Limiting Risk In Manifests for U.S. Army Airborne Operations:
An Optimization Framework for Risk-Aware Personnel Load Planning

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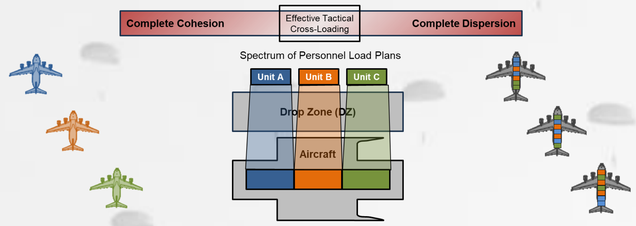
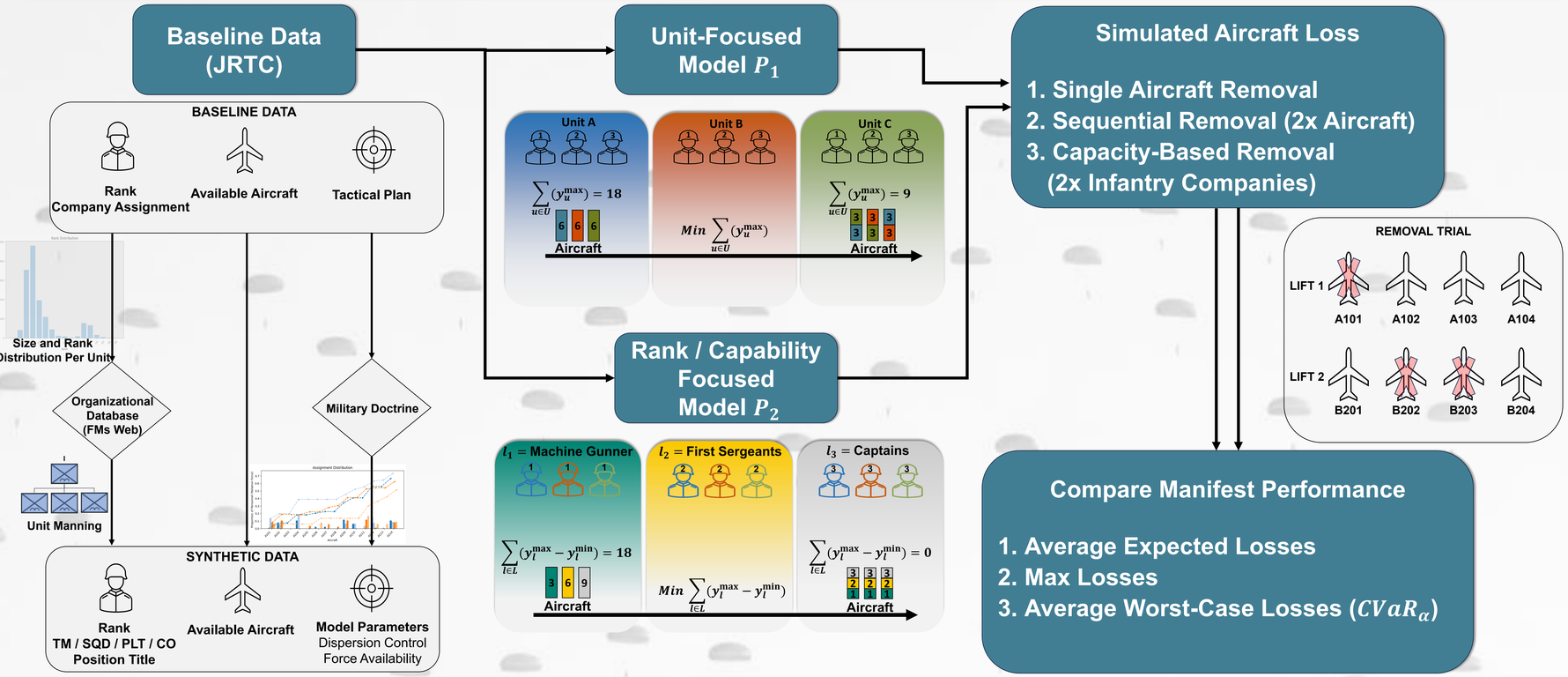
Background

- **Airborne Operations contain inherent risk.**
  - Enemy exploitation on route to the drop zone
  - Environmental factors can impact the precision of delivery
  - Aircraft may experience mechanical failure
- **Risk Trade-offs:** ***Delivery is not guaranteed;*** dispersion must not disrupt the planned operational timeline.
- **Quantifiable Importance:** Soldier importance is quantified using rank, equipment, and leadership factors.

