Aircraft
interiors
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Mining for Gold with *Lean Design*™ in Aircraft Interiors

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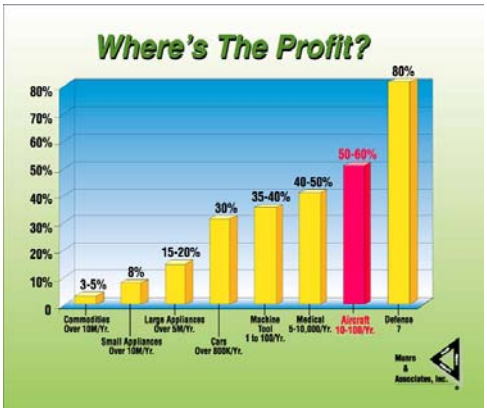
Abstract

Munro & Associates are "design miners" searching for gold amongst the waste ore. How much waste is in your interior design? 10%? 20%? How about 50% cost reductions with improved Quality and customer satisfaction. Companies such as Boeing, Jamco, de Havilland and others have found that by applying Lean Design™ techniques and technology transfer from other industries to be extremely profitable. You see, our job is to trim the fat out of your designs and manufacturing processes so you can move faster to market. This is a rigorous process, which starts with shifting the paradigm, challenging the norm and changing the rules. Our change mechanism is tons of creativity, knowledge and a suit of process tools called Design Profit™.

Design Profit™ is Munro's umbrella for ***Lean Design ™***, the **Quality Report Card™** and **Design for Serviceability™**. These tools serve to ferret out the fat in product manufacturing and assembly. Fat in the form of excessive part counts, operator movements, part reorientations, complex motions, use of special tools and yes, even poor ergonomic movements. And, it can be applied to all types of products, ranging from Barbie, to medical devices, to automotive, to space shuttles, to motorcycles and of course aircraft interiors.



Over the past fifteen years, Munro's ***Lean Design ™*** approach has been successful in helping companies as diverse as Mattel, General Motors, NASA, IVAC, Texas Instrument, Range Rover, Rolls Royce Jet Engine, Textron Industries, Lear, Boeing, JCI, Visteon, Delphi, and many others, to create and sustain profit, by changing the way they develop, design and manufacture products. After working on several hundred thousand projects patterns start to develop and we have found an interesting one I will share with you. Aircraft has more potential for ***Lean Design™*** than any other type of product!

At Munro & Associates, we don't make products, but we do make them more profitable. Consider these TeamMunro success stories. Here are a few:

- Consolidated parts in a console assembly, reduced the number of parts by 33%, the build time by 40%, and the piece cost by 12%.

- Reduced the overall cost of a Lavatory by 50% plus added extra features.

- On an exhaust system improved the customer satisfaction index by 30X and reduced the total cost by 80%

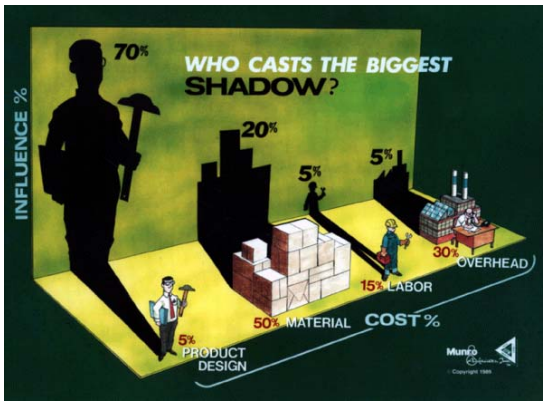
- Redesigned an accelerator pedal and reduced the number of parts from seven and one, generated an estimated 70% cost savings and eliminated 100% of the assembly labor.

If you have the burning need to increase Quality and profitability, you need TeamMunro.

