

Survivability Design of Ground Systems for Area Defense Operation in an Urban Scenario

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Objective of Thesis

The shift in conventional warfare to urban operations changes the determinants of an operationally-effective ground system design. This thesis applies a systems engineering approach with the following aim:

- Determine significant ground system design factors that impact the mission objectives of an urban area defense operation
- Investigate the relative contribution of passive and active protection, mobility, and sensor classification range on ground system's survivability

Research Methodology

The systems engineering waterfall model is modified for application to this thesis.

Measures of Effectiveness (MOEs)

- Success Rate
- Blue Force Attrition
- Loss Exchanger Ratio (LER)

Model Development

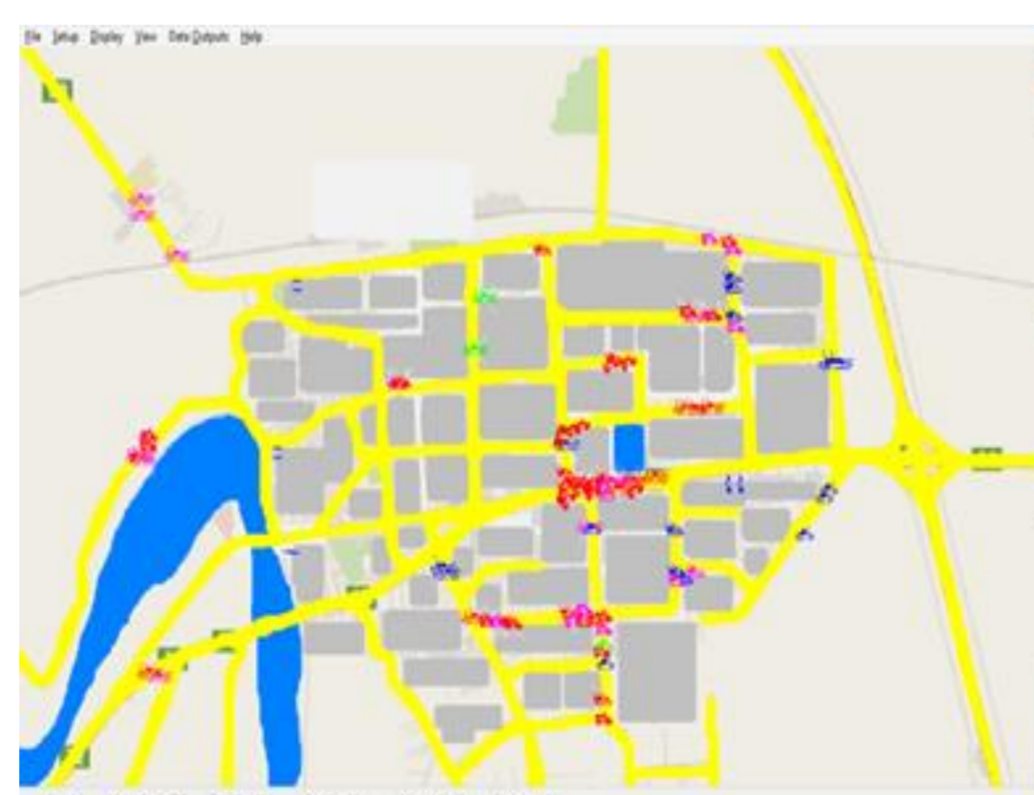
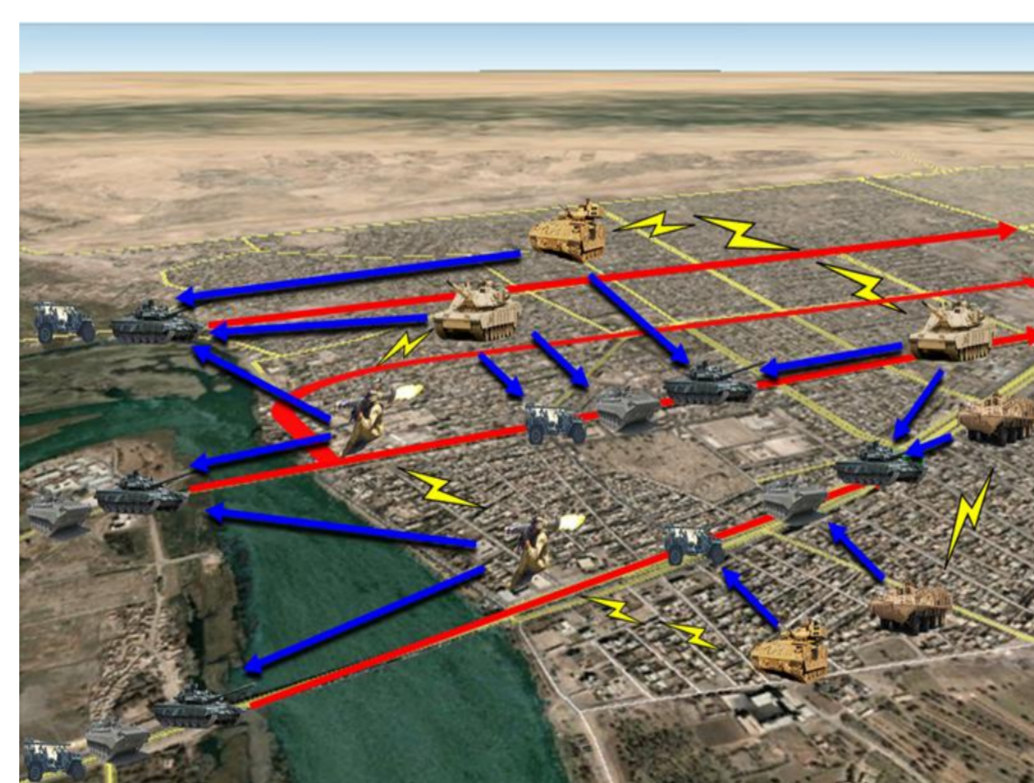
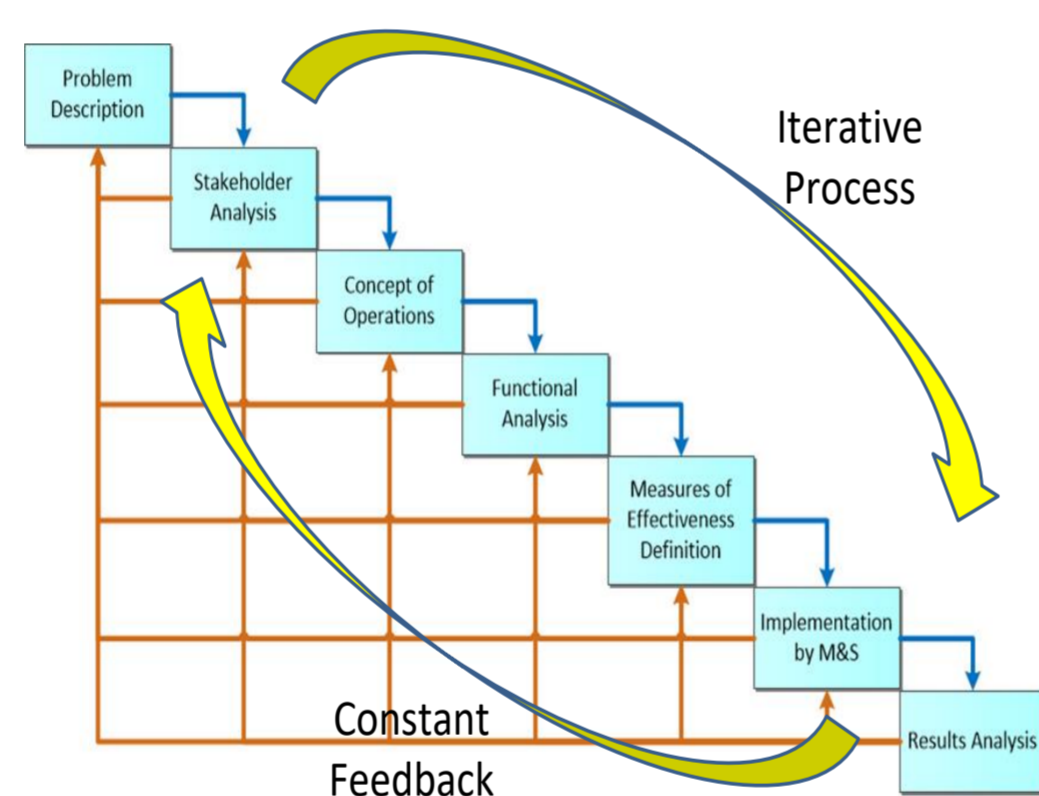
- Use of Map Aware Non-uniform Automata (MANA) for area defence urban operation model

