Optimizing Systems Architecture and Whole of Life Costs through Design Profit®

NDIA Systems Engineering Conference
ERS Track

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Munro & Associates Inc.

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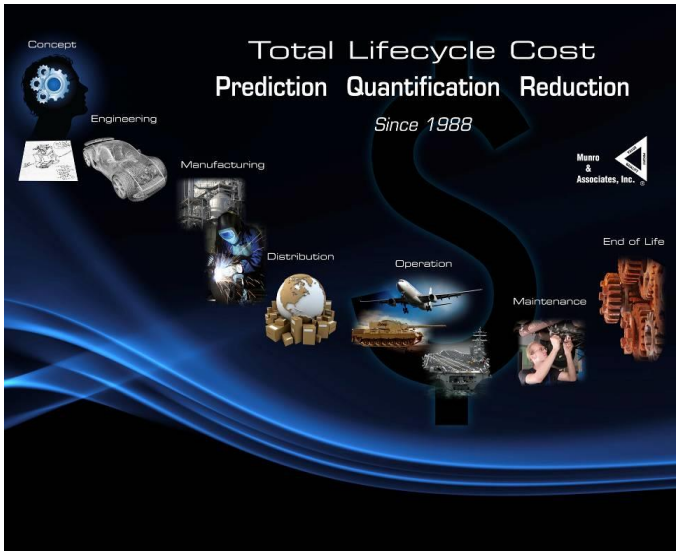
VALUE
PROFIT
QUALITY
MUNRO
& ASSOCIATES, INC.
Introduction
Design Profit® / ERS Correlation
Design Profit® Live Demonstration
Design Profit® Future Enhancements
Q&A

Since 1988, Munro has been a leader in delivering solutions to hundreds of customers around the world, helping them to achieve higher product quality with lower cost, resulting in better product value and higher company profits.

Munro understands the effects that design and other variables have on total life costs and has developed a unique suite of tools for managing cost and product complexity.



- **DFM / DFX, VE, VSM**
- **Lean Design® (reduce complexity)**
- **DP Cost of Quality™ (ensure robustness by design)**
- **Workshops**
  - **Bringing people together – rapid results**
- **Benchmarking and Teardown (technology infusion)**
- **The Wall Process® (stakeholder collaboration)**
- **Design for Manufacturing®**
- **Cost Estimating**
- **MRL Software, Training, and Assessments (risk & readiness)**

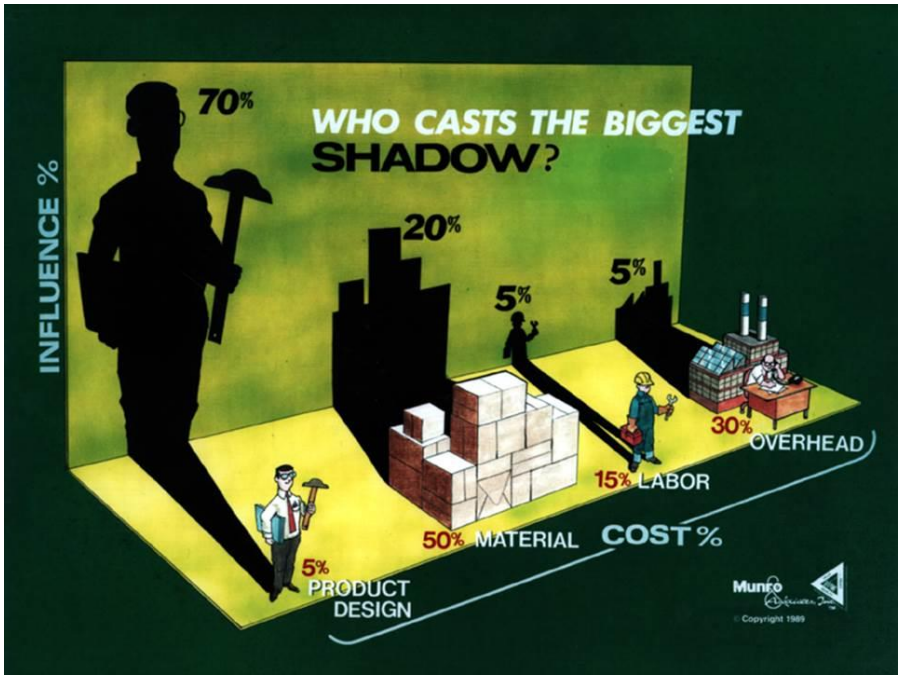
Design Profit® integrates these methodologies in a single integrated platform that provides a powerful collaborative AoA tradespace.

