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***Lean Design™* for Assembly and Manufacturability: Winning the Global Manufacturing War by Design**

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ABSTRACT:

Design for Assembly pioneer and Lean Design™ creator Sandy Munro explores how the commercial best practices of state-of-the-art computer software, combined with the 2,000 year old military philosophy developed by ancient Chinese strategist Sun Tzu – can help the North American shipbuilding industry win the battle for profitability.

Profitability in manufacturing derives largely from a product's design and development – where most of the product's total cost and potential profitability are established. By leveraging the power of Lean Design™ taking a strategic and holistic team approach, and adopting new rules, manufacturers of all kinds can create products, which can literally blow away the competition.

ANNIHILATION – PROFITABILITY OR FAILURE?

ANNIHILATE. That's a strong word. A word you don't use very often. For most, it brings to mind devastation, destruction and grief to the vanquished. In our "Politically Correct," "Kinder, Gentler" business world "its not fair," it has no place. Instead annihilate is reserved as a war word, the last uncivilized resort to end a conflict.

But annihilation does have a place in business ... and it can mean the difference between profitability and failure. War and business have long been compared.

To map out business strategies for our customers, we use the book The Art of War written by the great Chinese General and Philosopher Sun Tzu. Why? Because it's so easy to annihilate the competitors who use traditional or conventional business methods.

SAVE MONEY VS. MAKE MONEY

The **Save Money** approach – popularized by MBA's - always generates the same poor results. But because so many Americans are familiar with it, it is accepted as gospel and the only way to do things. We believe a **Save Money** approach always has the **same key elements:** running scared, short term objectives, cuts in labor & materials, no time or need for analytical methods, timing chart mentality, reactionary mode and run by hip shooters.

Let us explain: **Save Money** companies run scared because they have no strategy and when any company does something different, they react. Most of the time they react without thought. To put most American **Save Money** companies out of business, you can do it in three tries by using the **Munro** business strategy of "**innovate, innovate, innovate.**" Quarterly Goal Setting is very standard in North America. Who wants to look into the future more than three months?

The prime way to **Save Money** is to "make cuts" ... it's easy to attack the defenseless. Squeeze vendors, and make them come up with a 15% price reduction. Where do they get it? How is it going to affect quality? Who cares? Just get those cuts

... And by the way, lay-off half the workforce, we'll get our money this quarter. And why use analytical methods when there's the "good old gut feel?" "Why, I can feel an up-turn already, or is that gas? Never mind, we're on the right road; I can feel it!"

The timing chart mentality usually translates to: Let's rush it through development and we'll fix it on the factory floor. The "Activity" has become the substitute for "Achievement."

The last two points are inseparable. "Hip Shooters" react. It's so much easier and exciting than boring strategic planning. A **Save Money** approach yields a quick return. This cash infusion is usually turned into a photo opportunity for some rising star in the organization who has shown a quick and needed profit. The next phase that takes place is, "**Sitting Down in the Parade.**"

Business is like a parade ... as long as you keep marching you'll at least keep up and be a mediocre kind of company. **Save Money** companies, however, seem to go out of step, surge ahead for a block or two and then sit down thinking that they've got it made. This could be a problem if there is an elephant in back of you. As soon as you rest and stop innovating, you're likely to be crushed! You'll recognize these kinds of companies by their performance on Wall Street. The stock of **Save Money** companies usually rises like a shooting star, only to fade from view in a short time.

SUSTAINING SUCCESS

If there's one truth in today's business world, it's this: **Success is easy to attain, but difficult to sustain.**

If you want to not only attain success, but also sustain it ... you need to dump the **Save Money** approach and adopt the **Make Money** approach:

- Investment in time & money
- Long term goals (10-20-100 years)
- Analytical approach
- Team approach
- Little politics

No one ever made a nickel by putting his money in a sock and hiding it under his bed. To create and sustain profit, you must wisely invest your resources of time, money, and talent, always looking to meet your long-term objective. Sun Tzu says "**Plan for what is difficult when it is still easy, do what is great while it is small.**"

The **Make Money** Company uses the philosophy of "killing two birds with one stone." By planning and investing in a 20-year strategy, any company can lead the market in its sector. The one thing a corporate leader cannot do is accept a loss or a tie. No one remembers who came in second. Being second means you are "*the first to loser*". (For those who travel to Japan, think of how many times you heard the term "**Ichi Ban**" – number one). Lead the pack. Let the others all get the same view of you. Those in the world of dogsledding have a similar saying: "**The lead dog has the best view.**"

ANALYTICAL APPROACH

"If you have no numbers to support your theory you don't know what you are talking about."

