

## Expanded Kill Chain Analysis of Manned Unmanned Teaming for Future Strike Operations

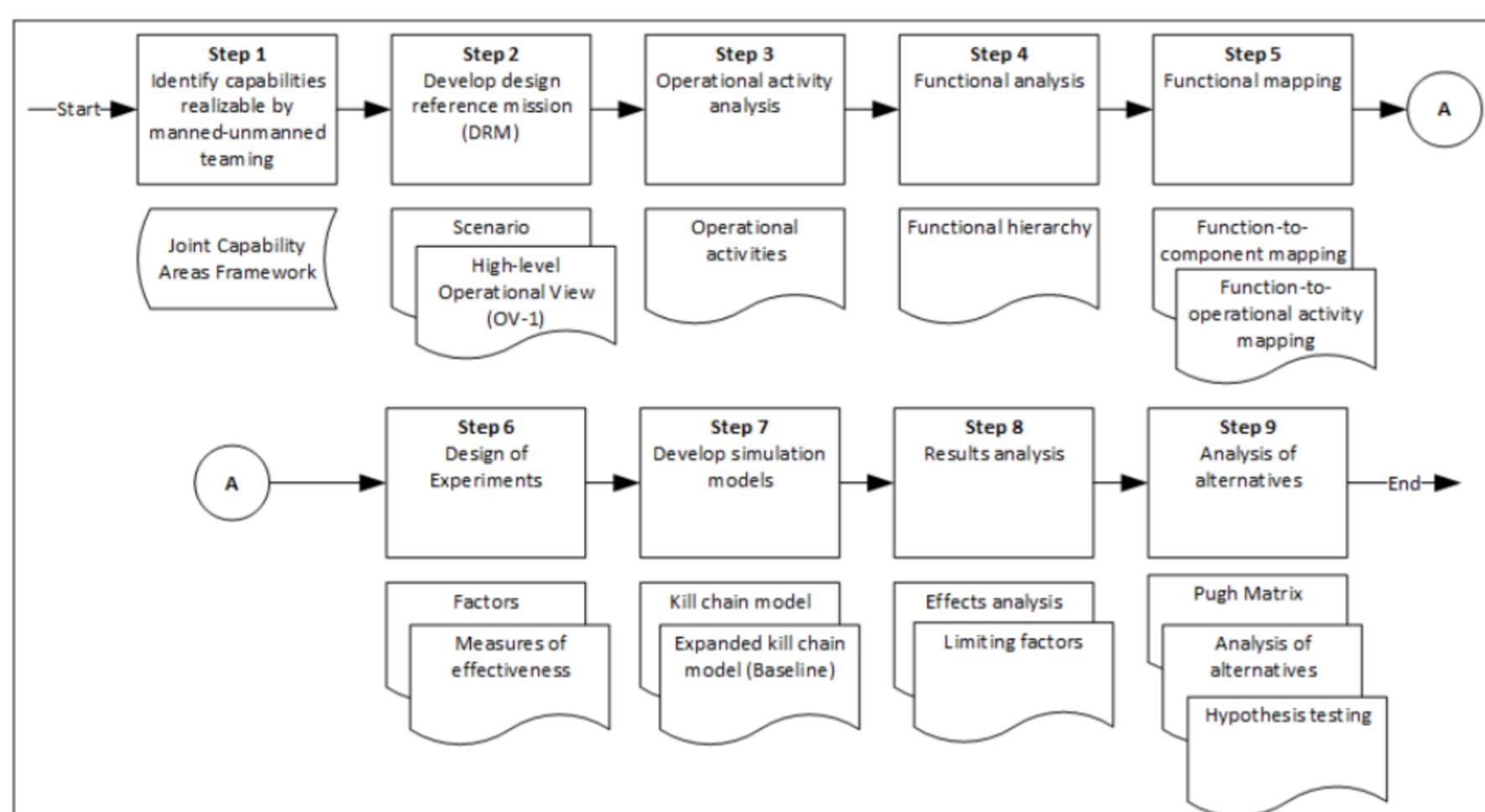