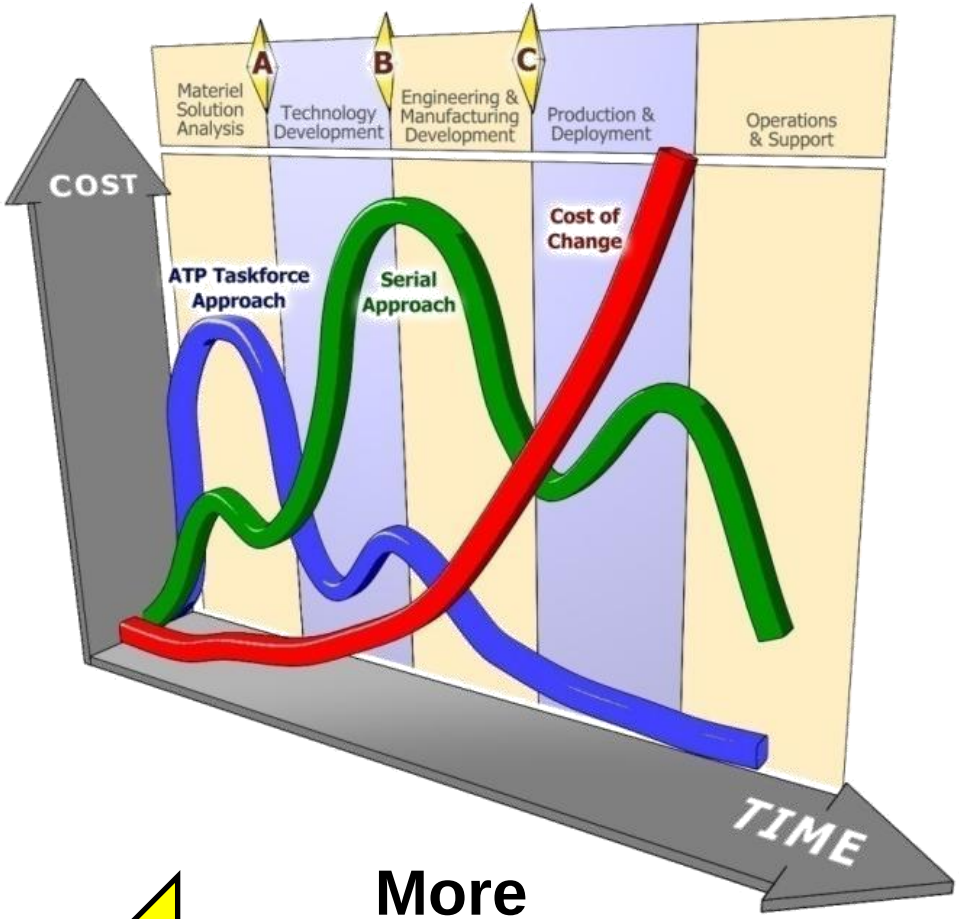
ERS
Engineered Resilient Systems

Integrated Lifecycle Engineering

5000.02 Approach

The majority of life cycle costs are fixed early in the concept stage.



