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TRAINING ENTERPRISE DIGITAL TWIN: OPTIMIZING DEFENSE CONTRACTOR TRAINING OPERATIONS THROUGH SIMULATION

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ABSTRACT

This paper examines Lockheed Martin's implementation of a Training Enterprise Digital Twin system that revolutionizes military training operations management. Using Simio, Lockheed Martin developed a digital model to optimize resources, forecast performance, and support decisions. The simulation framework incorporates student progression through training pipelines alongside asset availability and maintenance requirements. Results show improved training efficiency, resource utilization, and cost avoidance through optimized asset procurement. This case study illustrates how simulation technology enables defense contractors to meet performance-based contract requirements while maximizing return on investment in training operations.

1 INTRODUCTION AND PROBLEM STATEMENT

Defense contractor training operations face unique challenges in delivering performance-based services. Lockheed Martin's turnkey approach produces graduates while optimizing resources. This creates several critical challenges:

- Performance-Based Requirements: Payment is contingent on producing graduates meeting specifications, creating significant financial risk
- Resource Optimization: Training facilities include high-value assets (aircraft, simulators) with complex maintenance requirements and limited availability
- Forecasting Complexity: Predicting student progression through multiple training pipelines with variable attrition rates
- Weather Dependencies: External factors significantly impact training schedules, creating variability
- Limited Training Windows: Maximizing training time utilization amid competing constraints

Traditional planning failed to capture interdependencies, causing suboptimal resource allocation and efficiency. A more sophisticated approach was required to quantify and mitigate risks while providing decision support throughout the program lifecycle.

2 SIMULATION METHODOLOGY

Lockheed Martin implemented a comprehensive simulation framework using Simio to create a "Training Enterprise Digital Twin" with two interconnected modeling components:

- **Program Validation Model:** Simulates student progression through training pipelines
  - Incorporates course structures, lessons, and training events
  - Models student flows with variable attrition points

  - Accounts for instructor availability and qualifications
- **Sustainment and Logistics Model:** Simulates asset availability and maintenance
  - Models both planned and unplanned maintenance events
  - Captures maintenance dependencies and resource constraints
  - Forecasts asset availability based on usage patterns

The model uses data inputs like: (i) Training syllabi and pipeline structures; (ii) Attrition percentages at various checkpoints; (iii) Instructor and training device availability; (iv) Crew rest requirements and duty day limitations; (v) Weather impacts and seasonal variations; and (vi) Maintenance schedules and resource requirements.

Crucially, the implementation follows a closed-loop feedback system, where simulation outputs inform resource plans, plans are executed in operations, operational data is captured and fed back into the simulation, and models are continuously refined based on real-world performance.

This approach ensures the digital twin maintains fidelity with actual operations and enables continuous improvement through data-driven decision-making.

3 RESULTS

The following example demonstrates how a Training Enterprise Digital Twin can provide decision support for customers seeking operational improvements across multiple dimensions. A customer evaluating a syllabus change wants to see comparative analysis to evaluate operational impacts:

Table 1: Operational impacts.

Metric	*Basic Syllabus*	*Hybrid Syllabus*	*Improvement*
Average Training Time (with weather)	180 days	155 days	25 days faster
Training Time Consistency	High variability	Reduced variability	More predictable
Peak Student Load	75 students	60 students	20% reduction
Requirement Compliance	~60%	~90%	30% improvement

Beyond this specific example, the simulation framework provides: (i) Improved Stakeholder Communication: Clear forecasts of expected performance and resource requirements; (ii) Significant Cost Avoidance: Optimized asset procurement through accurate modeling of requirements; (iii) Realistic Operational Goals: Data-driven understanding of constraints and capabilities; and (iv) Enhanced Decision Support: Throughout the program lifecycle from solution development through steady-state operations.

The biggest impact is asset procurement optimization, showing fewer assets meet training needs, saving millions.

4 CONCLUSIONS

Lockheed Martin's Training Enterprise Digital Twin represents a significant advancement in simulation-based management of complex training operations. By creating a comprehensive digital replica of their training enterprise, they gained unprecedented visibility into operational dynamics and resource requirements. The implementation demonstrates how advanced simulation technologies enable defense contractors to: (i) Optimize resource allocation in complex, performance-based contract environments; (ii) Quantify and mitigate operational risks through scenario analysis; (iii) Support data-driven decision-making throughout the program lifecycle; and (iv) Deliver improved training outcomes at reduced cost.

Future developments include enhanced integration with scheduling systems, expanded what-if analysis capabilities, and application to additional training domains—providing a blueprint for how discrete event simulation can transform operational management in performance-based contract environments across the defense industry.