



Leverage AI to Learn, Optimize, and Wargame (LAILOW) for Strategic Laydown and Dispersal (SLD) of the Operating Forces of the U.S. Navy

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Background and Research Questions

- **Background**

- The laydown and dispersal of U.S. Naval forces requires manual processing
- The current process takes one full year to develop
- Not responsive to changes in the operating environment or strategic guidance

- **Research Questions:**

- How to standardize, digitize the process, and capture better data for decision making?
- Requirements and Objectives [Source: A memo from RDML T.R. Williams, former Director for Plans, Policy, and Integration (N5)]

- **Descriptive Phase**

- Current standalone SLD database to a cloud based and shareable website

- **Predictive Phase**

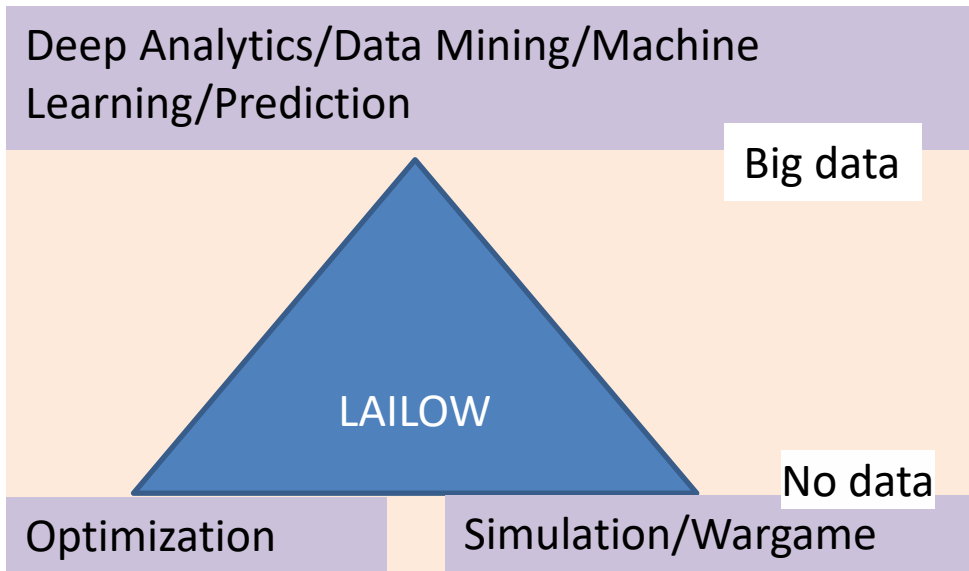
- How are we making decisions?
- What happens if I make a different decision?
- How do we develop an Excursion Modeling Tool – A decision support tool that uses existing authoritative data and models SLD excursions to assist in rapid decision making with increased accuracy?

- **Prescriptive Phase**

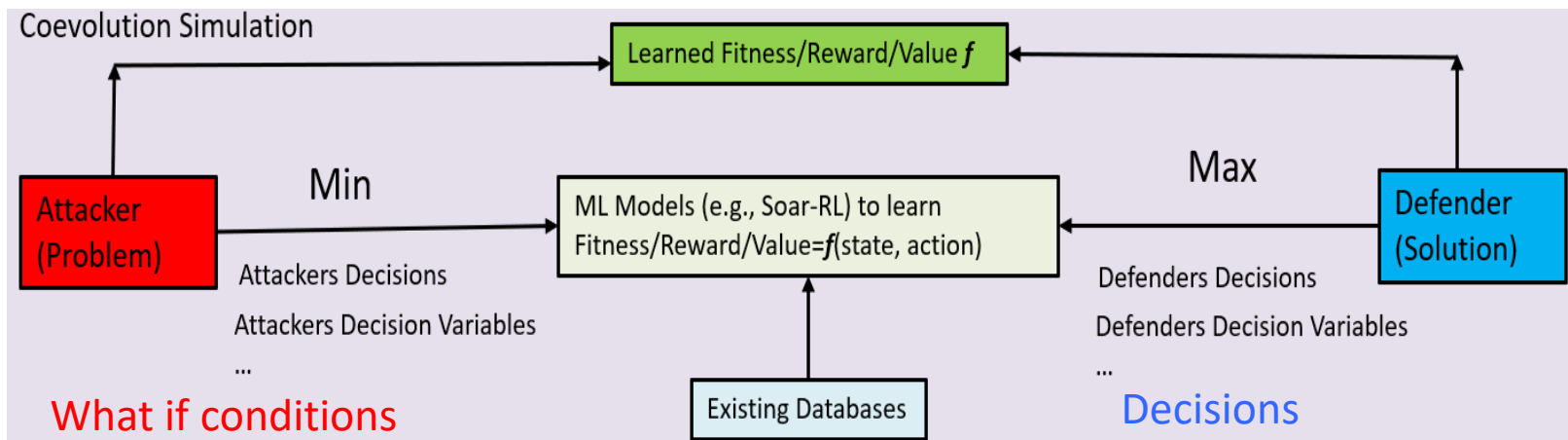
- Are we making the right decisions?
- How shall we utilize deep analytics including AI?
- How do we evaluate an SLD plan?
- How do we create an optimized plan by including global and theater posture and force generation (Fg) and force development (Fd) into the calculations?