Factors for Consideration

- Passive Armor
- Speed
- Sensor Classification Range
- Active Protection System (APS) equipping

Design of Experiment and Simulation

- Use of Nearly Orthogonal Latin Hypercube (NOLH) to sample design space
- 65 design points with 50 replications each, totaling 3,250 simulation runs



Research Results

Analysis Parameter	Success Rate	Blue Force Attrition	Loss Exchange Ratio (LER)
Significant design factor	Main Battle Tank armor APS equipping		
Critical armor value	1,000mm	1,075mm	1,075mm
Mean	74.70%	16.32	3.97
Effects of APS equipping	Greatly complements low armor configuration Viable substitute for passive armor	Reduces Blue Force attrition between 20% to 60%	Greatly increases LER with high armor configuration

Benefits and Potential Applications of Research

While the thesis uses hypothetical values for the variables used in the model, this research is useful in the following areas:

- Investigation of relative effects between passive armour, active protection system, mobility, and sensor classification range on the objectives of an area defence operation
- Use of actual design values of engineering parameters provide insights to the formulation of survivability requirements for ground systems design

Recommendation for Future Work

The following areas is recommended for future work to expand on current thesis work:

- Expansion of scope to other defence missions (e.g. Mobile defence and Retrograde operations)
- Investigate Lethality and Concealment improvement technologies as a factor of consideration
- Investigate the effects of tactics and task force allocation variation on an area defence operation