Business Impact Case Study

Quasonix, Inc.

Quasonix
Reinventing Telemetry™

Overview

Company
Quasonix designs, develops, and manufactures high-performance aeronautical telemetry systems.

Challenge
Quasonix customers expect the highest performance telemetry equipment available. With market pressure to meet exacting requirements and deliver equipment on time, Quasonix engineers need the tools to ensure design success as they continually work to improve all aspects of equipment performance.

Solution
To meet demanding performance requirements while mitigating costs and time schedule delays, Quasonix uses NI AWR simulation software in combination with accurate device models from Modelithics to achieve first-pass design success.

Results
A cost-effective and efficient first-pass design methodology that achieves industry-leading performance.

Telemetry Systems Development Design Flow Improves Productivity 150 Percent

Company

Quasonix designs, develops, and manufactures high-performance aeronautical telemetry systems and is a recognized industry leader for spectrally efficient modulations. The Quasonix' line of advanced products includes multi-mode telemetry transmitters, multi-mode, multi-symbol trellis telemetry demodulators, complete multi-mode telemetry receivers, and rack-mount receiver analyzers. Quasonix was founded with the purpose of filling a void in the flight-test telemetry market and is focused on exceeding customer expectations with the consistent development of products that push the envelope of spectral efficiency, power efficiency, size, packaging, and user friendliness.

Challenge

Aeronautical telemetry systems provide critical on-board flight information to validate and assess the performance of the aircraft's subsystems. Aeronautical manufacturers and their suppliers rely on robust instruments to monitor and transmit this information without failure. As the industry leader in high-performing, top-quality telemetry products for a demanding customer base, Quasonix must balance customer demand for products that outperform all others with the need to remain competitive in their pricing.

An issue telemetry product developers face is ensuring excellent agreement between simulations and measured performance in order to be confident about their design optimization results and achieve first pass success. In addition to world-class harmonic balance technology for nonlinear simulation, engineers rely on electromagnetic (EM) simulation for design verification and accurate device models for surface-mount passive and active components.

Often the nonlinear models, load-pull power device data, and/or S-parameter models for active, as well as passive, devices that are provided by many device manufacturers are not accurate enough to ensure first-pass design success.

"Instead of relying on multiple prototypes, our designers were able to use Microwave Office combined with Modelithics models to optimize a harmonic filter for **peak performance**. This approach eliminated several PCB spins, which shortened the circuit development cycle one to two months."

Ted Longshore, Quasonix

By relying heavily on RF/microwave simulation software combined with highly-accurate models, engineers at Quasonix can focus on improving the performance of their products without being concerned about the accuracy of the models used in their designs. Without simulations that yield accurate results, the design and production costs would rise with additional prototype iterations, delaying time to market and cutting profit margins.

Solution

Quasonix designers have developed a novel design flow that enables design success in a single pass. The methodology uses the NI AWR Design Environment platform, specifically Microwave Office circuit simulation software combined with EM simulation from the AXIEM 3D planar method-of-moments (MoM) solver and highly accurate Modelithics Microwave Global Models™ for passive components and nonlinear models for active devices such as transistors. When developing a new system, Quasonix typically builds the entire transmitter, rather than prototypes, relying on the accuracy of the RF simulations, including the component models, to ensure success.

Business Benefits

The adoption of Microwave Office software along with device models from Modelithics has enabled Quasonix designers to eliminate several printed circuit board (PCB) spins and shorten the circuit development cycle by one-to-two months. An additional benefit of this flow is that the substantial RF expertise required to accurately characterize a component and de-embed the results has been eliminated by deferring that effort to the characterization experts at Modelithics. This approach enables the engineer to proceed directly with circuit development, thereby saving several weeks of design effort.

A final benefit is that the designer can optimize the circuit performance for a particular application, given simulation capability and component models that accurately predict the operating performance. From this point, it is easy to redesign the amplifier for a different frequency band or power level to meet customer requirements, saving additional design time.

The Quasonix team documented the advantages of using this approach based on cost savings, shortened development schedule, and improved designer productivity. A cost/benefit analysis of the required models was done by preparing an example return-on-investment (ROI) calculation using a free ROI calculator tool available on the Modelithics website (Figure 1) and a case study of an actual transmitter circuit design project that was accomplished in a single pass. [1,2].

