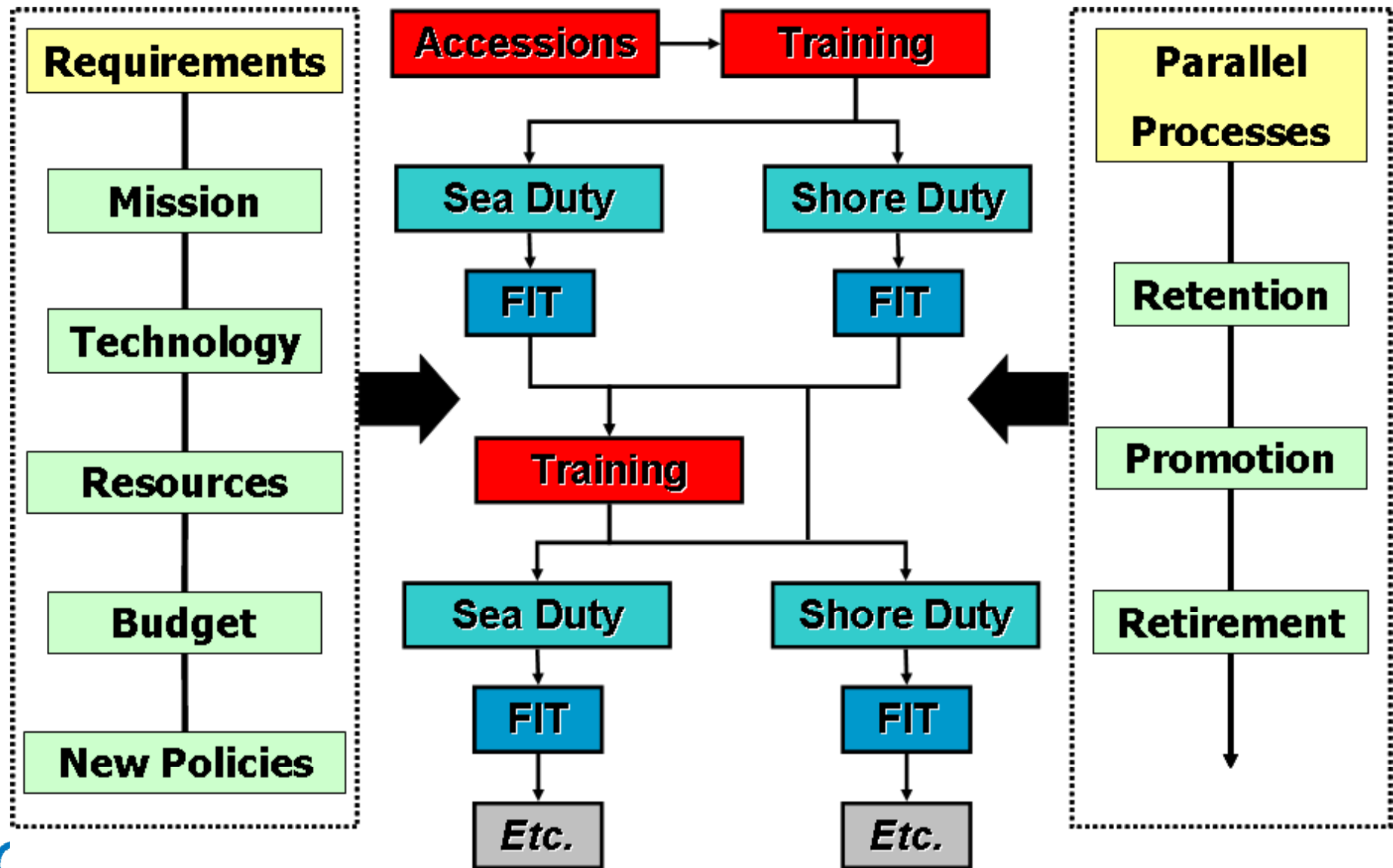


# Modeling approach

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- **Simulation model**
  - **User friendly front-end and displays**
- **Use of individual-level data**
  - **Capability to accurately reflect impact of changes at a micro-level**
- **Hybrid model**
  - **Historical aggregate rates for selected actions**
  - **Behavioral models to generate impact of changes in policies and resources at the micro-level**
- **Using ExtendSim**
  - **Mature off-the-shelf simulation software**
  - **Excellent development environment**
  - **Radically reduces model programming time**
  - **NMCI compliant**