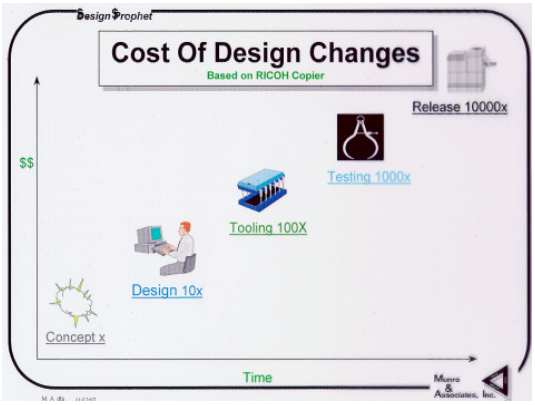
The *Lean Design™* Process – The Four T's

Timing: Do It Right The First Time:

The key to big success is timing. While in the concept stage, OEM's are experimenting with designs; designs, which can create a life sentence of satisfaction or great frustration on the factory floor. Design is the most critical step and the driving force in the manufacturing process. The proof is in the analyses of the product's total manufacturing cost, illustrated in Diagram (1). Product design may only account for five percent of a product's total cost, but it dictates 75 percent of the product's total manufacturing cost. Therefore, it becomes critical that designs are done right, the first time. While in the concept stage, designs can be modified easily with a stroke of a pen and few mouse clicks. Changes are rapid and relatively inexpensive. If additional changes are needed after the design is complete, one must consider all of the downstream activities, which may be affected, such as performance testing, assembly and checking fixtures, secondary tools and production tooling. As seen in Diagram (2) as the product time line progresses the cost to implement changes rises exponentially. To summarize, though it is never too late to do what is right, the later the change, the more expensive the correction.



Influence On Total Manufacturing Cost



Cost of Product Changes

TeamMunro's lesson is to slow down in the concept stage so you can move faster on the factory floor, because the factory floor is where value is created. Slowing down means taking the time to eliminate the fat from product design to create a lean design. Analysis such as ***Lean Design ™*** usually require 20 percent more up-front engineering cost and time, but it typically yields a 50 percent saving in cost and time down-stream.

Teamwork:

Why teamwork? It is not one person, but the collective effort of many specialized people who implement the process of product design and manufacturing. Just look at a few of the necessary product development steps: styling, design, testing, tooling, manufacturing and assembly. If we look at the cycle as a linear set of steps, where one person completes a task and throws it over the wall to the next person or department, who in turn completes their task and throws it over the wall until the last task is complete, what are the chances that the outcome will meet the first person or department intentions? Probably slim. The reason is lack of communication and sharing of information. But, if everyone is in the same room at the same time, information can be exchanged. Every team member has an opportunity to voice concerns and resolve these concerns for the collective benefit of the team and the product. It is a win-win for people and products. The right team has several success ingredients: commitment, early formation, and multi-disciplinary.

Commitment vs. Contribution:

There is a big difference between contribution and commitment. Contribution is short -term assistance; commitment on the other hand, is sometimes legal, but always a morally binding dedication. Though both are voluntary, one is a definite binding arrangement, that once initiated is hard to break without consequences. When in a commitment, it becomes personal, and each member is mutually accountable for the outcome, no finger pointing, shifting blame or excuses. So, it is understandable that many people are very leery about commitments. But, no great invention, discovery, innovation or breakthrough came about through contribution. There is no substitute for commitment, you either are or you are not. TeamMunro has a saying; ***"A focused, committed team will outperform a group of individuals with more technology but less focus every time".*** So, if success is the desired outcome, commitment is the first, and most important ingredient.

Early:

Early team formation is essential. Getting in early guarantees every team member has the capability to influence the design in the concept stage. And as we said earlier, product design dictates 75 percent of the product's total manufacturing cost. So, getting to the gate on time is important if you want to win the race.

Multi-disciplinary:

To win the race everyone needs to hand the baton over to the next person or department so they can run their leg of the race. If that person or department is not represented or present, everyone on the team loses the race. This is why all product disciplines must be represented,

from the finance office to the factory floor; include men and women, union and management, OEM and suppliers. Have you ever noticed a team on the playing field? You cannot tell one member from another, if it was not for the number on the back of their jersey? The reason is simple, everyone on the team is an equal and important member, and collectively, they present a united front. That is a Team. Every member works towards a common goal. They have a function to perform, and have an equal stake in the outcome.

Training:

Teams train to win. Training is the process used to strengthen and stretch team members to go beyond their current skill set and limitations. Futurist, Joel Barker speaks to the ***"paradigm effect"*** in which individuals and teams see only what they want to see because they are blinded by their own experiences and perspectives. In product design, the "paradigm effect" creates blind spots where there is opportunity. The end result is parts and products that never change. The ***Lean Design ™*** training helps people to break-through the paradigms so the team can begin to think in new and creative ways. The process of product design break-through begins with changing the rules.