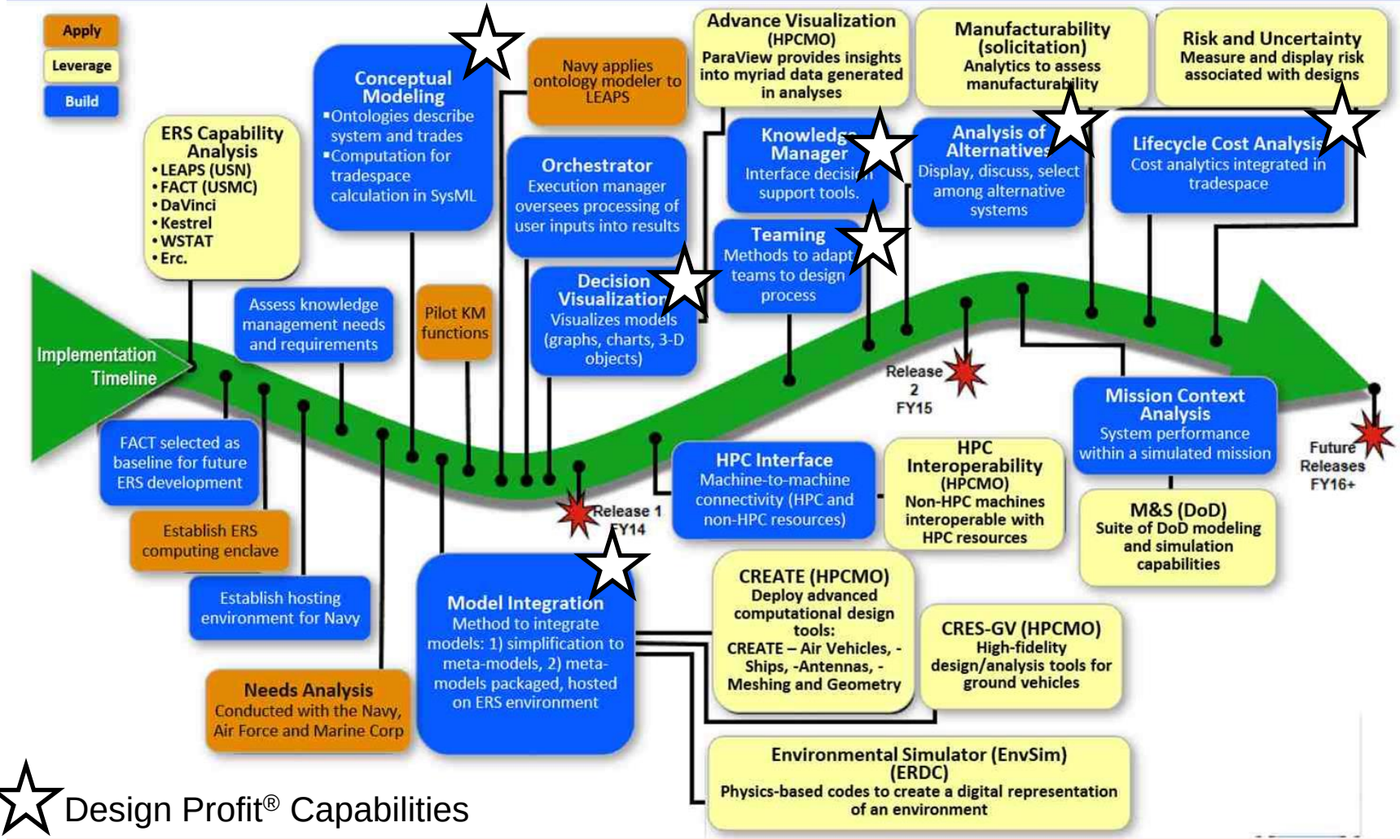


More

Knowledge

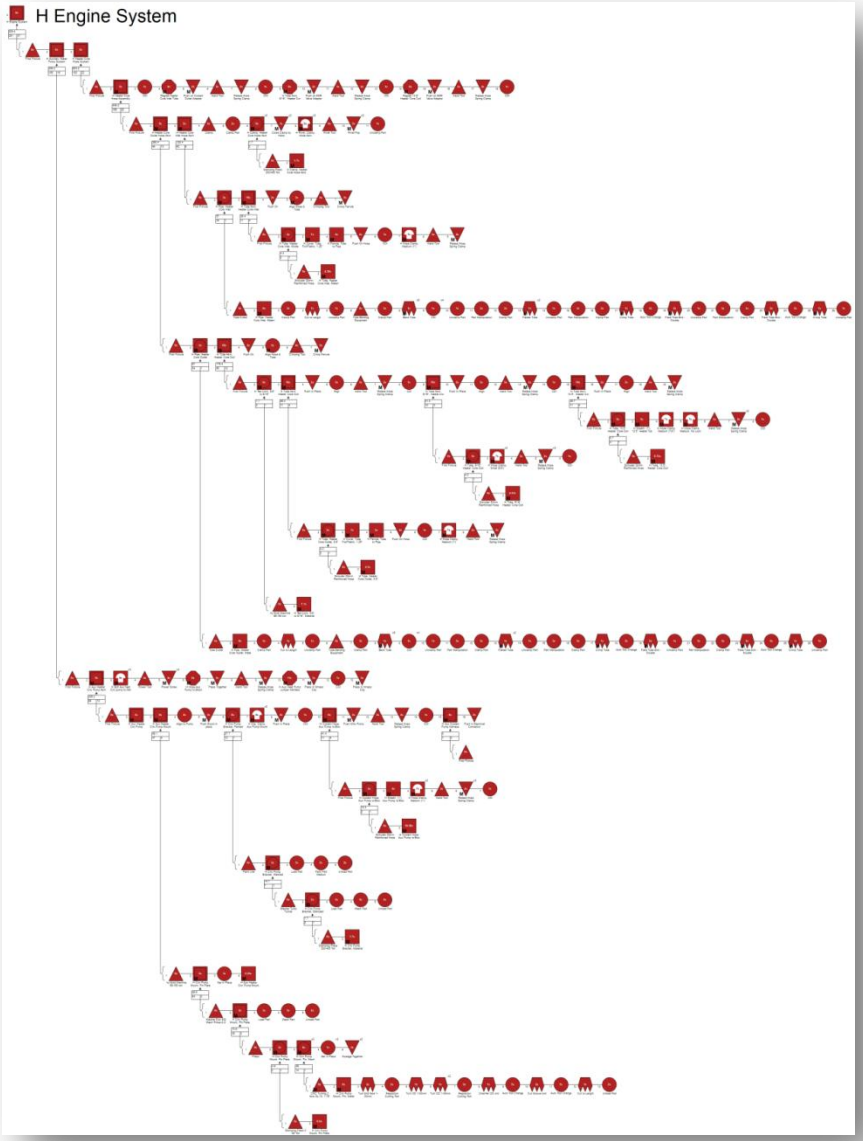
Up Front

Architecture Roadmap



☆ Design Profit® Capabilities

Source: ERS Overview, December 2013, Jeffery P. Holland, PhD, PE



Model Integration and Knowledge Manager

Design Profit® provides a systematic approach to translate requirements into total life cycle costs through conceptual modeling.

