Expand your Experience
Expand your Capabilities
Don't Expand your Staff

TECHcetera...

Engineering Design & Consultation Services

Providing the services you need when you need them

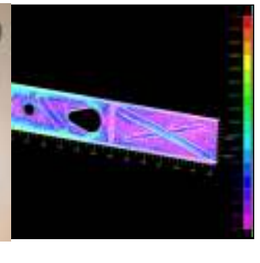
No More - No Less

CONCEPTUAL DESIGN – PROPRIETARY DESIGN OPTIMIZATION METHODS
CLASSICAL ANALYSIS - FINITE ELEMENT ANALYSIS
DETAIL DESIGN – PRODUCTION DRAWINGS & DATA
COMPLIANCE REVIEWS - TEST PLANS - TEST ADMINISTRATION - CERTIFICATION REPORTS
MANUFACTURING SUPPORT - STRATEGIC SOURCING

Clint Luttgeharm, PE (316)253-1891 clint@techcetera.net www.techcetera.net

TECHcetera…

Clint Luttgeharm, PE



NEi Software

TECHcetera began from my desire to assist clients of all sizes and endeavors with the technical issues that are important to their business.

In 1991, shortly after obtaining my Professional Engineer (PE) license, I began offering these services to small companies in the Wichita, KS area. At the time, I was employed by The Boeing Company performing Research & Development. With their approval, I became known within Boeing as "Double-Spin" obtaining experience within Boeing and also on the "outside" as a consulting design engineer. During the next ten years, I had the opportunity to help many smaller companies accomplish projects and product introductions that would have otherwise been beyond their reach.

Eventually, I became a Chief Engineer for Boeing but resigned from that position to work directly and exclusively for a smaller manufacturing company.

After eleven years in that position, the time was right to return to my passion for assisting small, and not so small, companies expand their capabilities.

I hope that you will find the enclosed materials helpful and insightful as you consider the services that TECHcetera can provide. A collection of recent and older TECHcetera projects is included. Several interesting projects from the period when I was directly employed in industry are also featured.

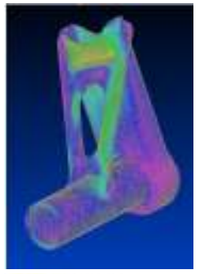
I would welcome the opportunity to review your project or inquiry and let you know exactly how I can help.

As you look over these materials, please don't hesitate to call or email me with any questions that you might have.

Sincerely,

Clint Luttgeharm, PE

Design & Analysis



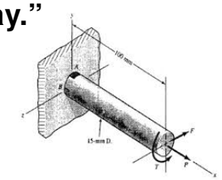
FINITE ELEMENT ANALYSIS (FEA)

TECHcetera applies state-of-the-art Finite Element Analysis (FEA) software tools and 29 years of FEA experience to complex design and analysis problems. This combination has proven to provide rapid, accurate results. Analysis projects can take many forms: design, verification, or forensic. Finite Element Analysis tools from NEi Software provide TECHcetera with robust linear & non-linear solution capabilities for all of these problems. Whatever the problem or goal, TECHcetera is there to provide what the project demands.

CLASSICAL ANALYSIS

"Sometimes the old-fashioned way is still the best way."

There are certain problems which are best addressed using classical formulas and methods. These classic solutions are often incorporated in computerized, parametric form which makes them even more powerful.

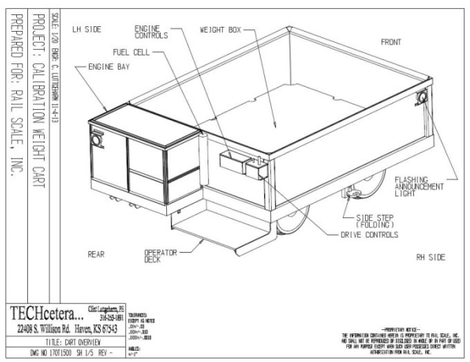


CONCEPTUAL DESIGN

Sometimes a design is a product. Sometimes it is a process. In either case, the design concept is critical to success. The design process evaluates the requirements and goals for the project and devises a means of achieving them. A broad background providing a familiarity with the design, manufacturing, and business issues relating to the project is an asset in creating a successful conceptual design. TECHcetera offers this experience and a proven record in creating successful conceptual designs for a variety of products and industries.

DETAIL DESIGN

TECHcetera is experienced in transitioning conceptual designs into reality. Full 3-D Computer Aided Design (CAD) services are used to assure design accuracy and data transmittal. Production drawings assure that the design can be produced as expected.

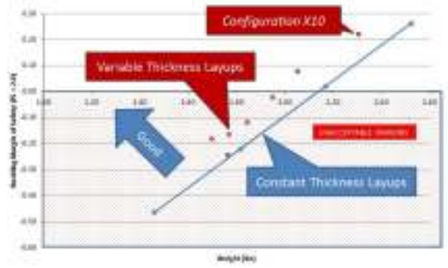


Other Services

DESIGN OPTIMIZATION

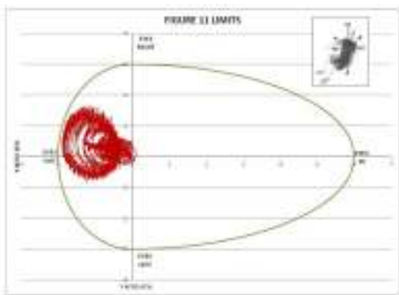
"A successful solution requires more than working the problem correctly. The key is to work the correct problem."