Method: Leverage Artificial Intelligence to Learn, Optimize, and Wargame (LAILOW) for Decision Making Enterprises



- Logistics
- Cyber
- Mission planning
- SLD

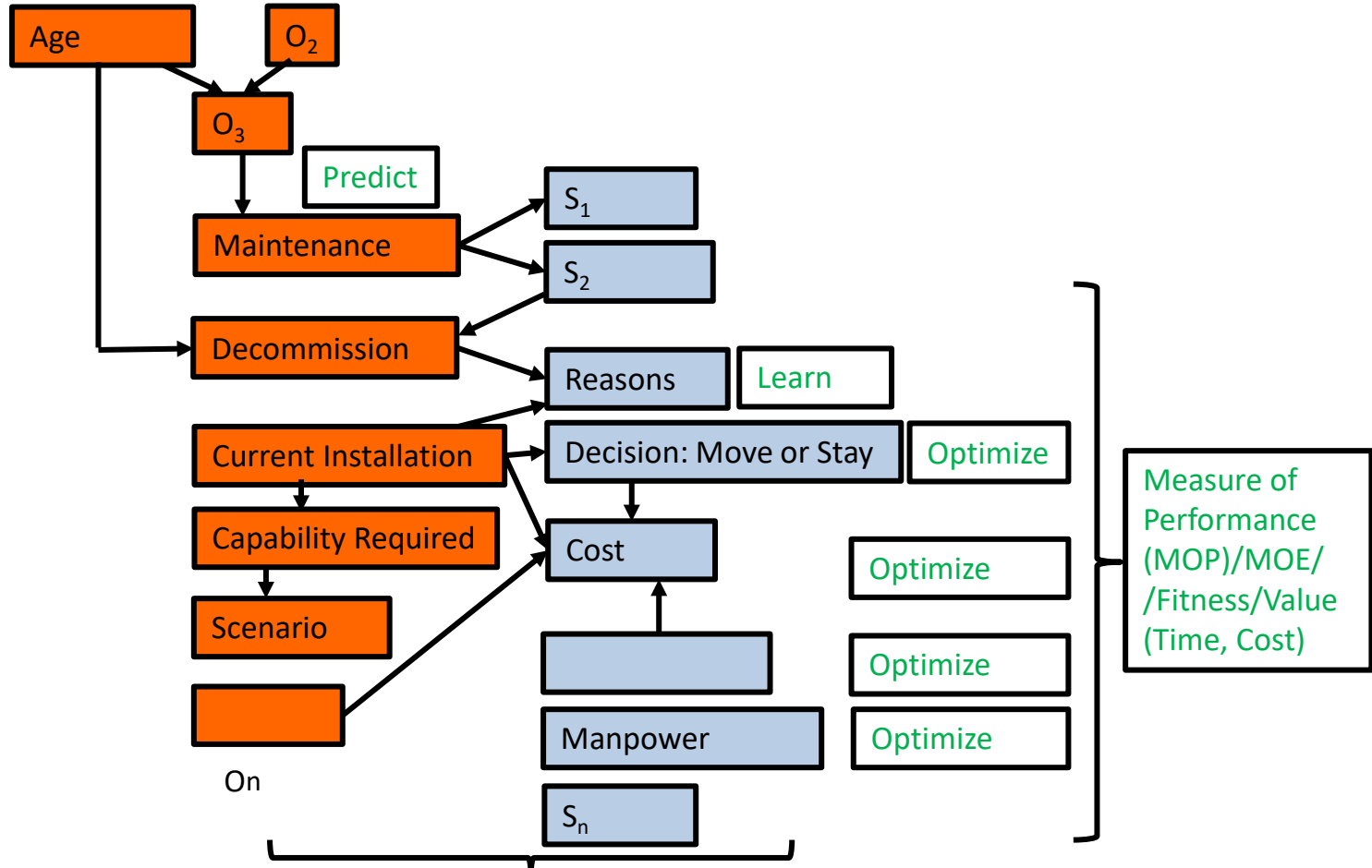




Use Case - Force Strategic Laydown and Dispersal (SLD): Standardize and digitize the current SLD decision making process, make an electronic SLD model, and reduce manual workload for the current method

Attacker/Opponent/State/Problem/Test

Defender/Self-player/Control/Decision/Action/Solution



Coevolutionary Wargame (or What-if Simulation) between Attacker and Defender



Mock Data: Can LAILOW Improve Decisions to Reduce Cost?