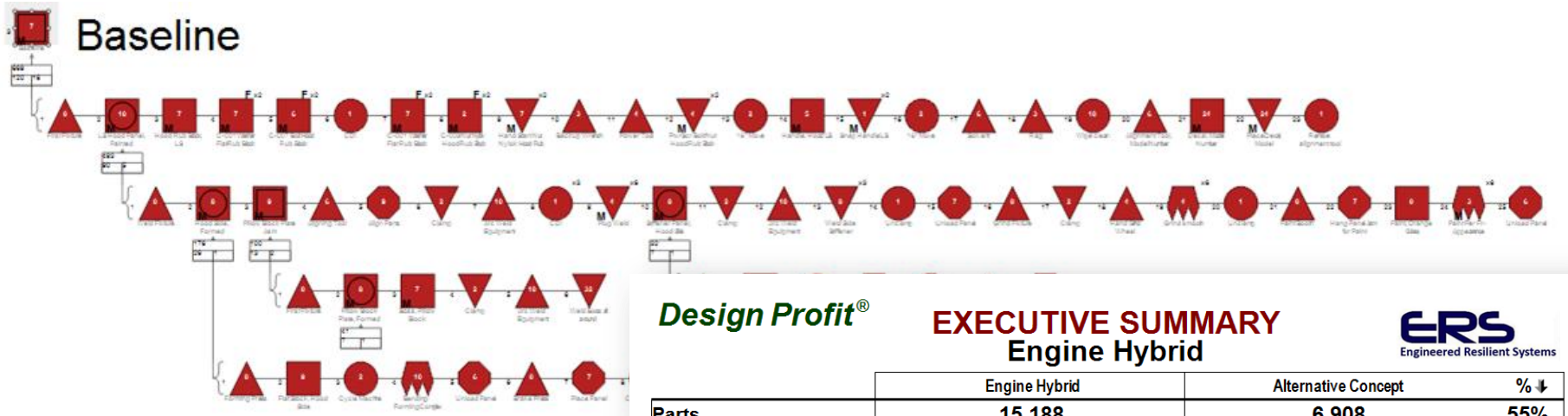
This provides the platform for effective decision-making considering all relevant metrics.

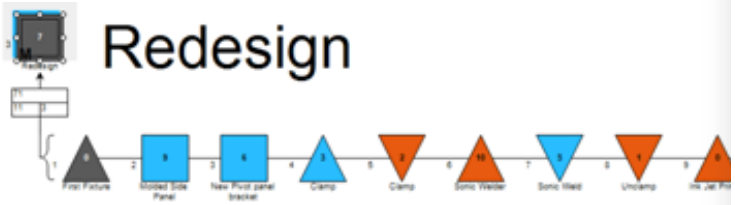
The baseline model consolidates and allocates data at the symbol level.

- Unit $
- Program $
- Quality $
- Labor $
- Machine $
- Overhead $
- Investment $

- MRL
- Maintainability
- Producibility
- Sustainability
- Supplier
- Lead Time
- etc.

Design Profit® provides rapid generation and quantification of alternatives.





Design Profit®

EXECUTIVE SUMMARY
Engine Hybrid

ERS Engineered Resilient Systems

	Engine Hybrid	Alternative Concept	% ↓
Parts	15,188	6,908	55%
Good Parts	41	41	0%
Steps	59,224	25,660	57%
Actual Time (hr)	25.75	13.85	46%
Fasteners	1,162	647	44%
Ergo Dangers	0	0	0%
Poka Yoke Issues	14	14	0%
Total Weight	623.31 lb	428.56 lb	31%
Piece Cost	$3,199.36	$1,523.91	52%
Total Labor Cost	$1,083.00	$644.29	41%
Q Burden	$0.00	$0.00	0%
Total Cost	$4,282.36	$2,168.20	49%
Investment Cost	$23,295,640	$27,957,326	-20%
Simple Payback	N/A	1 month(s)	0%
Annual Savings	N/A	$951,373,733	0%

AoA and Decision Visualization

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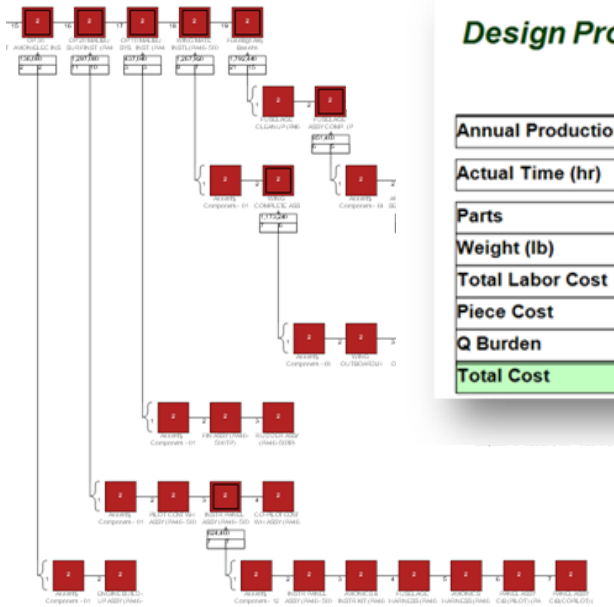
Optimal Data Fidelity: The right data at the right time to make the right decision.

“Perfection is the enemy of time.”