-- Sir Isaac Newton

That says it all. Analytical approaches are crucial. And they are available for all phases of a program – Quality Function Development (QFD) to understand the customers’ needs and wants; Pugh Analysis to help benchmark and compare features; *Lean Design*TM to eliminate waste and *Keep it simple*; Quality Report Card (6 sigma design) to ensure high quality and cost-effective processes; Failure Modes Effects Analysis (FMEA) to head off potential failures; and Design to Target Costs (DTC) to ensure the product is brought in at the right cost. These are the powerful tools that can transform ideas and feelings into universally understood factors and dollars.

Long-term product design decisions – which may affect millions of dollars over the life of the product – shouldn’t be made on a whim or on one person’s hunch. They should be made based on data.

Remember, in the absence of data, people make things up!

And by the way, Emotion is fine as long as we can quantify it.

TEAM APPROACH

Teamwork is the cornerstone of all the above. Without a diverse and dedicated team, none of the high sounding plans have any meaning. If you only have money or time to invest in one thing, invest in a team approach. The biggest problem we have seen with teams is a lack of diversity.

In a typical company, a bounty of knowledge exists within the established organizational areas: the executive staff, marketing, finance, purchasing, engineering and factory floor labor. Unfortunately, in many companies, new product developments or redesign efforts virtually ignore many of these information sources. While teams are created, they often lack diversity and dedication, so the high-sounding plans have no real meaning. They often involve the same old people, trained the same old way, sharing the same old experiences.

To let only engineers participate on the development team is like making **soup with no spices**. It has the main ingredients, but something is just not right.

In order to have successful product development, you must assemble the right team. Here is our **recipe for a team that can really get your product development efforts cooking**:

The Munro Cookbook Recipe for a Team: Start off with a basic engineering stock and add marketing and finance ... then spice up your team with hourly rated, add one executive for credibility, add a pinch of service, and if you like it hot, go crazy and add customers. Then stir constantly with an outside consultant until done. The recipe serves everyone, and you’ll love the results. A word of caution: the only thing that will spoil the broth is internal politics.

NO SILVER BULLETS

Most American companies are scrambling to acquire new technology and implement lean manufacturing strategies which will help them catch up to, and compete with, Japanese and European companies. They are looking for the silver bullet. But they are missing the chance to **leapfrog ahead of** and actually **annihilate the competition** in the marketplace. Trying to fix things by attacking downstream activities and

technologies is like pouring perfume on a pig; all you get is a pig wondering what the smell is. That is why we suggest you can never have Lean Manufacturing without first applying *Lean Design*[™].

The real **key to success is in the design work up front** – which controls the majority of the downstream costs. Dramatic improvements in the product and the product's profitability can only be enjoyed if the organization takes a holistic view of the process from QFD to first customer ship. If this is done, products manufacturing cost reductions of 30 to 60 percent are not unrealistic. In fact, they are common!

Other Benefits:

- Improved product quality/reliability due to significantly reduced variation;
- Reduced labor, overheads, manufacturing floor injuries, and administrative paperwork;
- Lower product service and warranty costs and easier product service; and
- Reduced product development and manufacturing cycle times.

In the war for market share and survival, the right tools and a team approach can be the **most potent weapons** in the company's arsenal. Yet, while Quality Function Development (QFD) and Design for Manufacturability (DFM), etc., are heard in corporate speeches and extolled in corporate strategies, they are only found in actual practice in a few small pockets of excellence – usually at the subsystem or system level.