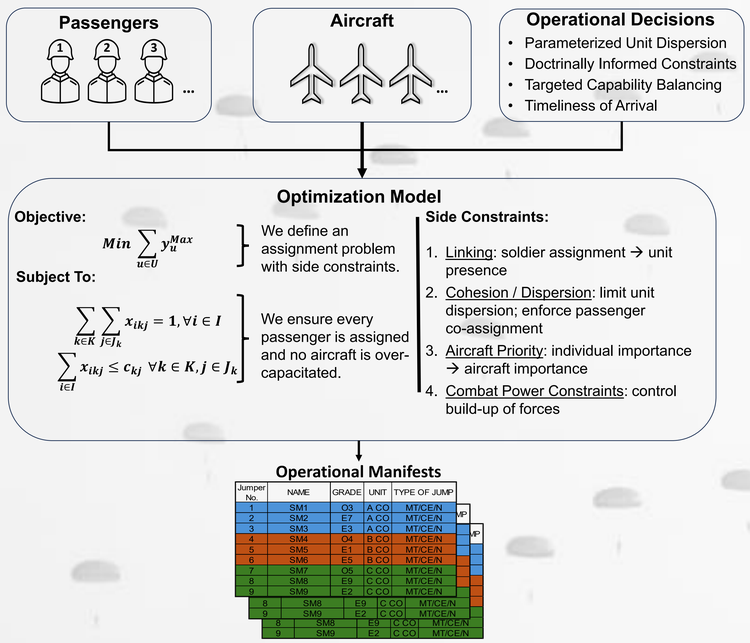


- **Manifests are currently generated *manually*.**
  - Time-intensive; lacks quality control and dispersion capability

Experiment Methodology



Framework

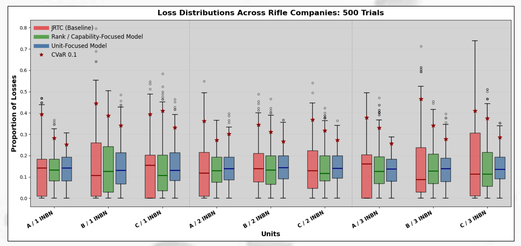


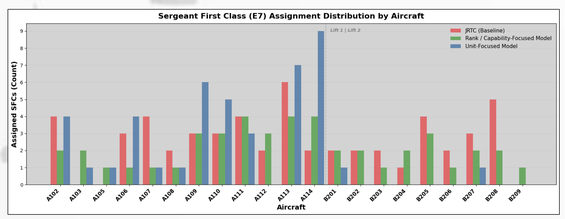
Jumper No.	NAME	GRADE	UNIT	TYPE OF JUMP
1	SM1	O3	A CO	MT/CE/N
2	SM2	E7	A CO	MT/CE/N
3	SM3	E3	A CO	MT/CE/N
4	SM4	O4	B CO	MT/CE/N
5	SM5	E1	B CO	MT/CE/N
6	SM6	E5	B CO	MT/CE/N
7	SM7	O5	C CO	MT/CE/N
8	SM8	E9	C CO	MT/CE/N
9	SM9	E2	C CO	MT/CE/N
8	SM8	E9	C CO	MT/CE/N
9	SM9	E2	C CO	MT/CE/N
8	SM8	E9	C CO	MT/CE/N
9	SM9	E2	C CO	MT/CE/N

Results

	Baseline (JRTC)				Rank/Capability-Focused				Unit-Focused			
Unit	AC	Max	L1	L2	AC	Max	L1	L2	AC	Max	L1	L2
A / 1 INBN	9	0.296	0.990	0.010	12	0.184	1.000	0.000	12	0.133	1.000	0.000
B / 1 INBN	9	0.262	0.029	0.971	10	0.204	0.010	0.990	12	0.146	0.068	0.932
C / 1 INBN	8	0.202	0.012	0.988	12	0.298	0.107	0.893	12	0.131	0.095	0.905
HHC / 1 INBN	14	0.321	0.857	0.143	12	0.190	0.857	0.143	12	0.167	0.857	0.143

AC = Aircraft Used, Max = Max Assignment Proportion, L1 = Cumulative Lift 1, L2 = Cumulative Lift 2





Modeled Units are more dispersed than baseline.
- This often coincides with a decrease in Max losses.

Unit-Focused Model Decreases Average worst-case loss in most cases
- This decrease can increase average expected losses, indicating a more equitable loss distribution.

Across-unit dispersion is essential.
- Rank / Capability-Focused Model effectively controls this issue.

Conclusions

This framework gives practitioners total control over manifest generation, improving current methods in the following manner:

- Reduced production time: ***1-2 days → ~ 1 hour.***
- Guaranteed doctrinal adherence with tunable adjustments.
- Provides objective metrics for comparison and evaluation
- Enables effective, tailorable capability dispersion