# Street → Fleet → Career → Retirement



# Progress to date

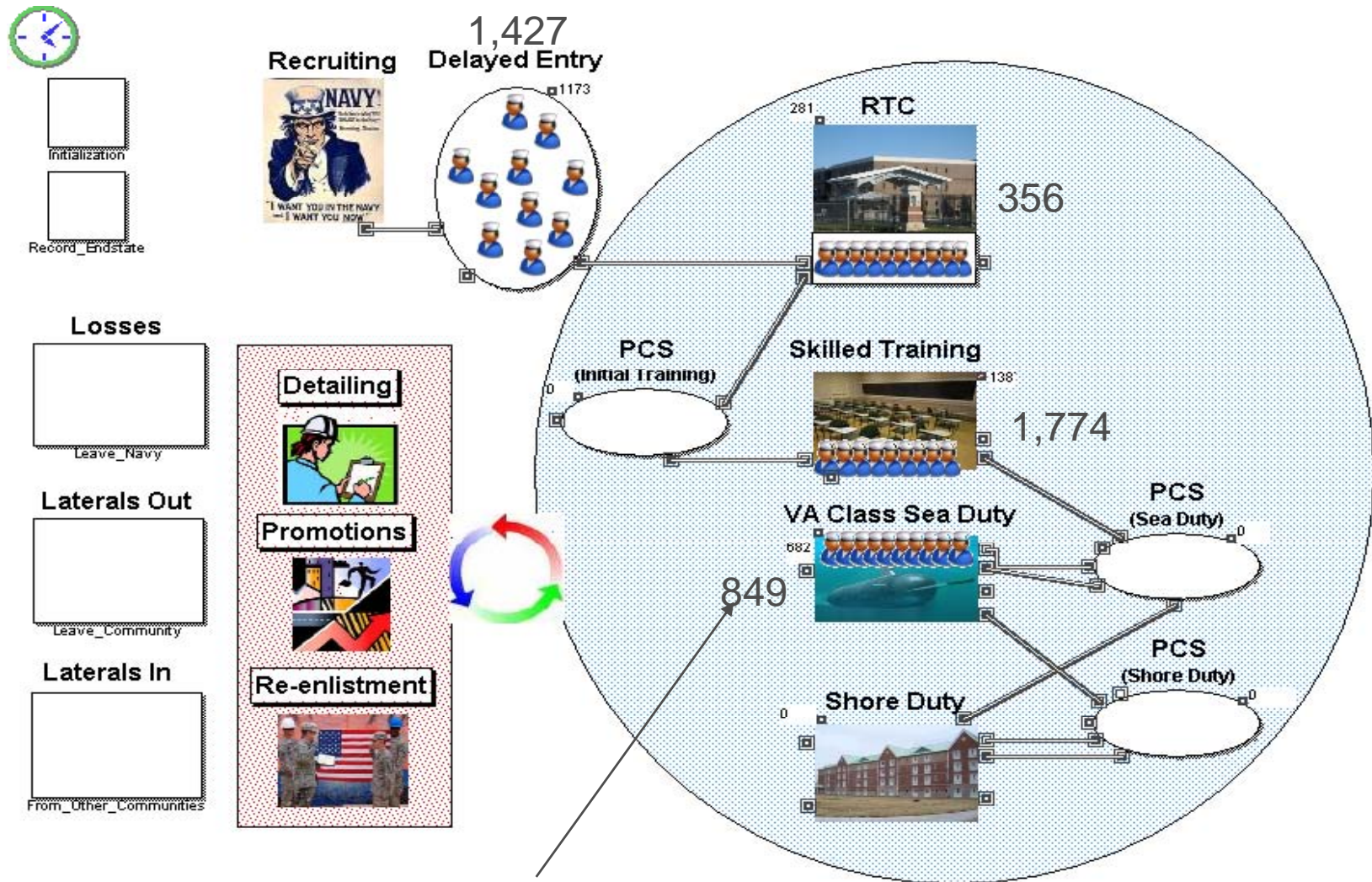
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- **Prototype model developed**
- **Macro flows established**
  - **Recruiting**
  - **Training**
  - **Sea/shore rotation**
  - **Retention**
  - **Advancement**
- **Model tested for Virginia class submarines**
- **Many details remain to be added**
  - **Details below**