Concept

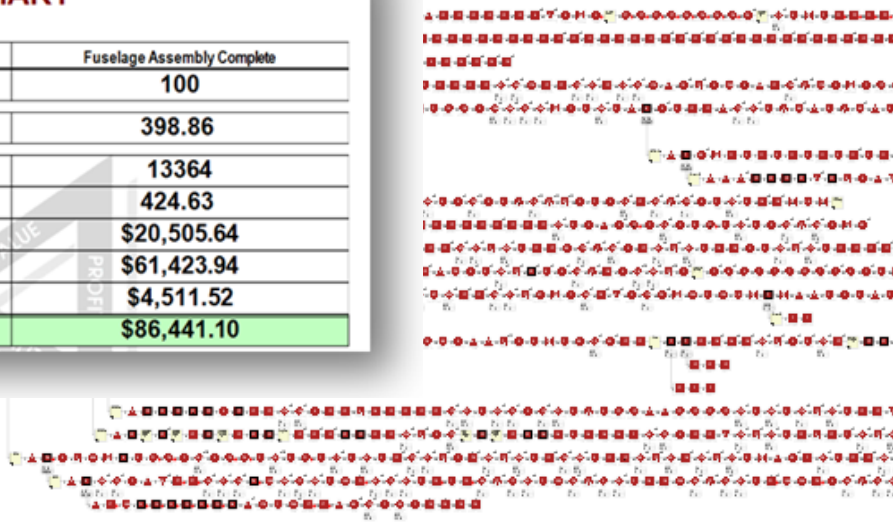


Full Granularity

Design Profit®

EXECUTIVE SUMMARY

	Fuselage Assy Baseline	Fuselage Assembly Complete
Annual Production	100	100
Actual Time (hr)	497.90	398.86
Parts	15	13364
Weight (lb)	0.00	424.63
Total Labor Cost	$25,597.04	$20,505.64
Piece Cost	$77,639.00	$61,423.94
Q Burden	$0.00	$4,511.52
Total Cost	$103,236.04	$86,441.10