Tools:

Lean Design ™ is TeamMunro's change kit. The process begins with **BOB.** **BOB** is TeamMunros' **B**lindfolded – **O**ne arm – **B**uilder. He is a member of every Lean Design team. And, when you design for **BOB** as a teammate, everything begins to change. **BOB** is **the** change agent, because he changes the rules. Now, every team must begin to think differently to accommodate **BOB** in their product designs. The Good Design Principles and the Part Value Challenge are focused on ensuring **BOB** can do his job.

Good Design Principles:

- Teamwork – The Difference Between Good/ Bad Designs
- Minimize The Number Of Parts
- Avoid Excessive Secondary Operations
- Design Out Handling Problems – Think Bulk Storage
- Use Gravity, Don't Fight It
- Design Parts That Are Easy To Insert/Align – Design for **BOB**
- Design The Parts To Fixture Themselves One To Another
- Design The Product For Poka-Yoke – Design for **BOB**
- Question Servicing And Simplify Or Eliminate Packaging
- Eliminate Movements, Adjustments, Ergonomic Problems, And Reorientations

The Part Value Challenge: **Good Part** ✓ or **Bad Part** ✗

1. Does It Have To Move?
2. Does It Have To Be A Fundamentally Different Material?

Is there a part you can't decide on? **When In Doubt, Throw It Out!**

Poor Quality Drivers: Eliminate them! Achieve better quality!

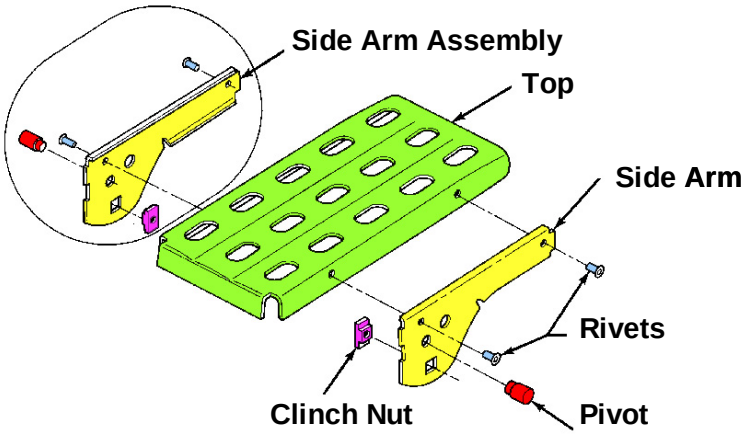
1. Fasteners
2. Springs
3. Belts

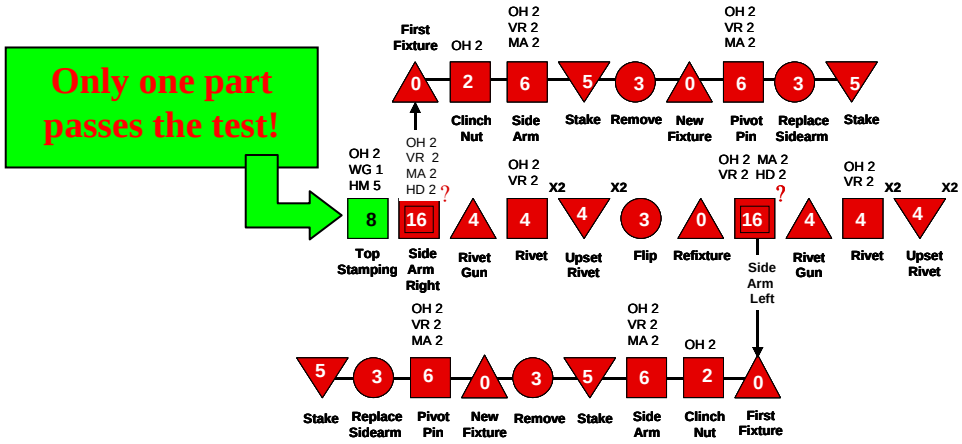
The easiest way to illustrate the impact of these simple rules is to review a product example.