# Further potential model development

- Add more detail to existing model flows
  - E.g., add geographic location to UICs
- Incorporate cost data
- Use of retention rates
- Incorporate econometric and behavioral effects
- Move beyond Virginia class

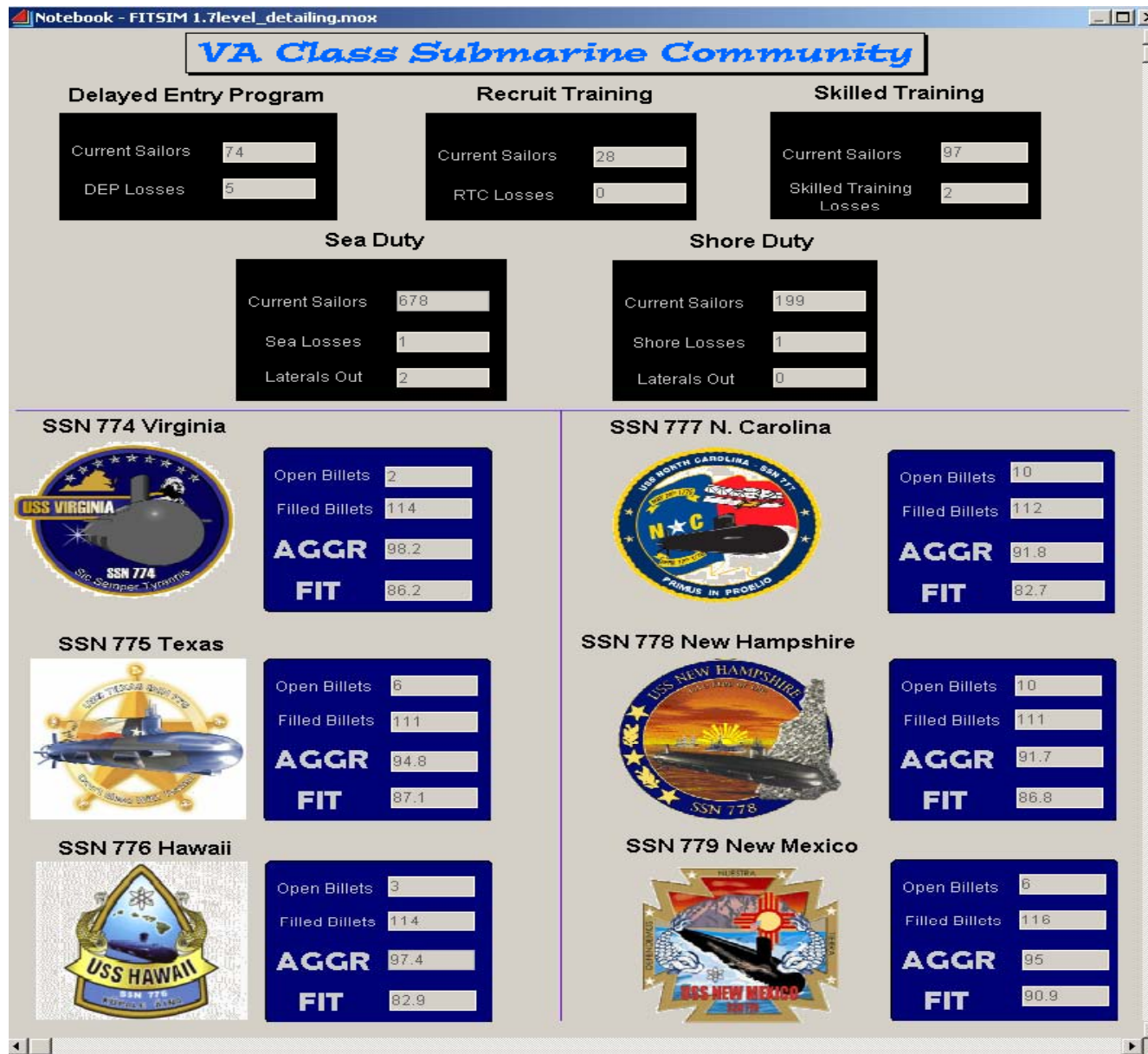
# Sample model screen shot



Virginia: 118, Texas: 112, Hawaii: 107, North Carolina: 119,  
 New Hampshire: 112, New Mexico: 116, Missouri: 112, California: 53