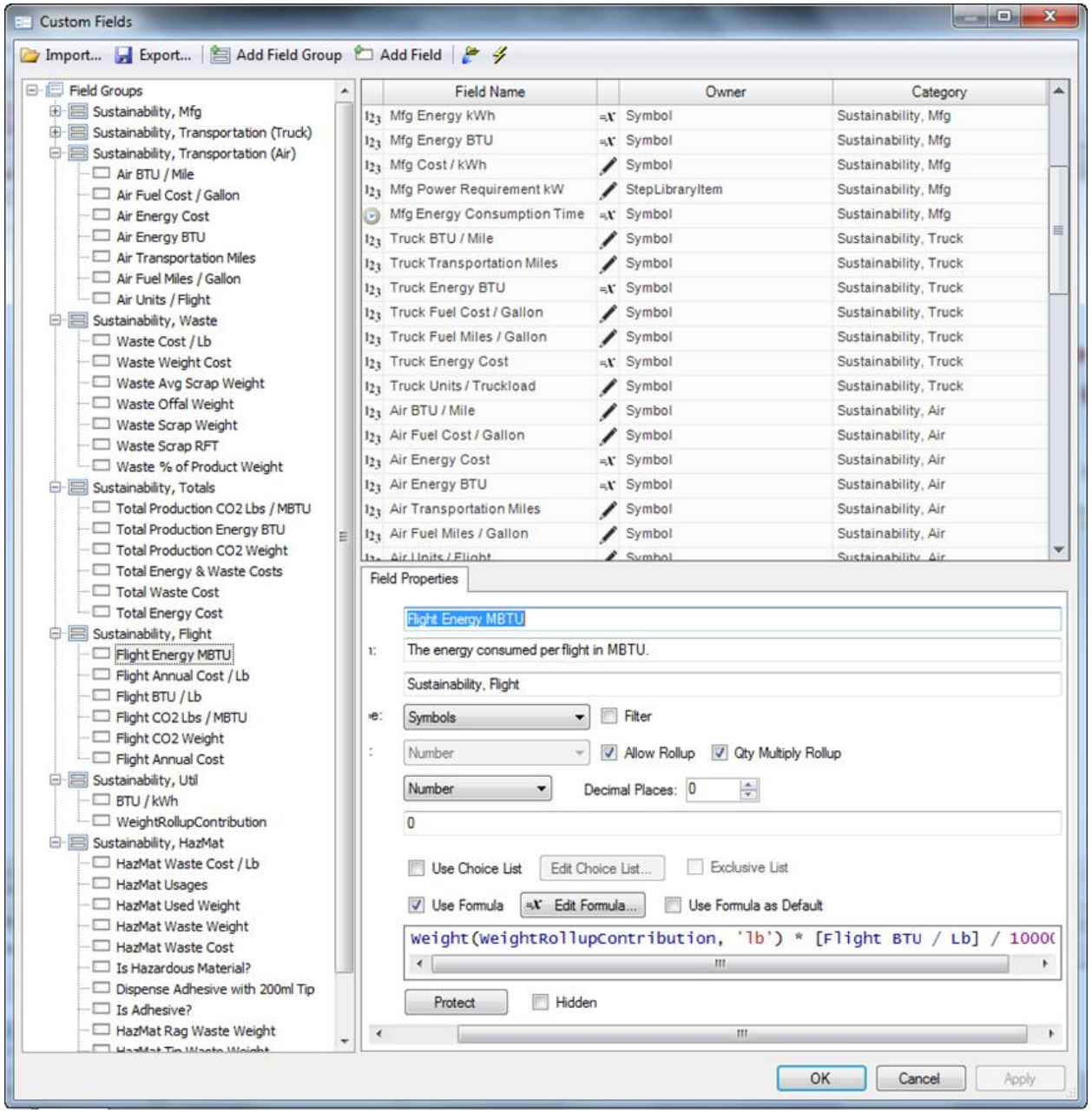
TIME

Low Fidelity
Low Granularity
Quick Turns

Increase granularity of unknowns to gain knowledge

High Fidelity
High Granularity
Detailed Refinements

Conceptual Modeling

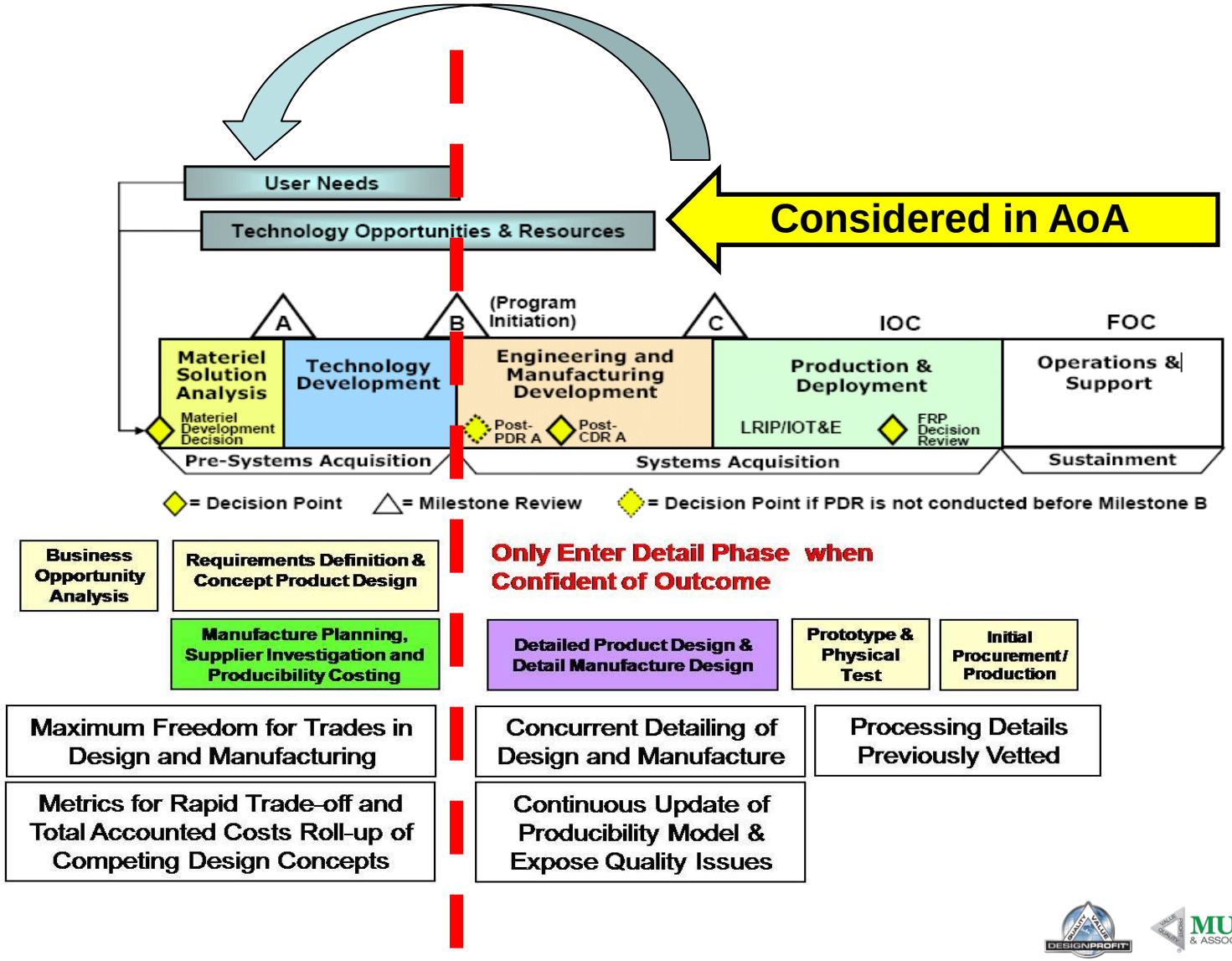


Integrated math modeling allows for nearly unlimited analytical capability.

The example shown allows the model to analyze and roll up sustainability costs.