Variables marked with (O):
Opponent - Attacker

Variables marked with (S):
Self-player - Defender

DecisionCostLow=1 if (billets + DistanceCost)<1492

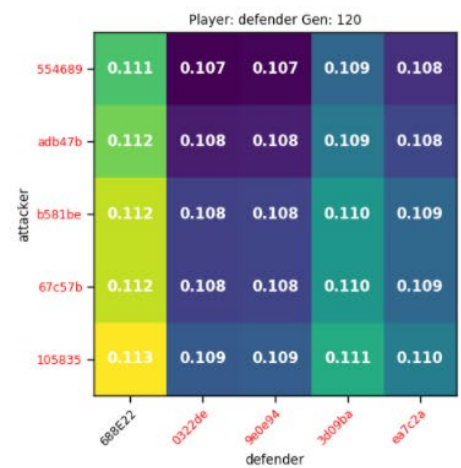
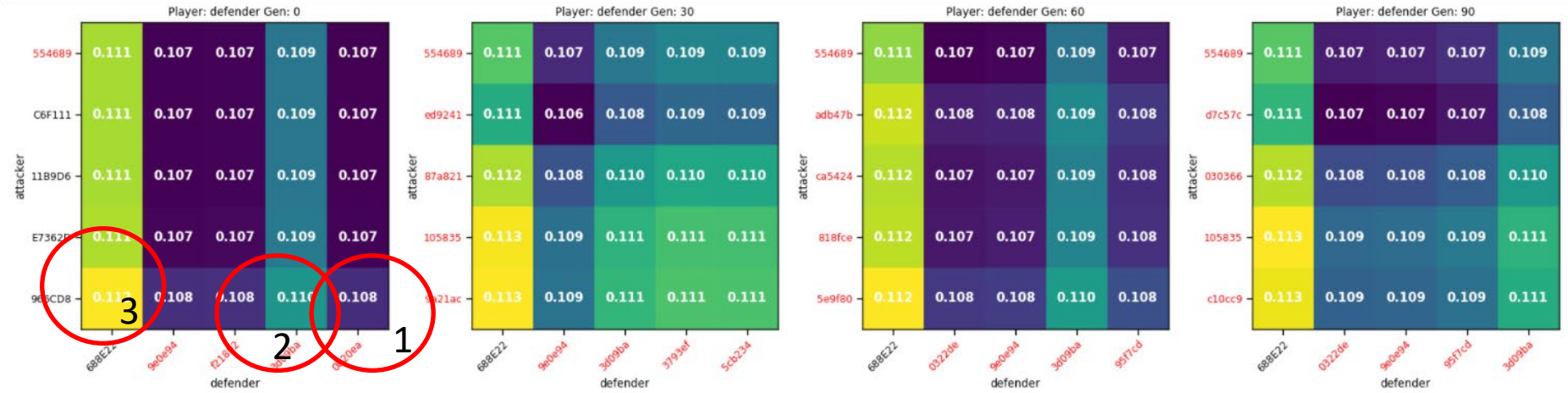
Name_I	(O)Hull	(O)CurrentInstallationGeolocation	(O)Reason	(S)Decision	(S)NextInstallationGeolocation	(O)Billets_I	(O)DistanceCost	(O)Age_N	TotalCost_I	DecisionCostLow
Newfane	AS-17	YokosukaJA	OCONUM_PACOM	STAY	n/a	149	0	5	149	1
Nyack	AS-18	MaineUS	COMM	MOVE	SigonellaIT	338	7000	1	7338	0
Nanny	AS-19	SaseboJA	OCONUS_PACOM	STAY	n/a	420	0	5	420	1
Goldspur	AS-27	YokosukaJA	MAINT	MOVE	HawaiiUS	149	1000	11	1149	1
Hampus	AS-28	MaineUS	COMM	MOVE	GuamUS	338	7000	1	7338	0
Godfrey	AS-29	SaseboJA	DECOMM	MOVE	NorfolkUS	420	7000	30	7420	0
Acheson	AS-37	YokosukaJA	DECOMM	MOVE	NorfolkUS	149	7000	30	7149	0
Admiral	AS-38	MaineUS	COMM	MOVE	BahrainBH	338	0	1	338	1
Abram	AS-39	SaseboJA	DECOMM	MOVE	NorfolkUS	420	7000	30	7420	0
Sharp	AS-47	YokosukaJA	OCONUM_PACOM	STAY	n/a	149	0	5	149	1
Shockley	AS-48	MaineUS	COMM	MOVE	GuamUS	338	7000	1	7338	0
Secor	AS-49	SaseboJA	OCONUS_PACOM	STAY	n/a	420	0	5	420	1
Tetofski	AS-57	YokosukaJA	OCONUM_PACOM	STAY	n/a	149	0	10	149	1
Thompson	AS-58	MaineUS	BUILDING	STAY	n/a	338	0	0	338	1