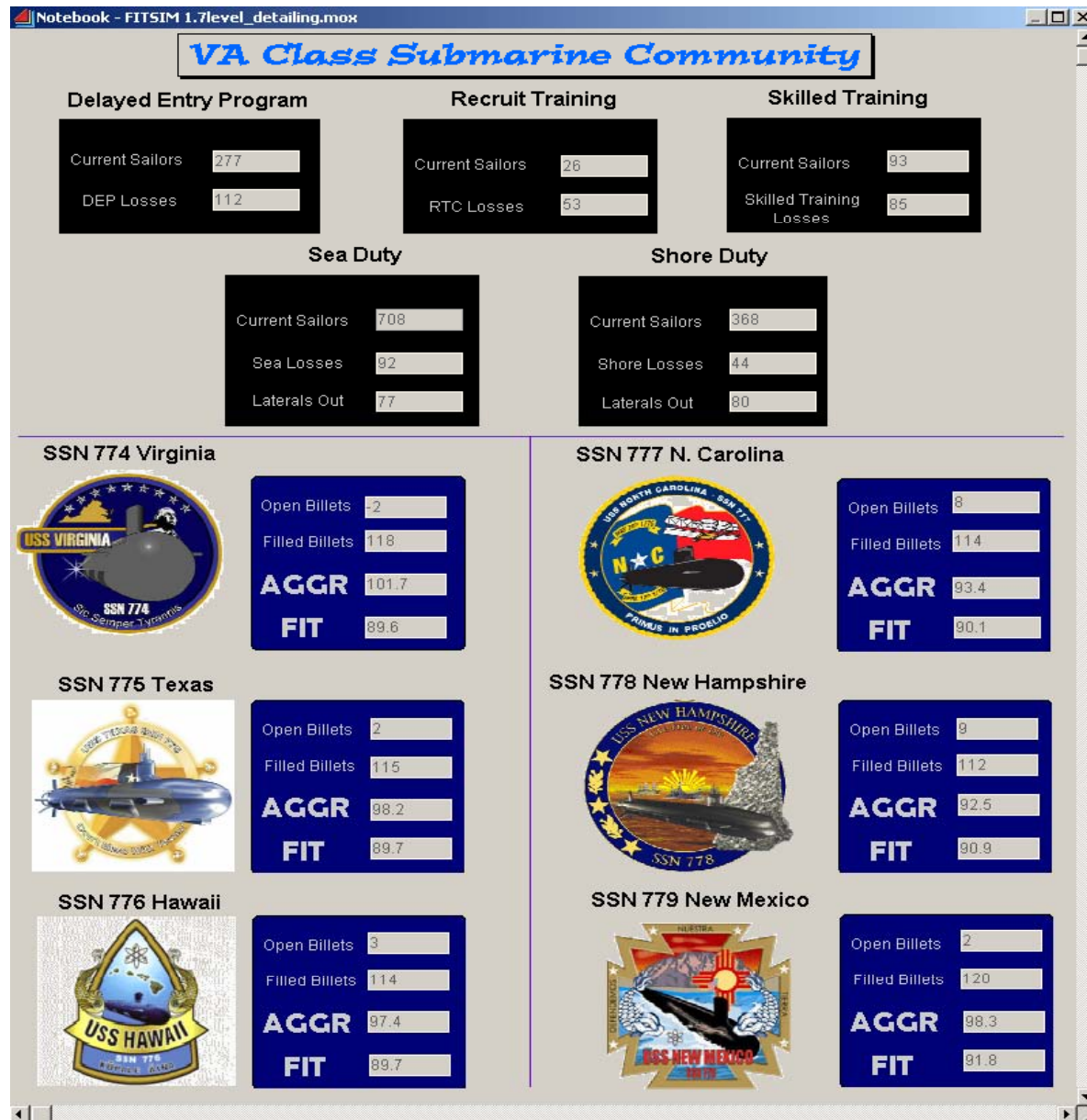
# Simulation Model Output Summary

Starting Inventory:  
End of FY09



# Simulation Model Output Summary

Projected Inventory:  
End of FY13



# Baseline

- Starts with end of FY09 inventory
- 240 Recruits into the DEP for VA class subs
- Skill training classes convene once a month
- Sea and Shore tours are 4 and 3 years respectively

	VA SSN 774	TX SSN 775	HI SSN 776	NC SSN 777	NH SSN 778	NM SSN 779
Aggregate % End FY09	100	95.7	100	96.7	93.4	95.1
FIT % End FY09	87.1	87.2	84.6	83.6	86.9	91.0
Aggregate % End FY13	101.7	98.3	97.4	93.4	92.6	98.4
FIT % End FY13	89.7	88.9	89.7	90.2	91.0	91.8



# Changing Accessions to 160 into VA class subs

	VA SSN 774	TX SSN 775	HI SSN 776	NC SSN 777	NH SSN 778	NM SSN 779
FY09 Aggregate %	100	95.7	100	96.7	93.4	95.1
FY09 FIT %	87.1	87.2	84.6	83.6	86.9	91.0
FY12 Aggregate %	102.6	91.5	82.9	88.5	90.1	82.0
FY12 FIT %	84.5	79.5	79.5	82.8	82.8	80.3
<b>FY12 Aggregate %</b>	<b>94.0</b>	<b>97.4</b>	<b>79.5</b>	<b>88.5</b>	<b>95.9</b>	<b>81.2</b>
<b>FY12 FIT %</b>	<b>80.2</b>	<b>76.1</b>	<b>76.1</b>	<b>82.0</b>	<b>81.2</b>	<b>77.9</b>

	DEP	RTC	Skill Training
End FY09 Inv.	79	45	113
End FY12 Inv.	222	21	93
<b>End FY12 Inv.</b>	<b>2</b>	<b>21</b>	<b>93</b>

# STEER Objectives

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- Create a flexible simulation platform to test and demonstrate capabilities for various MPT&E models
- Help to analyze and quantify the impact of varying policies on individual, unit, and enterprise behavior
- Facilitate the generation and testing of ideas, concepts
- Automated model testing and verification
- Automated graphical displays
- Transparency on model logic
- **STEER provides an environment for model operations**

# **STEER: Multiple User Types**

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## **3 Core User Types/Interaction Modes**

