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Total Ownership with Lifecycle Cost Model Under Uncertainty

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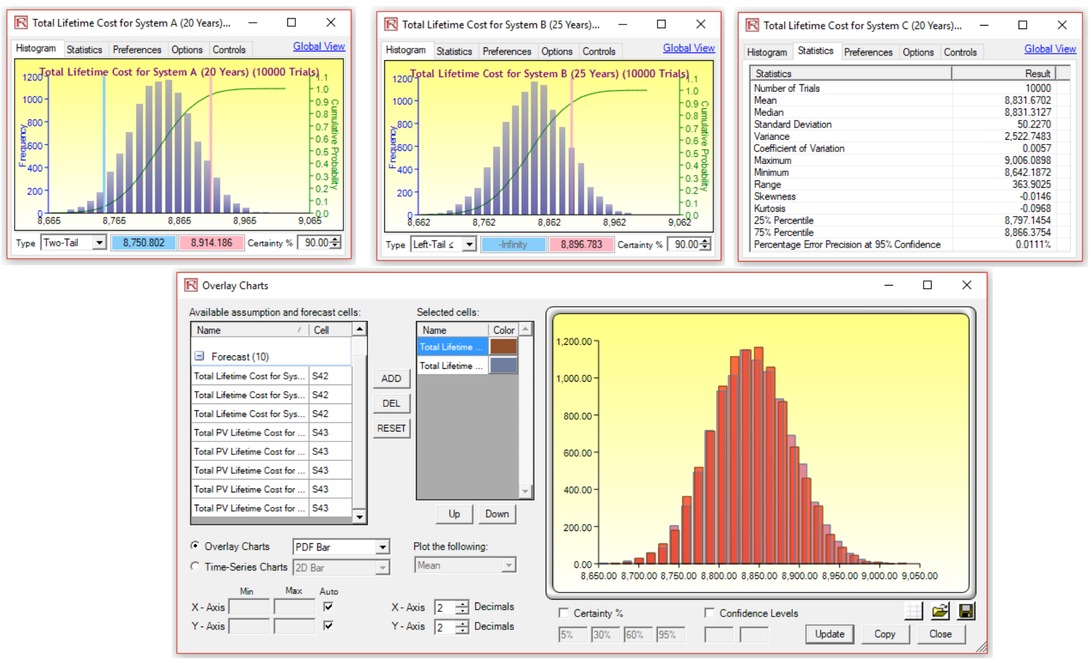
Background

- Modeling the lifecycle and total ownership cost (TOC) of Surface Electro-Optic Infrared (EO/IR) sensors for NAVSEA and DOD in general.
- Starts with the basics of TOC modeling over the life cycle of the EO/IR, including the inception phase of Acquisition Costs, followed by annual Operations and Maintenance (O&M) expenses, and a final set of Disposition Costs at the end of life of the sensor.
- Models and methodologies are extensible to include multiple sensors as a way to compare them under an analysis of alternatives paradigm.

Narrow-Medium Field of View (NFOV) Sensors	Supply Support	EO/IR Sensor Manager (ESM)	Manpower and Personnel
NF-DIR (NFOV Director)	Wholesale and Retail Supply Chain Management	Processing Equipment	Program Management Office Team
NF-TIS (Thermal Imaging Sensor) - TIS #1	Spares Worldwide Transportation	Processing Software	Manning and military occupational series training
NF-TIS (Thermal Imaging Sensor) - TIS #2	Spares Warehousing	Recording Equipment	Depot Activation
NF-EOS (Electro-Optic Sensor) - EOS #1	Consumable Spares Replenishment	Docking Station Equipment	Software Sustainment
NF-EOS (Electro-Optic Sensor) - EOS #2	Provisioning and Initial Spares Lay-in	Ancillary Material (video converters, encoders, switches, racks, cabling)	Initial Fielding Support
NF-EOS (Electro-Optic Sensor) - EOS #3	Obsolescence Mitigation (Cost should be escalated)		
NF-LRF (Laser Rangefinder)	Contracting Strategy	**Human Machine Interface (HMI)**	**Technical Data Management**
NF-LDR (Laser Designator/Rangefinder)	Decreasing Economies of Scale	HMI-B (HMI Bridge/Cockpit)	Depot Activation
NF-LDRFI (Laser Designator/Rangefinder/Illuminator)	Battle Damage	HMI-C (HMI Combat Information Center/Cabin)	Software Sustainment
NF-LP (Laser Pointer)	Initial Fielding Support	HMI-I (HMI Intel)	Manning and military occupational series training
NF-LOI (Laser Optical/Ocular Interrupter)	Prepositioned Stock	Ancillary Material (additional displays, control panel switches, cabling, mounts)	O-level publications and new equipment training
NF-LI (Laser Illuminator)			Sustainment Planning and Data Procurement
NF-IRU (Inertial Reference Unit)	**Maintenance Planning and Management**	**Product Support Management**	Contracting Strategy
NF-BSM (Boresight Module)	System Support Strategy	Program Management Office Team	Other: _____
NF-EU (Electronics Unit)	Title 10 Core 50/50	Sustainment Planning and Data Procurement	
Ancillary Material (cabling, mounting hardware, etc.)	Depot Activation	Depot Activation	**Nonrecurring Acquisition and End of Lifecycle Costs**
	Software Sustainment	Software Sustainment	**Acquisition and Procurement**
Wide Field of View (WFOV) Sensors	Depot Repair and Overhaul	Integrated Product Support Team	Bid Specifications Development
WF-DIR (Director)	Manning and military occupational series training	Provisioning and Initial Spares Lay-in	Proposal Evaluation
WF-TIS (Thermal Imaging Sensor)	O-level publications and new equipment training	Contracting Strategy	Data Collection
WF-EOS (Electro-Optic Sensor)	Sustainment Planning and Data Procurement	Full Scale Production	Data Analysis
WF-IRU (Inertial Reference Unit)	Provisioning and Initial Spares Lay-in		Contracts Development
WF-EU (Electronics Unit)	Demilitarization and Disposal	**Support Equipment**	Program Planning
Ancillary Material (cabling, mounting hardware, etc.)	Full Scale Production	Depot Activation	Hardware Purchases
	Decreasing Economies of Scale	Software Sustainment	*Personal Computers*
Design Interface	Initial Fielding Support	Special Tools & Equipment	*Peripherals*
Technology development (TRL2 to TRL4)	Obsolescence Mitigation (Cost should be escalated)	Ancillary Equipment	*Storage*
Materiel development and LRIP (TRL5 to TRL7)		Support Equipment Sustainment	*Networking*
Operational Test (TRL8)	**Training and Training Support**	Initial Fielding Support	*Related Equipment*
Combat system integration (software changes)	Depot Activation	Obsolescence Mitigation (Cost should be escalated)	Other costs
Reliability Growth Program	Software Sustainment		Administrative Cost
Technology Refresh (P3I, emerging threats, obsolescence…)	Manning and military occupational series training	**Packaging, Handling, Storage and Transportation**	Asset Management
Technology Roadmap	O-level publications and new equipment training	Transportability Requirements	Overseeing Contractor Services
Design for Maintainability	Sustainment Planning and Data Procurement	Transportation Limitations	In-House Training for Staff
Modularity	Transportability Requirements	Initial Fielding Support	Product Maintenance
Obsolescence Mitigation (Cost should be escalated)	Initial Fielding Support		Help Desk Support
		Nonrecurring End of Lifecycle Costs	IT Support for Database Management
Computer Resources	**Facilities and Infrastructure**	**End of Lifecycle**	Network Management Support
Manning and military occupational series training	Ship alteration for initial fielding	Administrative Cost	Software Upgrades
Depot Activation	Depot Activation	Asset Management	Hardware Upgrades
Software Sustainment	Software Sustainment	Vendor Contract Procurement	Internet and Network Access Cost
O-level publications and new equipment training		Staging, Sanitizing, Testing	Furniture and Equipment
Initial Fielding Support		Follow-Up Support	Energy Costs
		Recycling and Disposal Fees	Informal Training
		Value of Sold Products and Materials	Downtime Support and Outsource