Telstar	AS-59	SaseboJA	OCONUS_PACOM	STAY	n/a	420	0	10	420	1
Water	AS-67	YokosukaJA	OCONUM_PACOM	STAY	n/a	149	0	15	149	1
Webster	AS-68	MaineUS	BUILDING	STAY	n/a	338	0	0	338	1
Victory	AS-69	SaseboJA	OCONUS_PACOM	STAY	n/a	420	0	15	420	1
Fuji	DDG-112	SaseboJA	OCONUS_PACOMScenario	MOVE	YokosukaJA	490	1000	11	1490	1
Jonathan	DDG-113	GuamUS	OCONUS_PACOMScenario	MOVE	BarkingSandsUS	491	7000	11	7491	0
Lodi	DDG-114	YokosukaJA	OCONUM_PACOMScenario	MOVE	SaseboJA	492	1000	11	1492	1
Hokuto	DDG-115	GuantanamoBayCU	OCONUS_EUCOMScenario	MOVE	SoudaBayGR	493	7000	11	7493	0
Cameo	DDG-116	NorfolkUS	COMM	MOVE	SigonellaIT	494	7000	1	7494	0
Baldwin	DDG-117	BahrainBH	OCONUS_AFRICOMScenario	MOVE	GuantanamoBay	495	7000	11	7495	0
Suncrisp	DDG-119	KanedaAB	OCONUS_PACOMScenario	MOVE	YokosukaJA	490	1000	11	1490	1
Ultra Gold	DDG-120	GuamUS	OCONUS_PACOMScenario	MOVE	ChinhaeKR	491	1000	11	1491	1
Wild Chrisp	DDG-121	YokosukaJA	OCONUM_PACOMScenario	MOVE	RotaES	492	7000	11	7492	0
Rome	DDG-122	GuantanamoBayCU	OCONUS_PACOMScenario	MOVE	KanedaAB	493	7000	11	7493	0
Yorky	DDG-123	ChinhaeKR	OCONUS_EUCOMScenario	MOVE	SigonellaIT	494	7000	11	7494	0
Earlilver	DDG-124	RotaES	OCONUS_AFRICOMScenario	MOVE	GuantanamoBay	495	7000	11	7495	0
Adzamovka	DDG-19	BahrainBH	OCONUS_AFRICOMScenario	MOVE	GuantanamoBay	495	0	5	1080	0