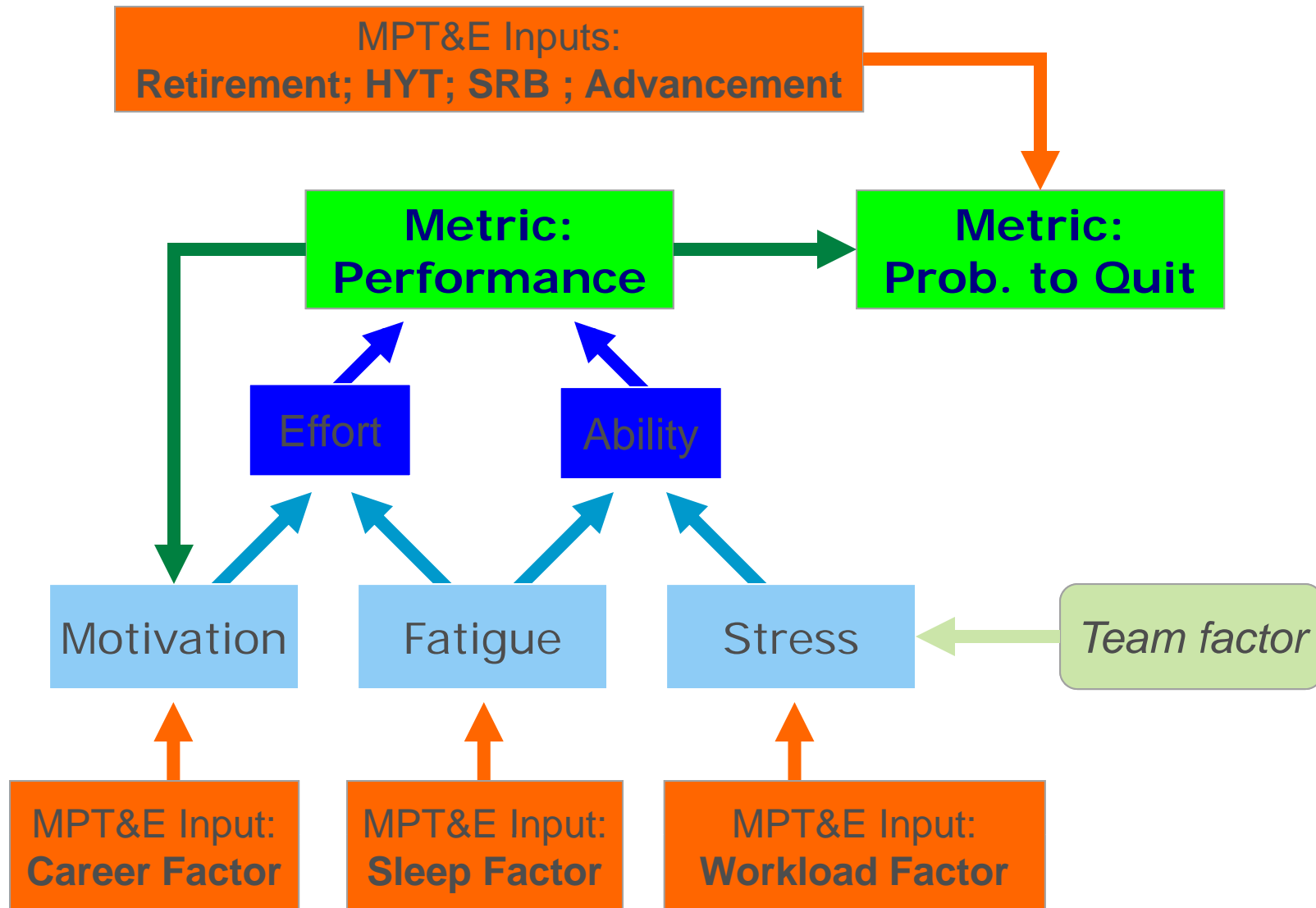
- **Analysts / End Users**
  - **Experiment with Models**
  - **Domain Expertise, Questions/Tool Expertise**
- **Modelers**
  - **Analyst + Develops Models**
  - **Domain Expertise, Modeling Expertise**
- **Developers**
  - **Expand Core Functionality**
  - **Software/Architecture/Modeling Expertise**