TECHcetera applies proprietary Parametric Design Optimization Techniques to make certain that the correct problem is worked correctly. Most design optimization problems involve minimizing cost and maximizing performance. Some problems involve maximizing performance and minimizing weight. A truly optimized design will balance many performance measures and meet the goals of the client or customer.



STRAIN GAGE & FIELD TESTING

TECHcetera provides Strain Gage & Field Testing services. Most testing is performed using the LORD MicroStrain Wireless Data Acquisition System. This system allows remote, wireless data acquisition from strain gages, accelerometers, and analog voltage devices.



LORD MicroStrain® SENSING SYSTEMS

ASTM INTERNATIONAL Designation: F2137 – 11

- **Dynamic Strain/Stress/Force**
- **Dynamic Hydraulic Pressures**
- **3-Axis Acceleration Profiles**
- **Vibration & Modes Analysis**
- **Amusement Ride Certification**

SkyQuest

"SkyQuest" is an observation ride surrounding the new International Orangutan Center at the Indianapolis Zoo.
This quarter mile aerial experience brings observers up to the swing lines & platforms so that they can experience the power & prowess of the orangutans in action.

- Track Structure Conceptual Design
- Operational Studies
- Pinch-Drive Conceptual Design
- Gondola Structure & Interior

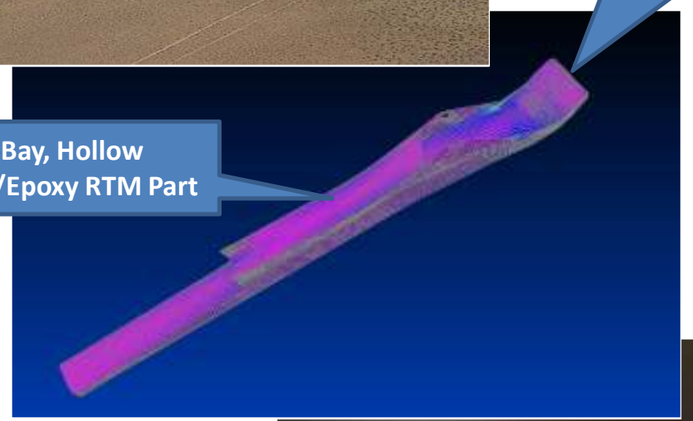
OPENING MAY 2014

Military Drone Landing Gear

Composite landing gear is stronger yet lighter providing improved performance for critical military missions.