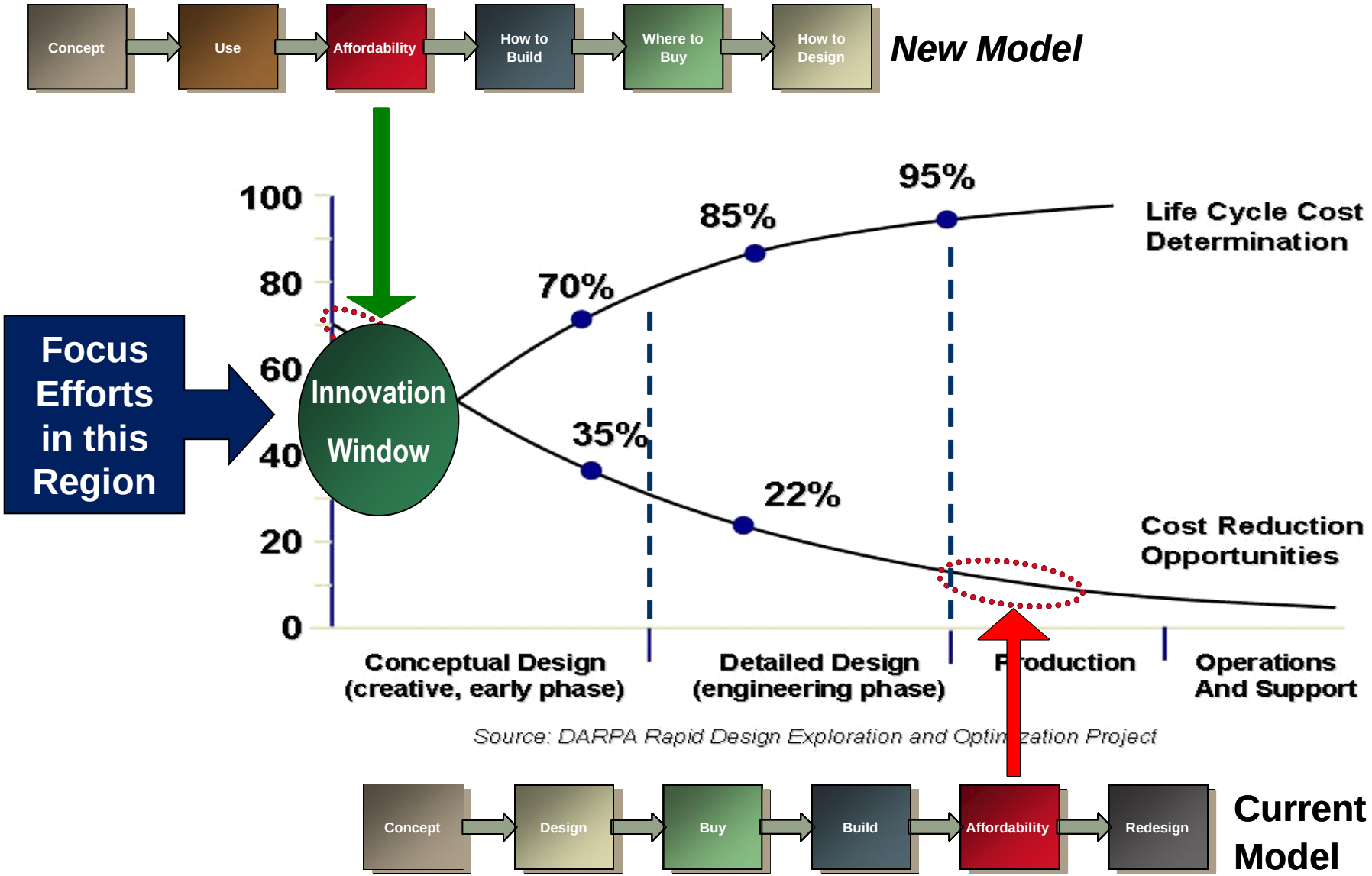
Life Cycle Cost Analysis

Design Profit® provides data and history needed to perform total life cycle trade studies to minimize risk before detailed design and engineering.



Shift Product Realization for Maximum Flexibility

Raytheon

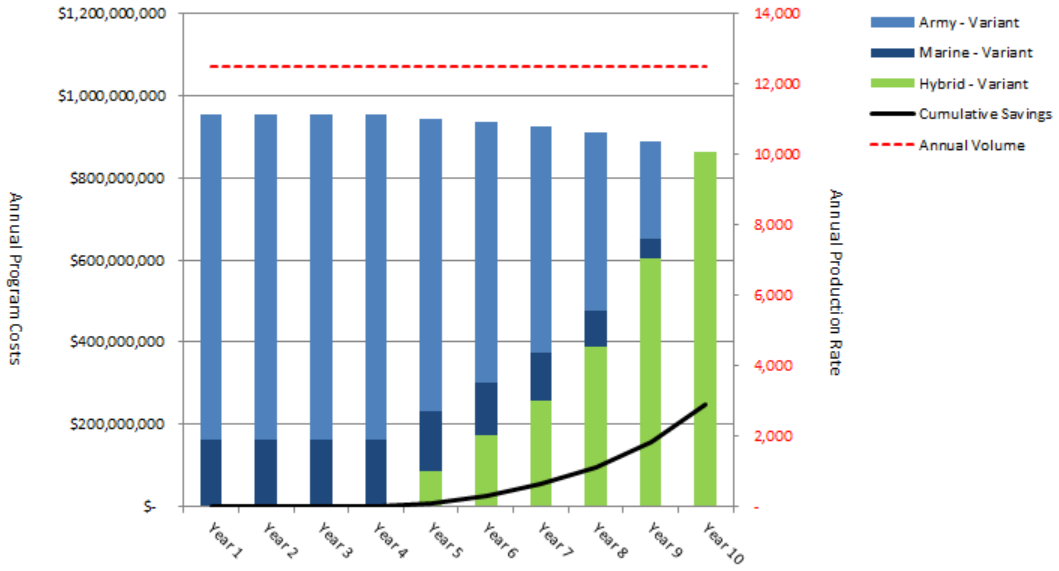


“I have been asking questions about this assembly for over a year and have never been satisfied with the answers. In just two hours, by mapping the build process all of my questions were answered without even having to ask any.”