# **IMPACT capabilities**

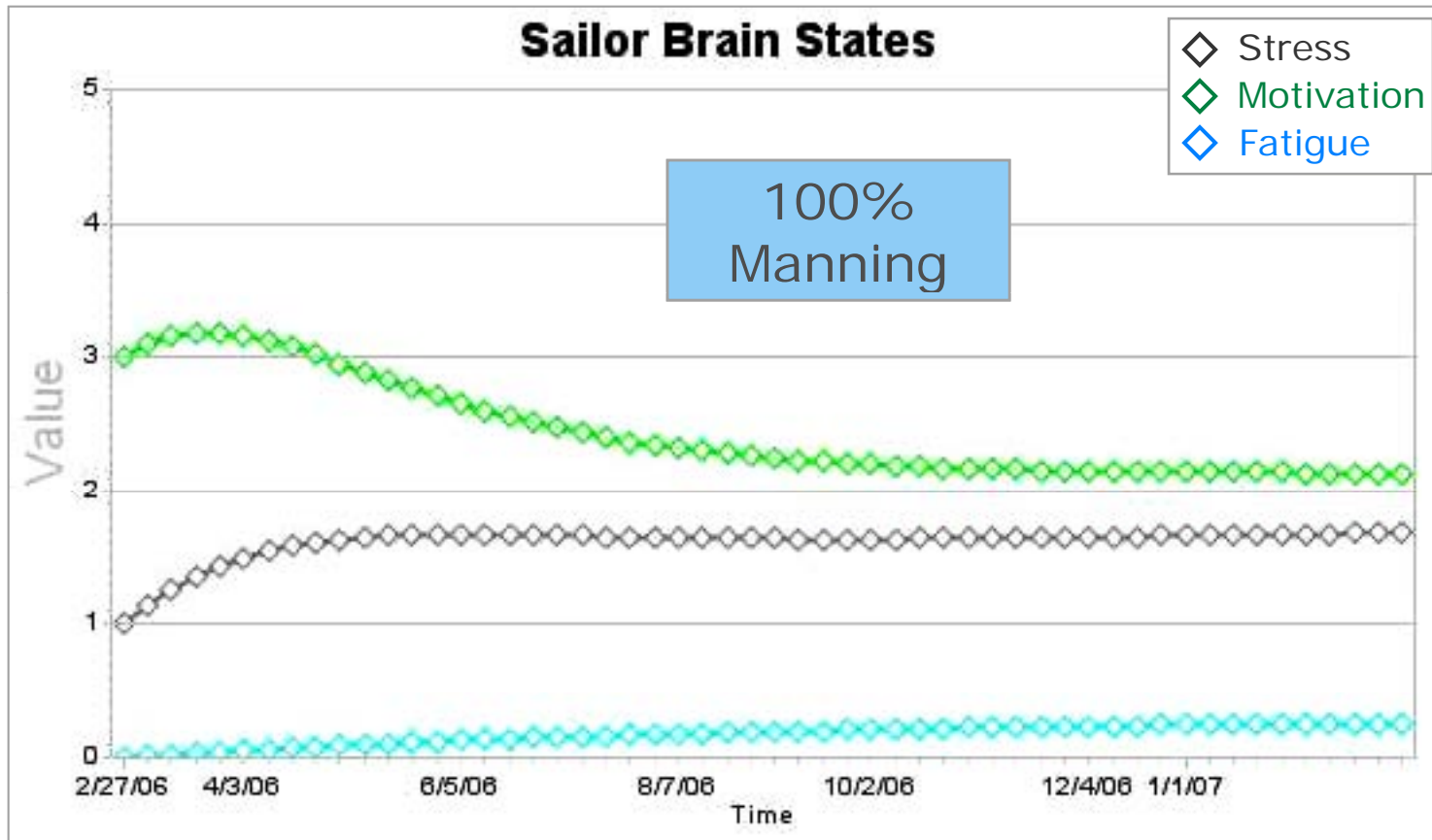
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- **Simulate Navy operations over multiple years**
- **Include high level of detail of most MPT&E systems and processes**
- **Manage multiple skill levels and pay scales**
- **Balance training and working periods**
- **Include personnel stress and fatigue resulting from understaffed ships**
- **Include optimizer to find best staffing levels under various constraints**