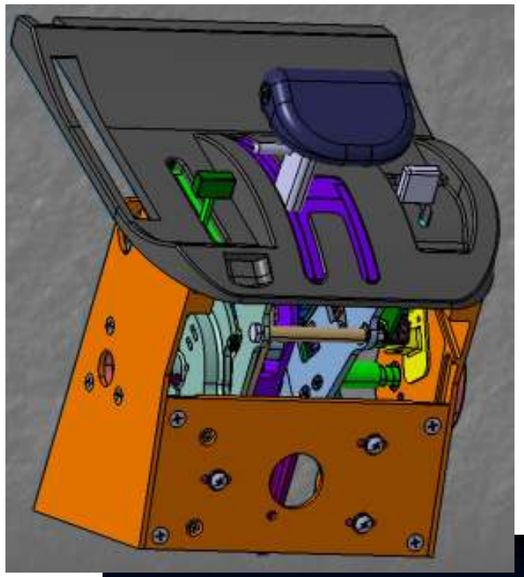
Laminated Lugs: Titanium/Graphite

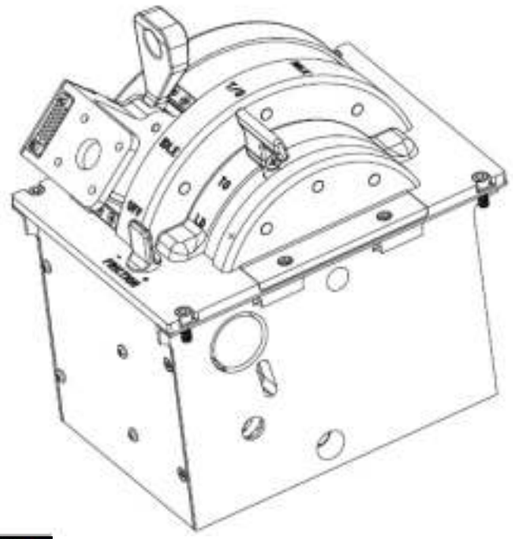
Two-Bay, Hollow Graphite/Epoxy RTM Part

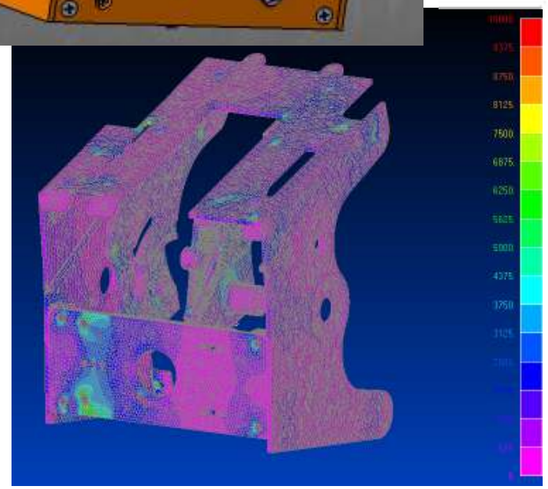


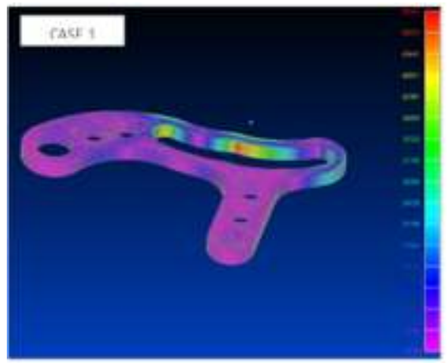
Unit #1 Passed OEM Qualification Testing

Aircraft Throttle Systems









- ✓ Structural Verification (FEA)
- ✓ Structural Certification Reports
- ✓ Reliability Verification (FMEA)
- ✓ Reliability Certification Reports

- **General Aviation**
- **Military Aviation**
- **FAA**
- **EASA**

Mower Jacks

- ✓ Design Optimization
- ✓ Structural Verification (FEA)
- ✓ Strain Gage Verification

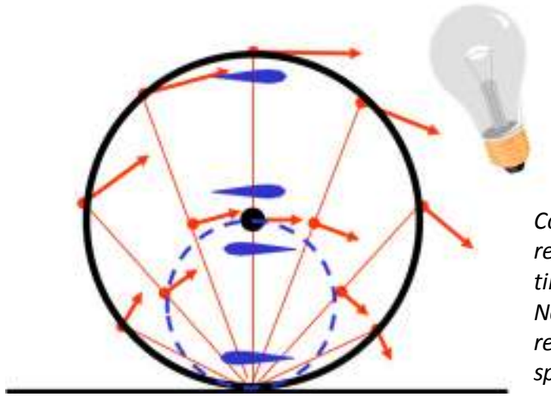
Bicycle Wheels

The “Crosswind” is the most prominent of the wheels developed for Nimble. All aspects of the product design and testing as well as the tooling design were provided by TECHcetera.

Hollow Graphite/Epoxy RTM Wheel Body

Special Edition for 2000 Olympic Triathlon

TECHcetera…

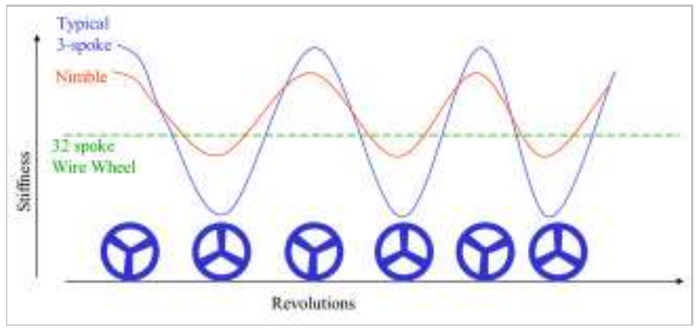


A rolling wheel rotates around the ground contact point.
Not the axle.
It is not a propeller.

Consequently, as the spoke rotates, the air flow fully reverses over the spoke. This reversal is from two times the bicycle speed to zero at the tip of the spoke. Near the hub the spoke is exposed to forward and reverse flows of a magnitude matching the bicycle speed.

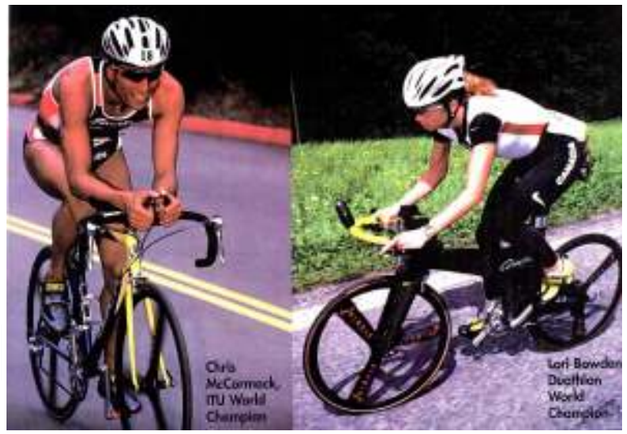
Standard airfoils are not the best solution to this complex problem.
Custom airfoils shapes were developed and then tested using an extremely accurate centrifuge designed and built by TECHcetera.

As the wheel rolls, a three spoke wheel produces a three-beat harmonic response. Most riders report that the resulting “highway hop” is fatiguing.