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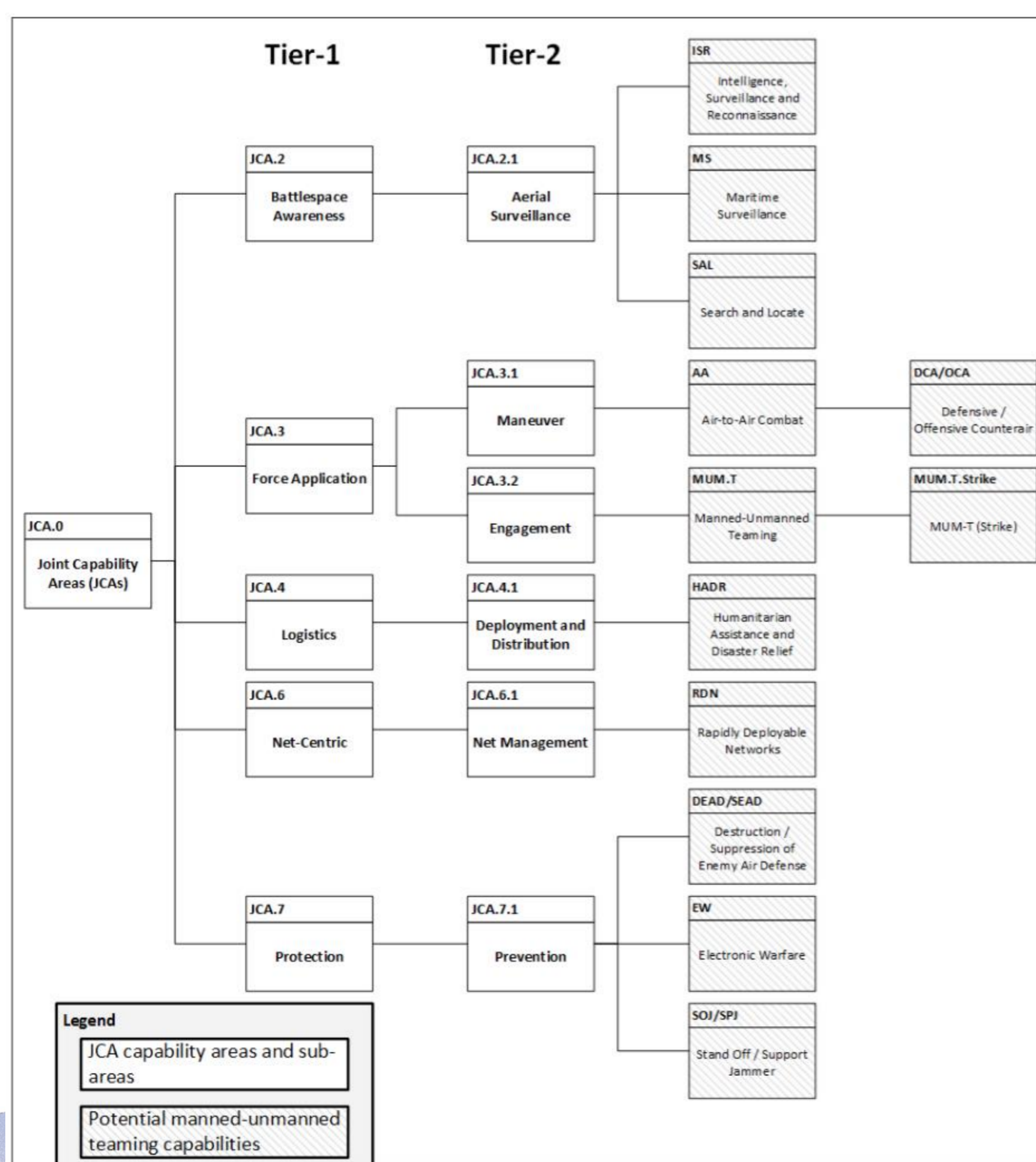
### ABSTRACT