Product Example:

Below is an exploded view of and existing stamped and riveted metal armrest bracket assembly and the ***Lean Design ™*** Assembly Diagram. The Assembly Diagram graphically illustrates the following:

- There are 11 parts designated by ■
- There are 9 Fastening Operations designated by ▼
- There are 7 Tools designated by ▲
- There are 5 Operations designated by ●
- And 2 Subassemblies (Side Arms) designated by ◘





Using the Part Value Challenge and Poor Quality Drivers, we look to eliminate the fat from the design in the form of unnecessary parts and operations. We start by assigning value to

one part, the part that most represents the work being done by the entire system, i.e. the top. All other assembled parts to the top are challenged for part value. Analyzing each component, the following are eliminated:

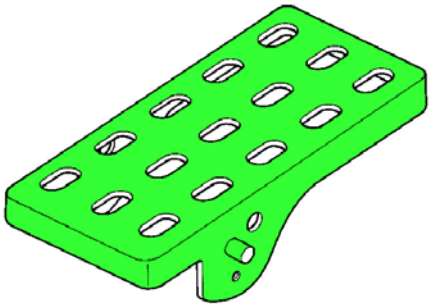
The Part Value Challenge**:** **Good Part** ✓ or **Bad Part** ✗

1. Does It Have To Move?
2. Does It Have To Be A Fundamentally Different Material? – ***(Side Arms*** ✗***, Pivot*** ✗***)***
3. When In Doubt, Throw It Out

Poor Quality Drivers:

- No Springs
- No Belts
- No Fasteners – ***(Rivets*** ✗***, Clinch Nuts*** ✗***)***

The analysis shows only one part is necessary to satisfy **BOB;** it is the top.



But this is not the best design! We found a way to decrease weight and incorporate the cloth and foam in one step! All for less money than the metal bracket alone!

Redesigned One-Piece Armrest Bracket

The creative process of brainstorming is used to generate redesign ideas to meet the new ***Lean Design*** ™ requirements. In this example, the break through is material selection. Unless the team is willing to embrace new material choices and manufacturing processes, the answer will never surface and the product improvement will be insignificant. A one-piece plastic armrest bracket is a very feasible idea involving only engineering, no development or research. TeamMunro calls this Low Innovation.

Low Innovation: These ideas require **engineering** only. The technology is not new to the product market and all team members feel comfortable that, with minimum testing and validation the ideas can be incorporated.

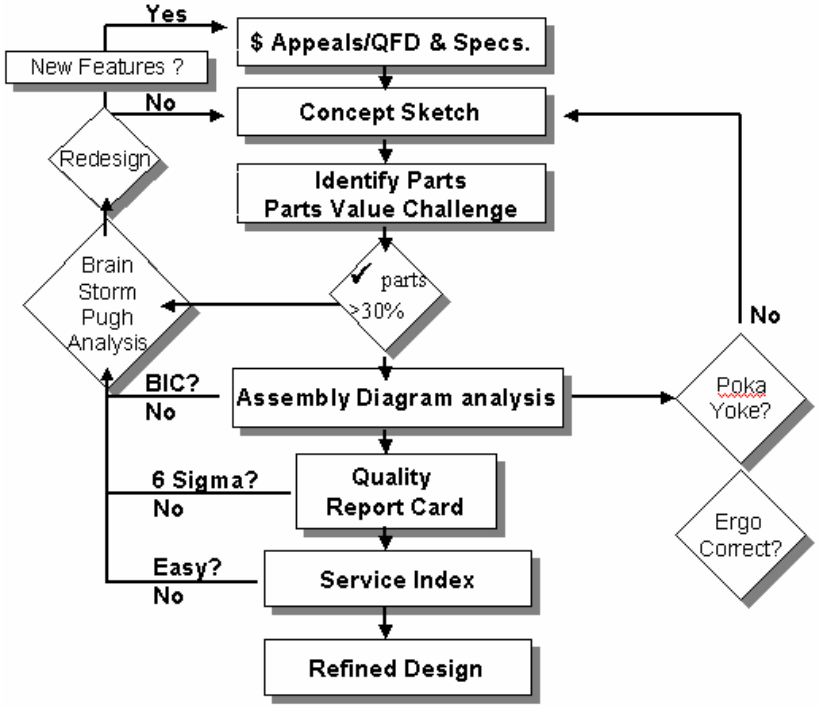
Medium Innovation: The medium risk idea requires **development**. It may be a technology utilized by another industry or a combination of materials and processes unfamiliar to the team. This level can sometimes product patentable ideas and is the most likely level to implement.

Stretch: These ideas are inventions and require **research**, experimentation, testing and validation. They are ideas that are on the edge of a new paradigm and in some cases thrust their companies to the forefront of their businesses. Almost always patentable, these ideas are the ones, which have the potential to leapfrog past the competition.