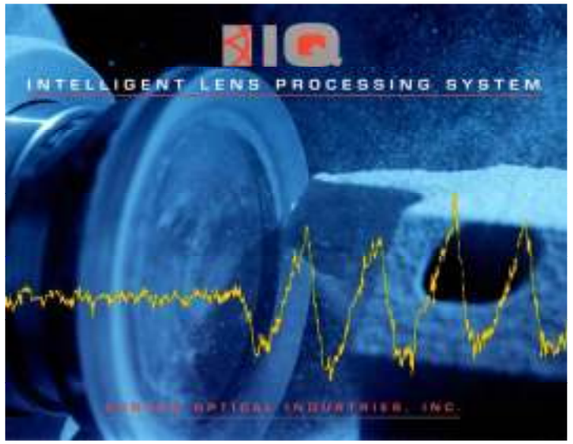
A “variable section” was designed to stiffen the rim as it rolls. An “axially compliant” laminate was used in the spoke to reduce the “hard spots”. Riders report that the road fatigue is gone.

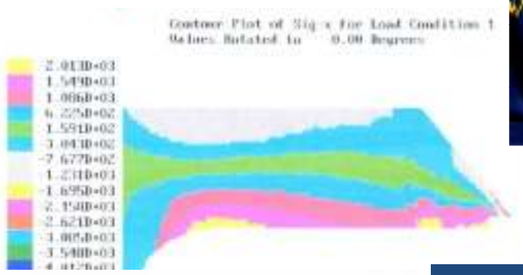
The results tell the story.



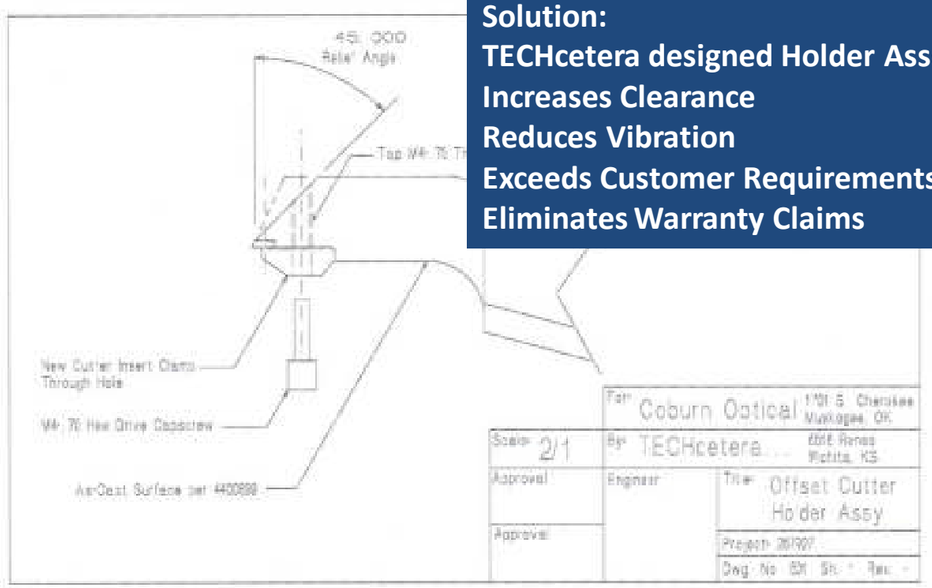
CNC Lensmaker

PROBLEM: Interference & Dynamic Response Prevent Machine from Delivering Guaranteed Performance





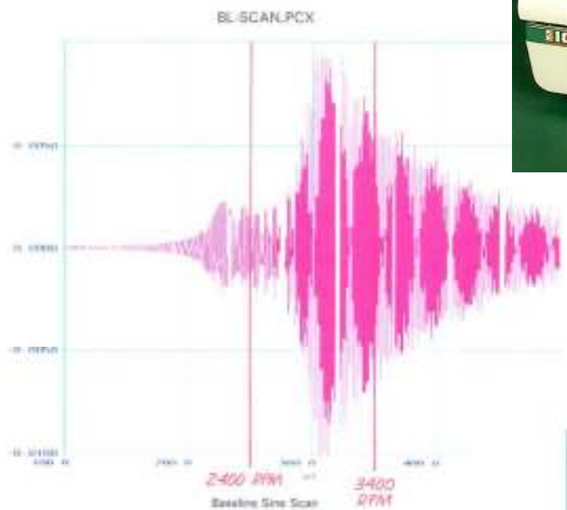
Finite Element Analysis (FEA)



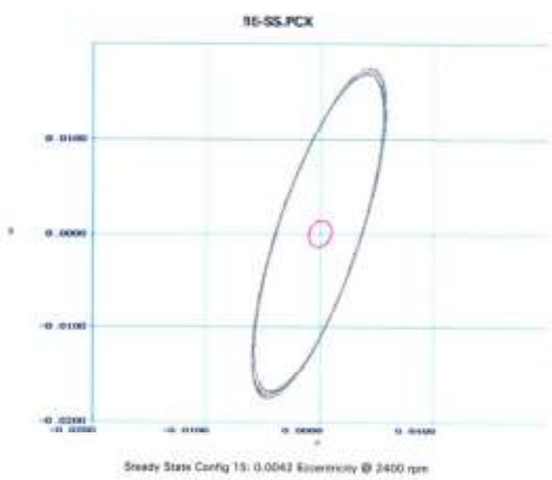
Solution:
TECHcetera designed Holder Assembly:
Increases Clearance
Reduces Vibration
Exceeds Customer Requirements
Eliminates Warranty Claims