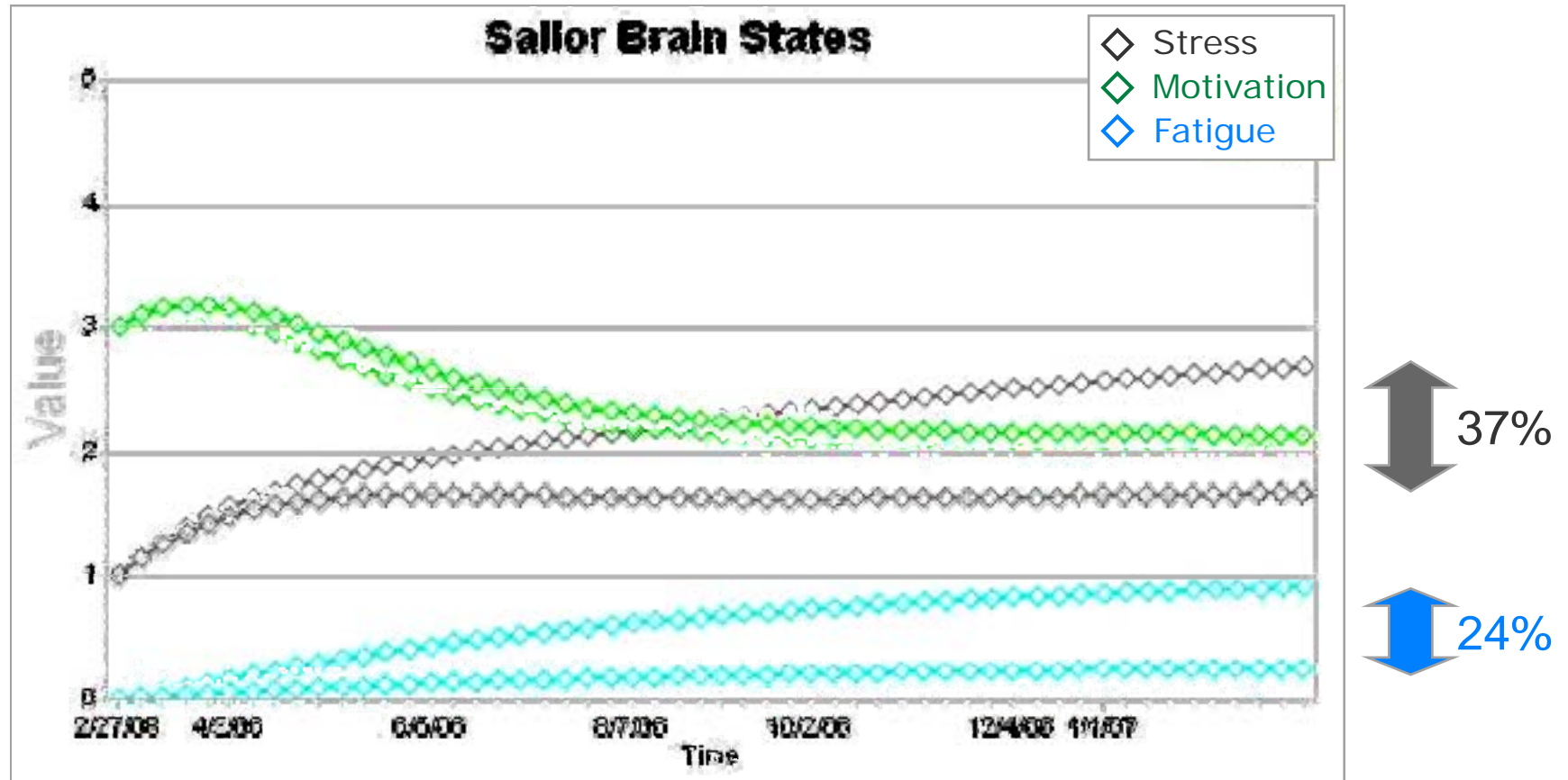
# The Dynamic Sailor Model



# Sample Scenarios: Nominal



# Optimize Cost Only



*Cost-only optimization leads to dramatically reduced performance*