Cost Elements Structure in Total Ownership Cost Model



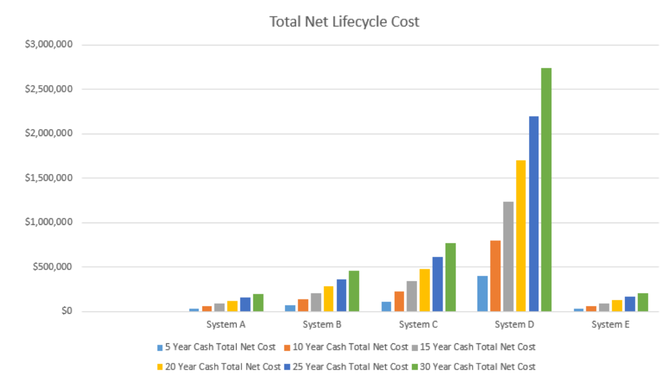
Risk-based Monte Carlo Simulation for Predictive Modeling

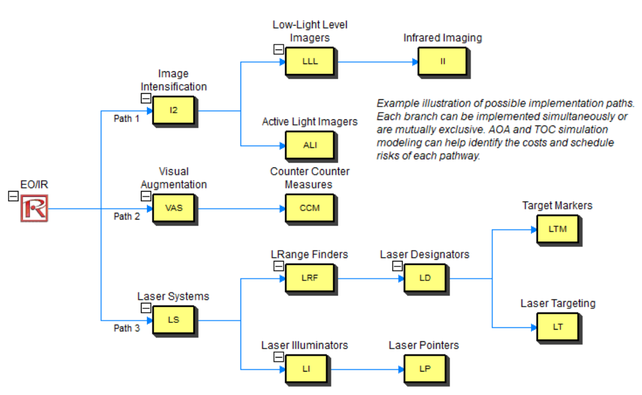
Methodology

- Lifecycle costs are modeled with predictive modeling and Monte Carlo risk simulation to determine the probabilistic outcomes of each cost element.
- Multiple EO/IR capabilities are compared side by side, with cost and risk elements directly comparable in present values.
- Analysis of alternatives can be easily implemented using the same cost modeling techniques for cross comparisons of multiple programs simultaneously.

DOD Applications

- The current research can act as a proof of concept for lifecycle cost and TOC simulation and modeling for other DOD programs.
- Results from said models will assist in making strategic investment and acquisition decisions and provide an objective set of comparisons across multiple programs within an analysis of alternatives paradigm.
- Various implementation paths can be modeled for each program or multiple dependent programs can be nested and linked to each other, and the optimal implementation paths based on cost and schedule risks can be determined.





Analysis of Alternatives

Conclusion and Recommendations for Future Work

- Obtaining the correct cost projections over the lifecycle of an EO/IR program is critical to making the correct strategic decisions in terms of portfolio program selection subject to a set allocation of cost.
- The recommended next step is to collect real-life data to implement the proposed methodology, and to create a modeling standard for analysis of alternatives of multiple EO/IR sensors and beyond.

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