CNC LensEdger

PROBLEM: Machine Would Not Hold Dimensional Tolerance Creating Customer Complaints & Claims

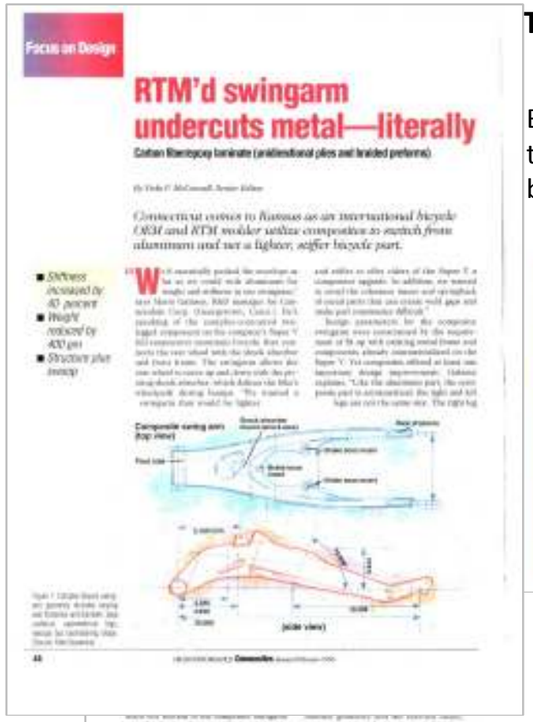


Dynamic Analysis
Spectral Response



Solution:
Reduced Steady State Dynamic Response (confirmed by high-speed video)
Exceeds Customer Requirements
Eliminates Warranty Claims

Cannondale SV4000 Suspension Arm


Focus on Design

RTM'd swingarm undercuts metal—literally

Carbon fiber/epoxy laminate (unidirectional plies and braided preforms)

Connecticut comes to Kansas as an international bicycle OEM and RTM molder utilize composites to snatch from aluminum and set a lighter, stiffer bicycle part.

- Stiffness increased by 40 percent
- Weight reduced by 400 gm
- Structure plus design

(side view)

This project was accepted in a state of crisis.
The existing design did not work.

By applying FEA and Design Optimization techniques, the redesigned arm was far better than both the original metallic and composite designs.

40% Stiffness Improvement
400g Weight Reduction
Good Reviews
Satisfied Client
over 10,000 manufactured


Cannon Fiber

Cannondale, long a bastion of oversize aluminum frames, has started dabbling in carbon fiber. This is nothing short of heresy for the Connecticut-based company that, with Klein, was instrumental in making large-diameter, thin-wall aluminum a staple in the bike industry.

Members of the elite Vision Cannondale mountain bike team have been racing Super V dual-suspension bikes with carbon fiber swingarms in downhill events since the beginning of the season. (The main frame is still aluminum.) The so-called HCV-440 swingarm will be standard on some '96 Super V models, and will also be offered as a $449 retrofit. It saves 3½ pound compared with the aluminum swingarm and adds rigidity, according to the company.

For industry pundits, the news begs the question: Will Cannondale introduce a complete carbon-fiber frame anytime soon? "This is our first foray into the carbon fiber arena," says Cannondale's Tom Armstrong. "I guess our toes in the water, and we're not sure where we'll go from here." Nonetheless, Armstrong hinted that such a move might be offered late in '96. Our prediction: You'll see a prototype carbon-fiber frame from Cannondale at the fall bicycle shows.

The swingarm is made using a "hot core" method, in which a removable core sandwiches the fibers and resin against the outside of the mold during construction. The cryptic HCV-440 draws its name from "high carbon volume," 440-gram weight savings, and a 40% increase in rigidity. Other Cannondale news: The company plans to offer a line of helmets made by Giro, as well as its own line of air pumps.

Cannondale *SLICE*

A venture into the unknown sometimes means that the real requirements aren't yet known.

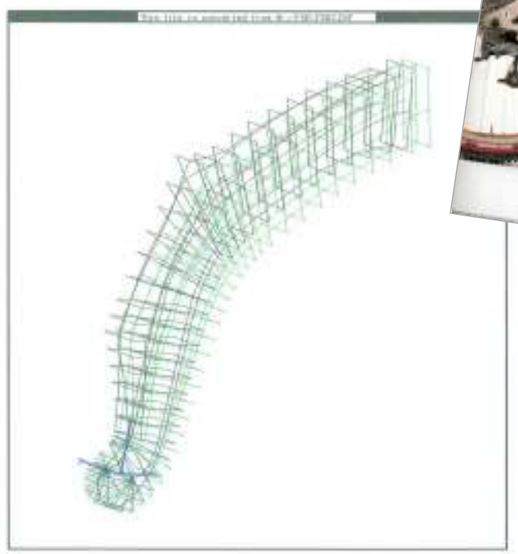
Combine that with a tight budget

and, by the way,
it has to be at the trade show
in *3 weeks*
so the press can:
See it
Touch it
Ride it