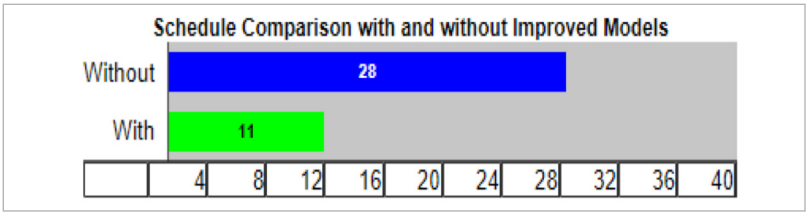

Figure 1: Sample graph from the Modelithics free ROI calculator (roi.modelithics.com).

1. T. Longshore and L. Dunleavy, Using High Accuracy Models to Achieve First Pass Success- A Transmitter Case Study: Part 1 Harmonic Filter Design, High Frequency Design, August 2017.
2. T. Longshore and L. Dunleavy, Using High Accuracy Models to Achieve First Pass Success- A Transmitter Case Study: Part 2, Power Amplifier Design, High Frequency Electronics, September 2017.

Results

- Several PCB spins eliminated
- Circuit R&D shortened by 1 - 2 months
- 150% engineering productivity improvement
- 3X savings in development schedule
- 3X fewer in circuit design iterations
- 3X reduction in total cost

"Our company is committed to providing models and data that **accelerate the design process**. It was a pleasure to work with Quasonix to use our ROI tool to illustrate cost and schedule savings."

Larry Dunleavy, Modelithics

An estimate of the design cost and schedule impact with and without adequate models is presented in Figure 2. Without improved models, the total number of engineering hours required was 101 engineer/132 technician/6 management hours, resulting in a time schedule of 27.9 weeks (pink box) and a cost of $35,752 (red box). On the other hand, the total number of hours to achieve a successful design with improved models was 77 engineer/100 technician/3 management hours, resulting in a 2.5X reduction in schedule by 17 weeks (pink boxes) and 2.8X savings in cost of $22,672 (red boxes). Related analysis shows an annualized engineering productivity improvement of over 150 percent on similar designs.

Without Improved Models

	Engr. Hours	Tech Hours	Mgmt Hours	Cost	Time / Schedule (Weeks)
Design and Test Labor	101.0	132.0	6.0	$14,126	12.0
Material and Fabrication				$2500	2.0
Total for First Pass	101.0	132.0	6.0	$16,626	14.0
Total Number of Circuit Iterations	3	Including Fixs (2 is minimum)			
Estimated Schedule Time Per Re-work Iteration (Weeks)	7.0				
Total Cost and Schedule per Design	$35,752				27.9

With Improved Models

	Engr. Hours	Tech Hours	Mgmt Hours	Cost	Time / Schedule (Weeks)
Design and Test Labor	77.0	100.0	3.0	$10,580	9.0
Material and Fabrication				$2,500	2.0
Total for First Pass	77.0	100.0	3.0	$13,080	11.0
Total Number of Circuit Iterations	1	Including First Pass			
Estimated Schedule Time Per Re-work Iteration (Weeks)	6.5				
Total Cost and Schedule per Design	$13,080				11.0

Update | Results Summary

Figure 2: Cost and schedule estimates for design completion without and with accurate models.

Figure 3 shows the cost impact when two additional iterations were required to complete the design without adequate transistor and passive component models. A similar cost analysis was done on a related entirely passive filter design that resulted in a schedule savings of 2.2X (5 weeks), a cost savings of $6,400, and an estimated annual engineering productivity improvement of 90 percent on similar designs.

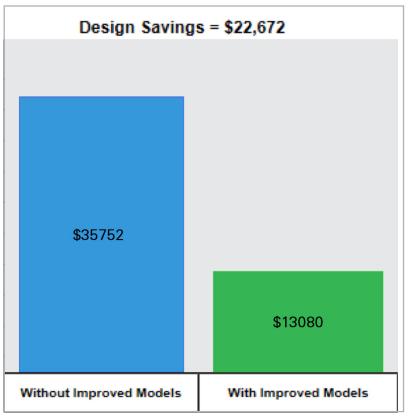

Figure 3: ROI results estimated cost savings.

Conclusion

It can be concluded that, on cost alone, the design cost savings would nearly be justified on the basis of a single design using NI AWR simulation software combined with accurate Modelithics models. The remaining cost difference would be justified quite easily because of the schedule improvement from 28 weeks without accurate models, to 11 weeks with models, due to the first-pass success that was achieved in the design.