This study explores the concept of manned-unmanned teaming in the context of the joint capability areas (JCA) and investigates the expanded kill chain for a manned and unmanned team for future strike operations. The study first elucidated capabilities that can be realized by manned-unmanned teams. A design reference mission for a manned-unmanned team (strike) operation was developed, enabling operational activity and functional analysis of the expanded kill chain. Simulation models were built to examine the time-efficiencies of the manned-unmanned teaming concept. This research used insights from the results of the models to explore alternatives in asset generation and systems link-up tactics. The analysis of strike operations cycle times that include total mission operations time, airborne time, and time to complete systems link-up provided data to generate recommendations. Besides identifying areas on which to focus efficiency improvement efforts, this study also proposes tactics and concept of operations to enhance the effectiveness of strike operations by manned-unmanned teams. This study reveals that fighter endurance is a limiting factor in manned-unmanned operations and proposes a synchronized launch or pre-launch establishment of communications and datalink as possible ways to mitigate these limiting factors.

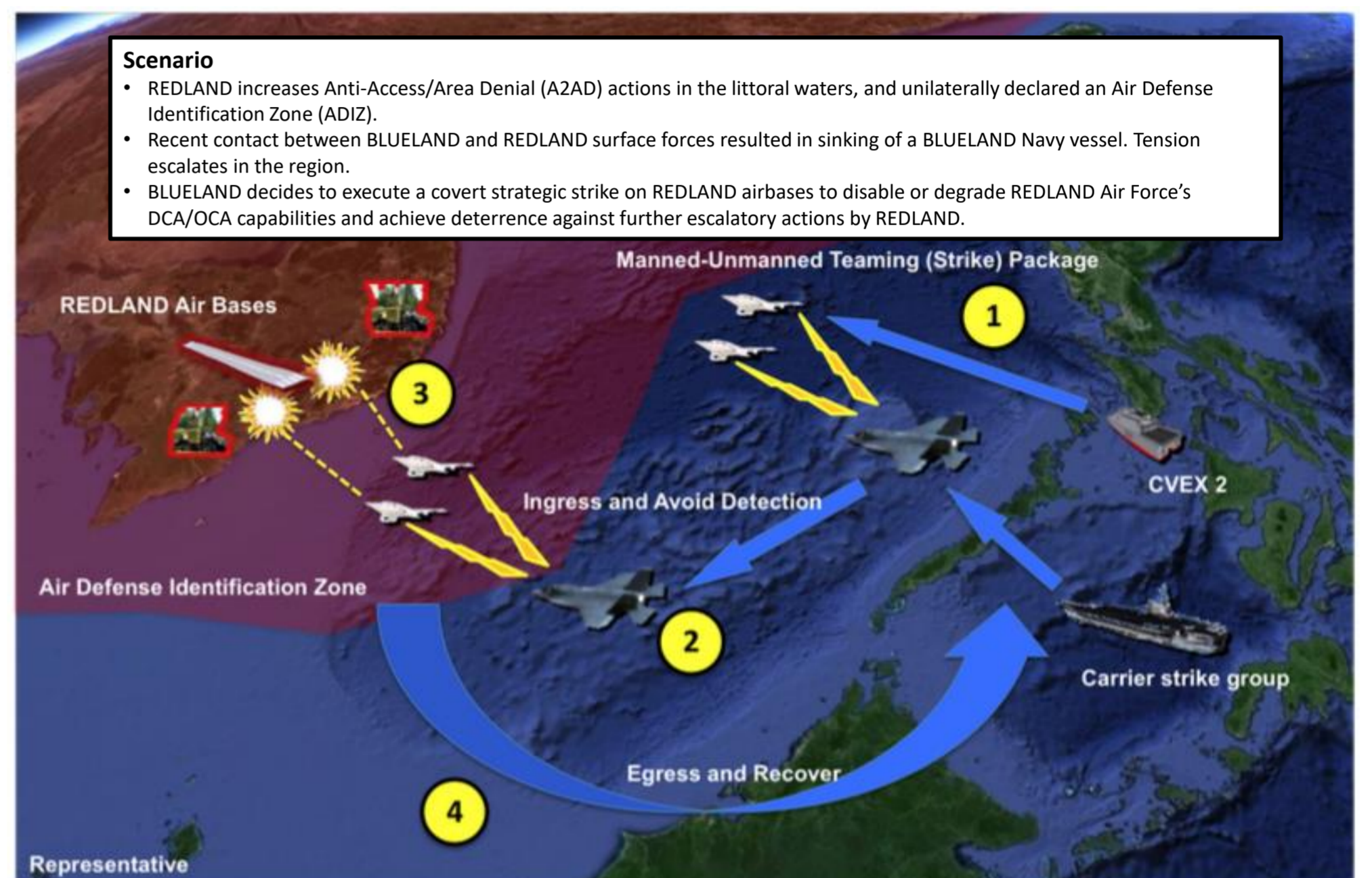
### APPROACH



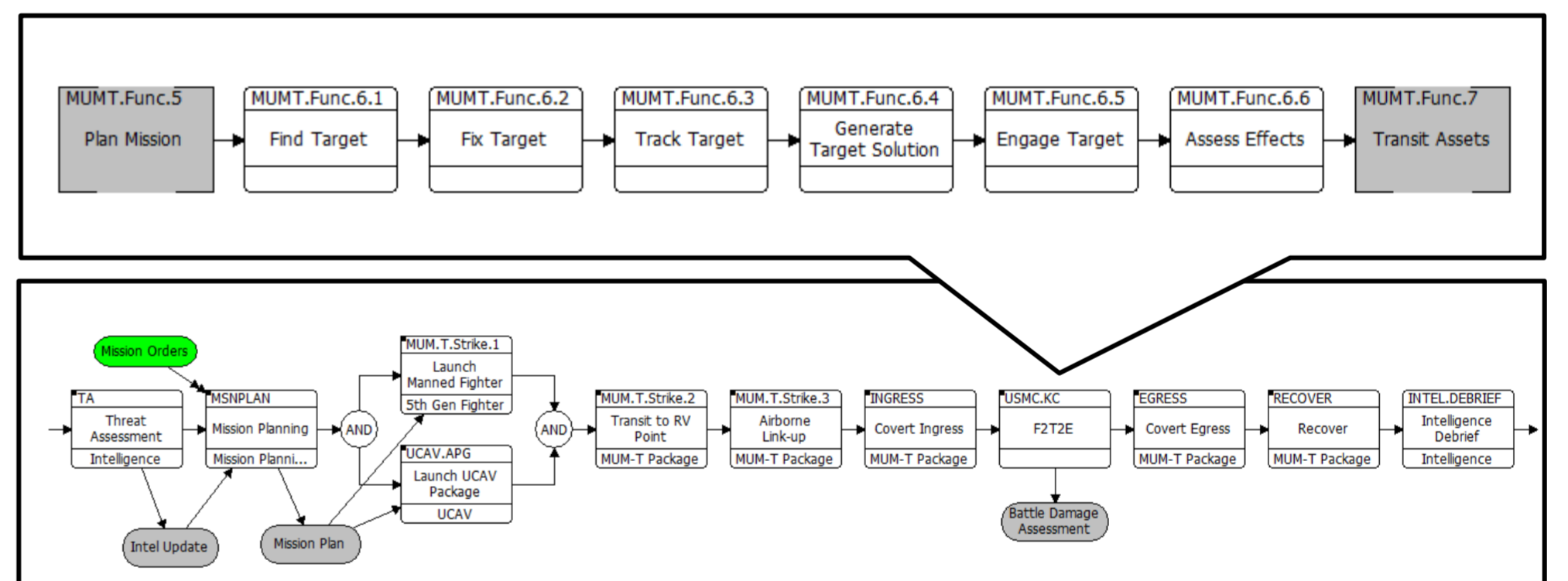
### MAPPING OF POTENTIAL MANNED-UNMANNED TEAMING TO JCA FRAMEWORK



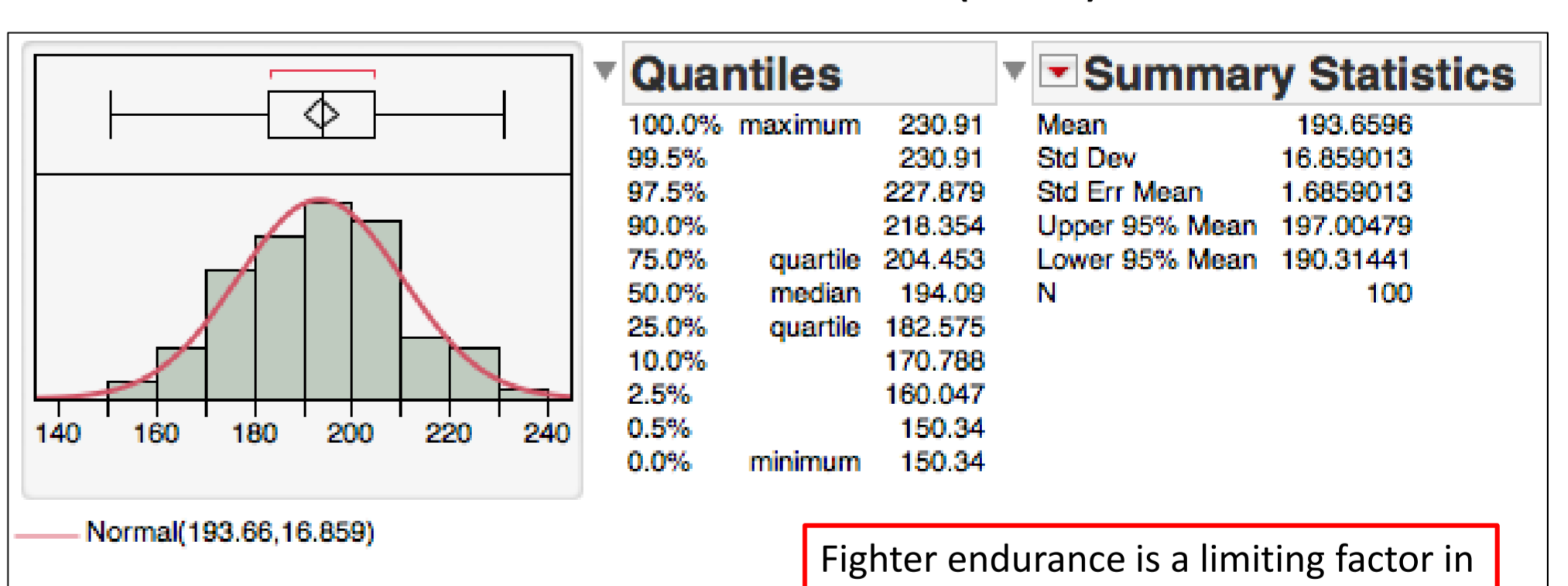
### DESIGN REFERENCE MISSION



### KILL CHAIN OPERATIONAL ACTIVITIES



### LIMITING FACTOR IN MANNED-UNMANNED TEAMING (STRIKE) OPERATIONS



Fighter endurance is a limiting factor in Manned-unmanned operations.

### ANALYSIS OF ALTERNATIVES

Three alternative CONOPs were developed and studied:

1. Aerial refueling tanker support
2. Synchronized launch of manned and unmanned assets
3. Pre-launch communications link-up between manned and unmanned assets

### INSIGHTS AND CONCLUSIONS

Using a system engineering approach and tools, this study elucidates possible capabilities from the JCA framework that potentially can be performed or realized by the teaming of manned and unmanned aircraft. However, the disproportionate endurance between the fighters and the UCAVs presents a challenge in such teaming operations.

The results from the expanded kill chain model suggest that the limiting factor in a MUM-T (Strike) lies in the airborne formation of the MUM-T (Strike) package. From the simulation, a significant amount of time is spent by either the fighter or the UCAV holding at the RV point. This is due to the lack of synchronization in the arrival of the assets at the RV point such that efficacy can be achieved in the airborne link up.

Of the three alternative CONOPs developed, a pre-launch communications link-up offered the most effective way to mitigate the fighter endurance limiting factor.

Reference