What's not to like?
Aerodynamic
2.5 lb frame
Great Handling

Specialized C-3 FSR

Monocoque Carbon Frame
Super Light Weight
Vertical Stiffness Optimized for Excellent Climbing
Torsional Stiffness Optimized for Excellent Stability & Handling
Parametric Design Optimization for Maximum Stiffness/Weight Ratio

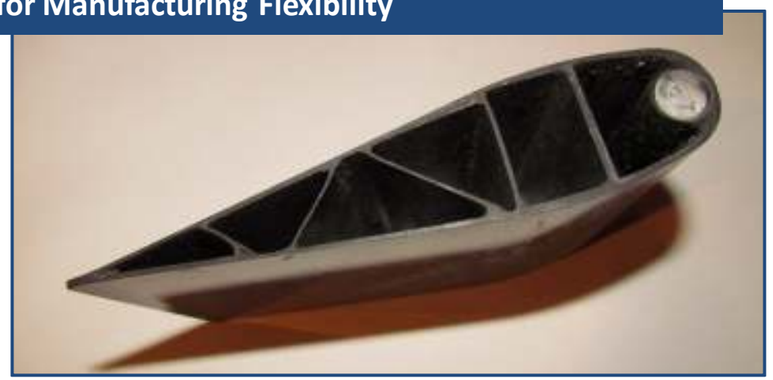


Proprietary "Ply Group" Finite Element Analysis (FEA) Designed to Meet All Customer Specifications

Raytheon MQM Target Drone

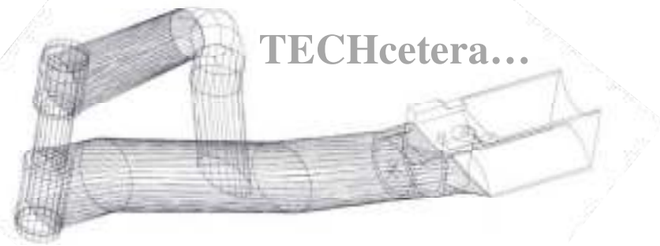
PROBLEM: Aluminum Control Surfaces are:
Heavy
Easily Damaged
Difficult to Repair

SOLUTION:
TECHcetera designed "Common Molding" Control Surface for use as: Ailerons, Elevators, & Rudder
Unique Truss Core Design Improves Stiffness
Co-Molded Balance Weight Reduces Assembly Cost
Modular End Fittings for Manufacturing Flexibility



RADD "RATZ" Prototype

Radical Suspension Design by RADD



Technology Licensed to Yamaha Grand Prix Team

TECHcetera…

PROBLEM: Suspension Arms Not Stiff Enough
Suspension Arms Too Heavy

Solution:
TECHcetera designed "Mold-In-Place" Braided Jacket for Front Suspension Arm
Increases Stiffness

Solution:
TECHcetera designed
Replacement Rear Suspension Arm
Significant Stiffness Improvement
4 lb Weight Reduction