- Army Representative

Live Demo

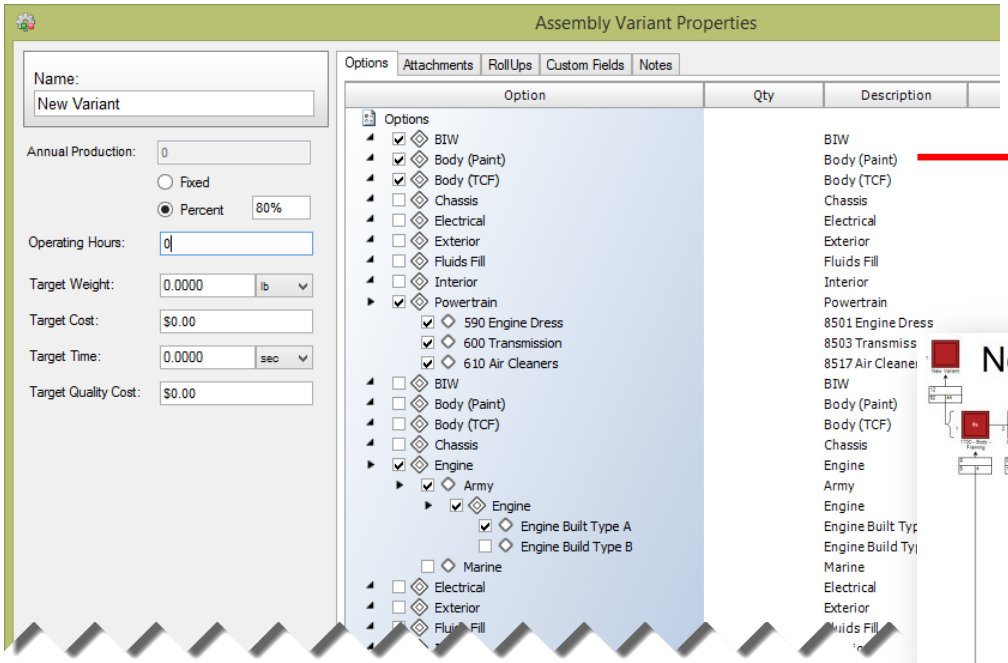
	Program	Army - Variant	Marine - Variant	Hybrid - Variant	Cumulative Savings	Annual Volume
Total Program Volume	125,000	100,000	25,000	125,000		
Cost Per Unit		$ 79,000	$ 65,000	$ 69,000		
Year 1	$ 952,500,000.00	$ 790,000,000	$ 162,500,000	$ -	$ -	12,500
Year 2	$ 952,500,000.00	$ 790,000,000	$ 162,500,000	$ -	$ -	12,500
Year 3	$ 952,500,000.00	$ 790,000,000	$ 162,500,000	$ -	$ -	12,500
Year 4	$ 952,500,000.00	$ 790,000,000	$ 162,500,000	$ -	$ -	12,500
Year 5	$ 943,500,000.00	$ 711,000,000	$ 146,250,000	$ 86,250,000	$ 9,000,000	12,500
Year 6	$ 934,500,000.00	$ 632,000,000	$ 130,000,000	$ 172,500,000	$ 27,000,000	12,500
Year 7	$ 925,500,000.00	$ 553,000,000	$ 113,750,000	$ 258,750,000	$ 54,000,000	12,500
Year 8	$ 912,000,000.00	$ 434,500,000	$ 89,375,000	$ 388,125,000	$ 94,500,000	12,500
Year 9	$ 889,500,000.00	$ 237,000,000	$ 48,750,000	$ 603,750,000	$ 157,500,000	12,500
Year 10	$ 862,500,000.00	$ -	$ -	$ 862,500,000	$ 247,500,000	12,500
Total Program Cost	$ 9,277,500,000.00	$ 5,727,500,000.00	$ 1,178,125,000.00	$ 2,371,875,000	$ 247,500,000	125,000



Using Design Profit®, model variations can be easily created to perform 'what if' scenarios.

Cost and weight targets can also be generated (Actual vs. Target).

Enhancements will need to be made for yearly volumes and visualization.



A life cycle cost model is generated based on your requirements.

Currently, the definition of a product requires a person to build the variant (Model X).

We propose to identify requirements and construct a model based on the requirements. The model will identify associated costs to the requirement. Putting costs against requirements can improve program definition.

Modeling is capturing knowledge, and this knowledge can be used to easily generate designs. Multiple options can be proposed based on factors such as cost, weight, and timing requirements.

Early intensive data mining is needed.

Future Enhancements

LRU Packaging Optimization Analysis Tool

Electrical/Electronic LRUs and their connecting harnesses are a tremendous driver of design and manufacturing complexity and in service reliability and serviceability.

The proposed tool would reduce system complexity by optimizing LRU configuration and location to:

- Prioritize packaging of low-reliability LRUs to minimize service impacts.
- Prioritize configuration and location of LRUs to minimize harness circuits and length.

Summary

- Munro has been working with military and commercial manufacturers for over 25 years to help create robust, cost-effective products.

- Design Profit® capabilities have been continuously developed to maximize product development efficiency based on customer needs and Munro's engineering services.

- Design Profit® remains very agile and adapts to industry needs quickly.

- The simplicity and speed of using Design Profit® to model the build, and by extension the design, in a systematic and data-driven fashion provides an ideal platform for stakeholder collaboration.

- Many Design Profit® capabilities already developed directly address the vision of the ERS Architecture Roadmap. Design Profit® is an excellent platform to provide expanded capabilities that support additional needs.

Questions?