But how can we make it ***"Faster, Cheaper and Better"?***

- Bring all relevant information about the product or ideas: Sketches, drawings, parts, prototypes, FMEA's and appeals, competitors products, $APPEALS, competitors products, QFD specifications, costs, weights, data, labor rates and product volumes. In other words, the more data the better.
- Assign component numbers to the parts as they are logged in order of assembly on the ***Lean Design ™*** worksheet and carry out the part value challenge. (**Good Part ✓** or **Bad Part ✗**)
- If working on a concept design, calculate the design efficiency immediately. If the value is less than 30%, stop, redesign and reanalyze.
- Create the assembly sequence chart. Document all assembly processes including the use of jigs, tools, and all non-value-added operations such as reorientations and multiple handling.
- Keep good notes and make sketches throughout the process.
- Fill in the appropriate penalty units and identify poka-yoke, ergonomic and service opportunities for design.
- On service items, calculate the service index. If more than one area for service exists, then total the indices to determine the overall service index.

Flow Chart of Method:



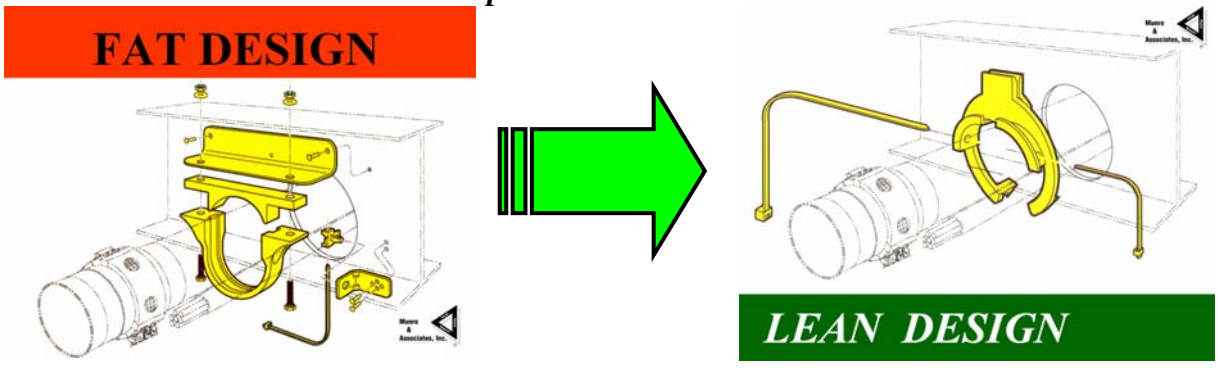
Project Steps for Existing Product Design:

- Familiarization: Project Leader Reviews The Design Status
- Assembly Diagram Of The Current Design – Establish Baseline
- Analysis of current design:
  - **Good Parts** ✓ -VS - **Bad Parts** ✗
  - Get Parts – Look at the problems **BOB** will encounter when he tries to remove a part from its shipping container and gets it ready to "PUT" into place
  - Put Parts – Once **BOB** has the part in his hand he must put the part into the assembly. **BOB's** problems with getting the part are usually small compared to putting it into position.
  - Poka-Yoke – To Do Without Thought.
  - Material Costs
- Brainstorm:
  - Generate Ideas – Go for Quantity not Quality
  - Rank Ideas By Quality and Risk Level
  - Package Into Concepts
- Redesign
- Analyze Redesign Concepts (Same as Analysis Of Current Design)
- Prepare Presentations

Summary:

At Munro & Associates, we have three rules for business: innovate, innovate, innovate. Product engineers should dare to deviate, to move away from the norm. ***"We always did it that way before,"*** is a sure sign that progress is stagnant. And, while you're standing still, the competition is passing you by. Joel Barker says of industry, "If the rules change, everything goes back to zero". In other words, if the competition develops a new design or process, which essentially obsoletes your product, you are sent back to ground zero. Most companies avoid dramatic changes until they are at risk, and when it is too late. But, if you can start the change process before there are signs of trouble, there is a huge competitive advantage. Promoting continuous product improvement through the use of powerful tools, such as ***Lean Design ™,*** is one sure remedy for stagnate, lack luster product designs. The gains achieved through continuous product development activities will keep you in the market share race. Innovation, on the other hand, will escalate you to a leadership position. Innovation begins with changing the rules and shifting the paradigms. – So, ask yourself this simple question:

"What today is impossible to do, but if it could be done…. Would fundamentally put your competition back to zero?"



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