In fact, in spite of all the talk about DFM in the auto industry, no North American automaker, division or platform can boast a true concurrently engineered/DFM'ed vehicle because of carryover parts, piece-cost accounting procedures and "car versus career" decision-making.

Again, **scoring a single success is easy. Sustaining success is difficult.**

The power of an integrated concurrent engineering approach revolves around two indisputable, but often overlooked facts:

- The design process is the only step in the product cycle where value and profit can be created.
- **Product design**, which accounts for only **five percent** of a product's total cost, actually **dictates about 75 percent** of the product's total accounted manufacturing cost.

With an integrated approach, a company considers all of the downstream activities during the earliest design stages. It uses analytical tools to quantify and test for the best possible processes and approaches up front, so that a team can get the product **right the first time** ... and avoid costly, late fixes on the factory floor.

By taking a teamwork approach to incorporating the critical input of finance, marketing, purchasing, manufacturing, and factory floor labor in the earliest design phases, you can generate **significant reductions** in total manufacturing cost, product development time, and manufacturing variation. The result is a more elegant, reliable design that is **easier to manufacture and assemble**, and substantially **more profitable** to produce. In other words, a design that can help to annihilate the competition.

Here's our definition of **an Elegant Design**:

- Looks good,
- Functions well, and
- Can be built with quality at a profit.

The key challenge in successful programs requires people and companies to castoff the old tried-and-true approaches. It requires them to see what everyone has seen, but think differently from the way everyone else has thought. It requires them to attack – rather than revere – the company’s “**sacred cows**” and venture into uncharted, uncomfortable territory. **To succeed, dare to deviate.**

Such dramatic paradigm shifts do not occur easily or quickly, especially in old or large companies. But they can occur with a committed and supportive leadership.

OBSTACLES TO SUCCESS

Today, the three most common reasons for a company failing to realize its full potential stem from the old corporate cultures.

First is what the Japanese call the “**fast gun/slow bullet**” syndrome. This is a company’s propensity to rush through initial engineering to produce a design quickly, only to spend exorbitant amounts of time, effort, and money to correct the design and perfect the manufacturing processes after the product is on the factory floor. Although *Lean Design*[™] usually requires 20 percent more engineering cost and time up front, it typically **yields a 50 percent savings** in cost and time downstream.

The second most common obstacle for not reaching its potential is the nomadic migration of key team personnel in and out of a project. In the North American auto industry, it is not uncommon for as much as 60 percent of the personnel to turnover during a development program.

This turnover tends to erode ownership of team goals, cloud the team vision, and weaken individual commitment to the project. And when individuals lose a sense of ownership in the new solutions, they lose sight of the team’s long-term goals and revert back to the old ways. **Sun Tzu says, “Good warriors seek effectiveness in battle from the force of momentum and not from individual people.”**

The third major obstacle to success stems from the fact that, in most corporate cultures, radical new designs or innovative approaches are not only left unrewarded, they are often punished.

Sometimes the parts reduction or cost reduction generated by a team’s innovation is so drastic and so incredible that the senior executive in charge cannot accept it. When this happens, they lash out at the very team they are supposed to nurture, banish them to a less desirable position, and occasionally even fire the person responsible for what is really a breakthrough idea.

KEYS TO SUCCESS

In our work over the past two decades helping North American manufacturers of all types implement VA/VE, *Lean Design*[™], or DFA & DFM it appears that the **companies that have been truly successful have five factors in common.**

First, the company’s leadership has acquired an **intimate, detailed knowledge** of all the tools and has ‘hands-on’ experience on a project team. They have also demonstrated a fervent, long-term commitment to the discipline. At companies where we’ve seen only a half-hearted commitment by senior managers or cursory participation by a key executive’s experience, the entire project is at peril.

Second, the successful company has developed and implemented a **detailed, strategic and all-inclusive action plan.** This plan helps to immerse the whole

organization into the process and nurtures the team-oriented culture so crucial to its success. It also includes the key elements involved, such as the scope of knowledge, timing, tools, methodology, and resources, which will be required. Remember, Dr. Deming's first point about creating a constancy of purpose. A detailed plan does this.