KC-135 FMS Aerial Refueling Boom*

FMS Boom Incorporates Improvements to USAF Aerial Refueling Boom

Original Design

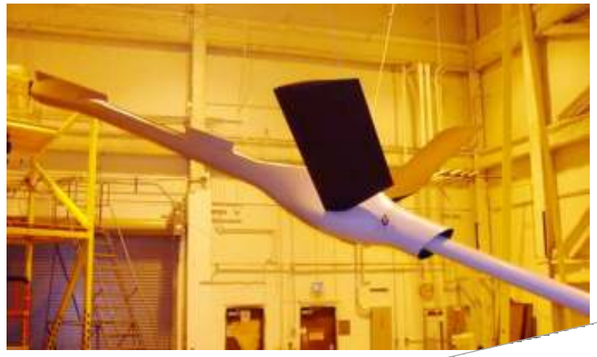
New Design

Flight Test Program Demonstrated Interoperability with USAF/NATO Aircraft

Clint Luttgeharm, PE
Chief Engineer, FMS Boom Program
The Boeing Company

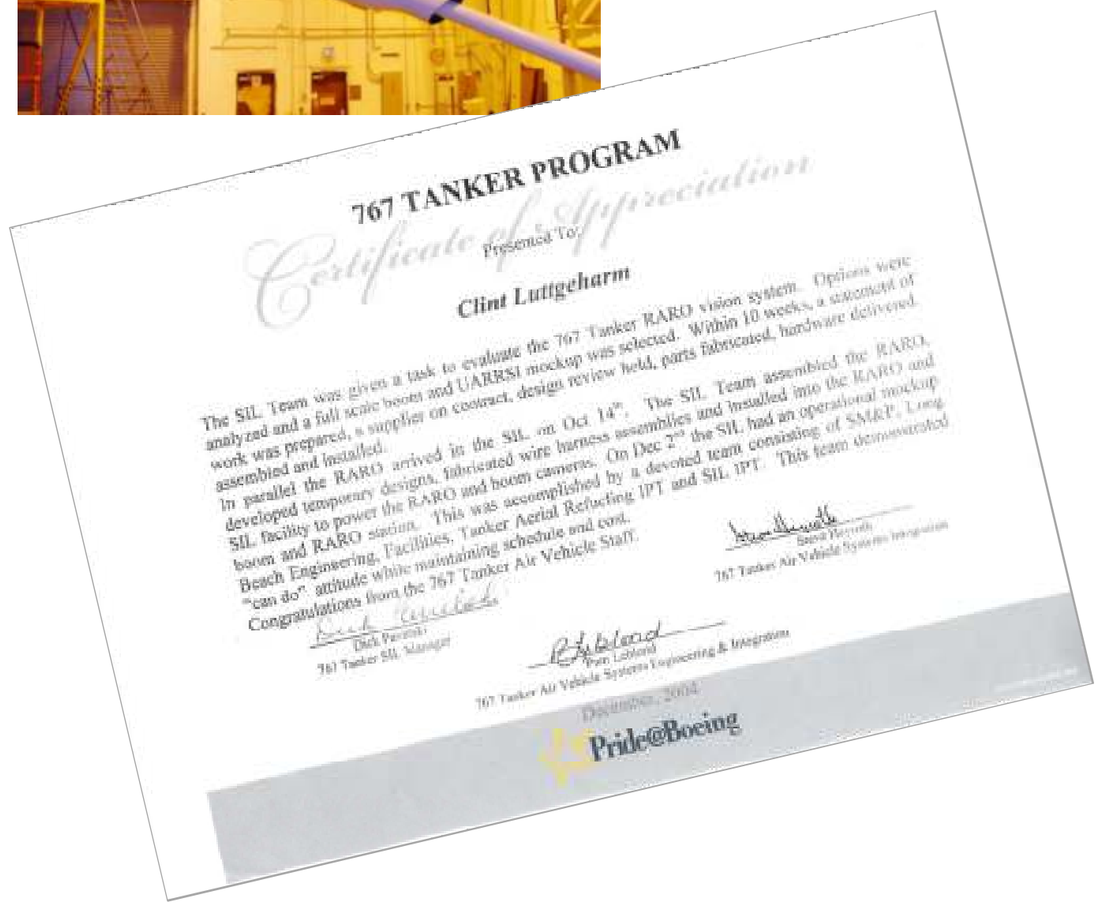
***This project was performed and administered by Clint Luttgeharm, PE while employed by The Boeing Company**

767-GTTA Boom Flight Simulator*



A "Crash-Course" Project for a Full-Scale Flight Simulator System

Design, Fabrication, and Delivery in only 10 weeks


767 TANKER PROGRAM

Certificate of Appreciation

Presented To:

Clint Luttgeharm

The SIL Team was given a task to evaluate the 767 Tanker RARO vision system. Options were analyzed and a full scale boom and UARRSI mockup was selected. Within 10 weeks, a statement of work was prepared, a supplier on contract, design review held, parts fabricated, hardware delivered, assembled and installed.

In parallel the RARO arrived in the SIL on Oct 14th. The SIL Team assembled the RARO, developed temporary designs, fabricated wire harness assemblies and installed into the RARO and boom and RARO station. This was accomplished by a devoted team consisting of SM&P, Long Beach Engineering, Facilities, Tanker Aerial Refueling IPT and SIL IPT. This team demonstrated "can do" attitude while maintaining schedule and cost.

Congratulations from the 767 Tanker Air Vehicle Staff.