Results and Drill-Down

Results

Machine Learning Coevolutionary Wargame: Attacker Coevolutionary Wargame: Defender Coevolutionary Wargame Optimization: Heatmaps and Drill-Down



Sequence	Variable	Variable Name	Mean	Soar-RL_1_1	Soar-RL_0_1	Soar-RL_1_0	Soar-RL_0_0	Defender's Reward
0	F0	(O)Age_bt_02_08	0.467889908	0.000605917	0.000137289	-1.90E-06	1.27E-06	1
9	F9	(O)CurrentInstallationGeolocation_KanedAAB	0.009174312	1.20E-05	0.000731227	0	-6.33E-07	0.108
41	F41	(O)Hull_DDG-119	0.009174312	1.20E-05	0.000731227	0	-6.33E-07	0
128	F128	(O)Reason_OCONUM_PACOMScenario	0.018348624	-1.36E-06	0.000744571	0	-6.33E-07	0
138	F138	(S)Decision_MOVE	0.256880734	-0.000195164	0.00093837	1.27E-06	-1.90E-06	0
155	F155	(S)NextInstallationGeolocation_YokosukaJA	0.018348624	2.40E-05	0.000719252	0	-6.33E-07	0
1	F1	(O)Age_bt_08_14	0.266055046	0.000143931	0.000599276	0	-6.33E-07	0

Sequence	Variable	Variable Name	Mean	Soar-RL_1_1	Soar-RL_0_1	Soar-RL_1_0	Soar-RL_0_0	Defender's Reward
2	F2	(O)Age_It_02	0.091743119	-5.75E-05	0.000800722	5.93E-11	-6.33E-07	2
10	F10	(O)CurrentInstallationGeolocation_MaineUS	0.055045872	-4.09E-06	0.000747293	5.93E-11	-6.33E-07	0
41	F41	(O)Hull_DDG-119	0.009174312	1.20E-05	0.000731227	0	-6.33E-07	0
123	F123	(O)Reason_COMM	0.073394495	-8.14E-05	0.000824637	5.93E-11	-6.33E-07	0
128	F128	(O)Reason_OCONUM_PACOMScenario	0.018348624	-1.36E-06	0.000744571	0	-6.33E-07	0
138	F138	(S)Decision_MOVE	0.256880734	-0.000195164	0.00093837	1.27E-06	-1.90E-06	0.110
142	F142	(S)NextInstallationGeolocation_ChinhaeKR	0.027522936	1.05E-05	0.000732682	0	-6.33E-07	0

Sequence	Variable	Variable Name	Mean	Soar-RL_1_1	Soar-RL_0_1	Soar-RL_1_0	Soar-RL_0_0	Defender's Reward
0	F0	(O)Age_bt_02_08	0.467889908	0.000605917	0.000137289	-1.90E-06	1.27E-06	1
6	F6	(O)CurrentInstallationGeolocation_GuamUS	0.073394495	7.00E-05	0.000673199	0	-6.33E-07	0.113
41	F41	(O)Hull_DDG-119	0.009174312	1.20E-05	0.000731227	0	-6.33E-07	0
128	F128	(O)Reason_OCONUM_PACOMScenario	0.018348624	-1.36E-06	0.000744571	0	-6.33E-07	0
138	F138	(S)Decision_MOVE	0.256880734	-0.000195164	0.00093837	1.27E-06	-1.90E-06	0
142	F142	(S)NextInstallationGeolocation_ChinhaeKR	0.027522936	1.05E-05	0.000732682	0	-6.33E-07	0

1 is original decision, yet 2, 3 may be better than 1



Conclusions, Recommendation, and Disclaimer

- Conclusions
 - Demonstrated LAILOW using a mock data set towards the objectives (2022)
 - Validating using SIPR level real data (2023)
 - Use Recursion data and models related to Fg and Fd
 - Model Cost
 - Model Risk
- Recommendation
 - Proposing a minimum viable product (MVP): Integrate to a cloud database, deep analytics, and web-site sharing and display (2024)
- Disclaimer: The views presented are those of the authors and do not necessarily represent the views of the U.S. Government, Department of Defense (DoD), or their Components