Third, the **action plan is “owned” by everyone involved**. It is not enough to distribute the plan to the organization. To be successful, the plan must be understood and accepted by the individuals involved. They need to agree with the objectives, know how they fit into the plan, know what is expected of them, know that risk-taking will not be penalized, and make their own personal commitment.

As Sun Tzu put it: **“When people are skillfully led into battle, the momentum is like that of round rocks rolling down a high mountain.”**

Fourth, the successful companies have **turned to an outside organization** for what Dr. Deming has called **profound** knowledge. Since most companies and industries become myopic because of shared paradigms, they need someone to shake up their thinking, get them to question the old ways and to bring new ideas, approaches and technologies that have worked in other companies and other industries.

This outside perspective is crucial in guiding the company through the inevitable doubts and rough spots, and in keeping them from reverting back to old, more comfortable ways. As we said in our recipe for a team, **the outsider helps to stir the broth**, so the **right** things happen.

And fifth, the successful companies admit they have enjoyed **some luck**. But the strategic manager – just like the strategic general – can make his or her own luck by keeping **a couple of four-leaf clovers** with them throughout their campaign.

The first four-leaf clover outlines the crucial ingredients for success:

- True to management **commitment**, not just contribution;
- **Early involvement** – at the concept stage;
- A **multi-disciplinary team** that includes shop floor operators – the most product knowledgeable, yet underutilized resource a company has; and
- **Analytical approaches** – so decisions are made based on data and numbers, not emotions.

Of course, having the **second four-leaf clover** never hurts. This one the, “4Ts” emphasizes the key considerations for *Lean Design*TM success:

- **Teamwork** – a focused, committed team will outperform a group of individuals with more technology but less focus every time;
- **Timing** – extra time must be allotted at the design stage. In the end, you will save time by doing things right the first time ... and probably gain a product generation advantage over the competition;
- **Training** – People will not think in new ways or use new rules without training. Training helps people discover the limitations they have put on their own creativity. And it helps the team to see the product and the processes in the new and different perspective that is needed to create a breakthrough design; and
- **Tools** – Several analytical tools and computer methodologies are available to provide teams with the data they need to make wise choices.

These tools include such various approaches to QFD, Pugh Analysis, *Lean Design*TM, Quality Report Card (6 sigma design), FMEA and DTC. Teams should benchmark tools

rather than using those most readily available. For maximum advantage, they should pick the tools and approaches, which best fit their specific needs.

Tools are important, but remember: They are just tools. Thinking that tools will solve all your problems is like starting up a **chainsaw** and throwing it into the woods and expecting **finished 2 x 4's** to come out.

If done properly, *Lean Design*TM conducted in the team approach cuts investment cost, improves product quality and customer satisfaction by reducing variation, and reduces lead-time; it can also yield the additional **benefit of patents**. Hundreds of such patents have been generated by teams we've counseled. And the serendipity of patents is that they **double your payback** – first providing you a cost advantage over the competition and then providing a second income stream from selling patent rights.

As a result, *Lean Design*TM will not only help the manufacturers who embrace it become **more profitable and more competitive**, it can help industry address other key societal issues.

For example, by considering the factory floor operator in the initial design, **ergonomic workplace injuries** and related **health care costs** can be contained. And, by considering **service and recycling issues** in the initial design, manufacturers can make their products easier to service for the consumer and easier to recycle to help preserve the environment.

One customer's elegant design is based upon a strategy to actually make profit on the return of a used product, by starting with an easily recyclable material. A product like that, one that **generates profit for a company twice**, is truly a winning product.

Some 2,000 years ago, Sun Tzu developed a military strategy that applies in today's manufacturing industry. **"The battle is won in the strategy room, not on the battlefield."**

For us in the battle, it is still good advice today. **Take the extra effort to do it right the first time and win the battle for market share by designing for annihilation in the design room, not on the manufacturing floor.**