Dick Parenti
767 Tanker SIL Manager

Steve Reynolds
767 Tanker Air Vehicle System Integration

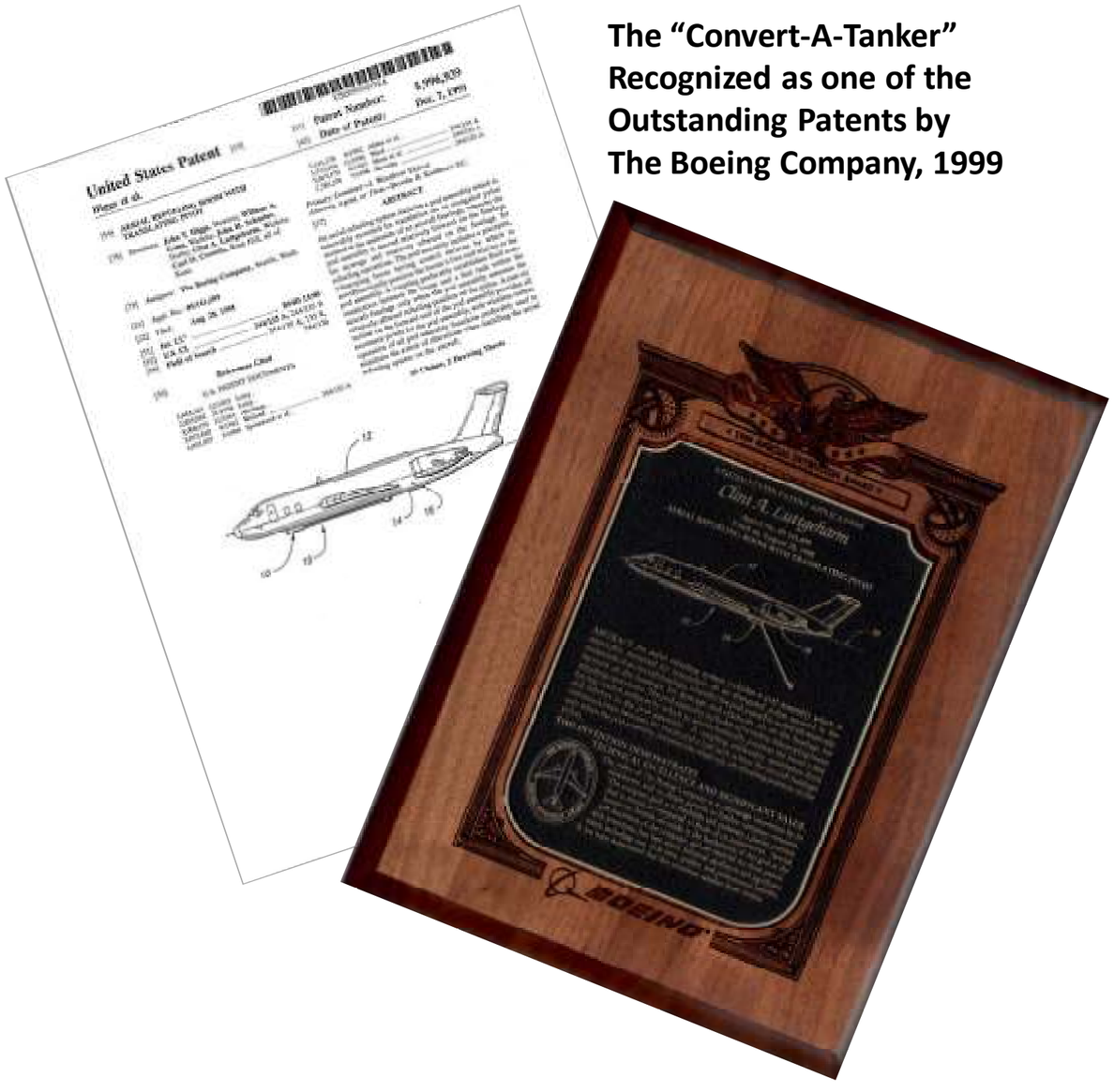
Tom Lofland
767 Tanker Air Vehicle Systems Engineering & Integration

December, 2004

Pride@Boeing

***This project was designed, fabricated, and delivered under the direction of Clint Luttgeharm, PE while employed by D-J Engineering, Inc.**

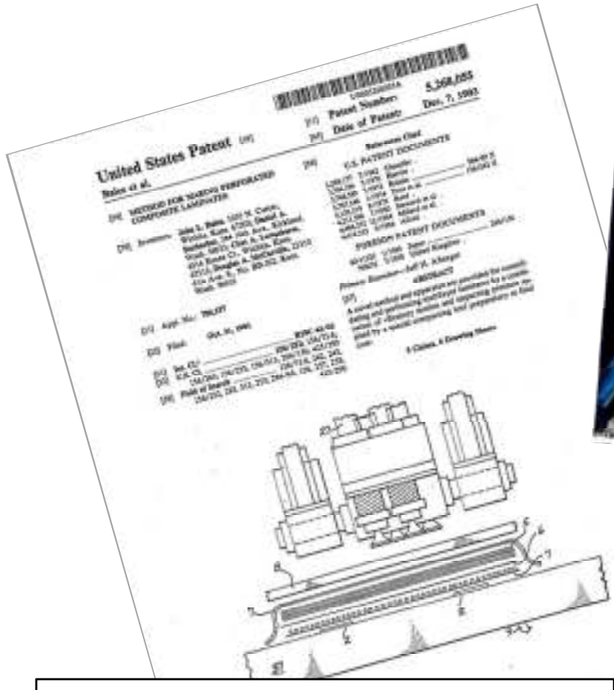
Translating Boom Pod*



The “Convert-A-Tanker” Recognized as one of the Outstanding Patents by The Boeing Company, 1999

***This project was performed and administered by Clint Luttgeharm, PE while employed by The Boeing Company**

Composite Acoustic Panels*



Patented Technology Makes Lighter, Stronger, & Better Acoustic Structures for Jet Engine Nacelles

Over 5900 Boeing aircraft delivered with this technology

Boeing 777

Boeing 737-700

Clint Luttgeharm, PE
Principal Inventor
Wichita Project Lead

***This project was performed and administered by Clint Luttgeharm, PE while employed by The Boeing Company**

CNC Stylus Forming*

Clint Luttgeharm, PE
Inventor

Patented Technology Allows Forming of Sheet Metal Using Standard CNC Milling Machines

***This technology was invented and developed by Clint Luttgeharm, PE while employed by D-J Engineering, Inc.**

TECHcetera…

Do you have a product that isn't performing as well as you or your customer would like?

Would you like to get more out of your production processes?

Would you like to simultaneously reduce the cost and increase the performance of your product?

Are you considering the launch of a new product?
Do you have a product that could use design expertise?

Does your product require certification and/or testing?
Wouldn't it be nice to know that it will work before you build it?

Are your current suppliers supporting your business goals & commitments? Would you like to have additional options?

You can resolve these issues without adding to your staff.
Contact TECHcetera and let me help.

Clint Luttgeharm, PE
316-253-1891
clint@techcetera.net