Chapter 3
Innovative Manufacturing

By Wayne Lundberg, CMfgE

In the first two chapters you were introduced to techniques to increase brainpower through visualization and mind mapping ®Tony Buzon which in effect doubles the average human being's thinking abilities.

The question raised in the introduction now looms. What? What will we try to do and why? There being so many opportunities and so few resources, it is imperative to discover where the biggest bang can be had for the least expense in time and money.

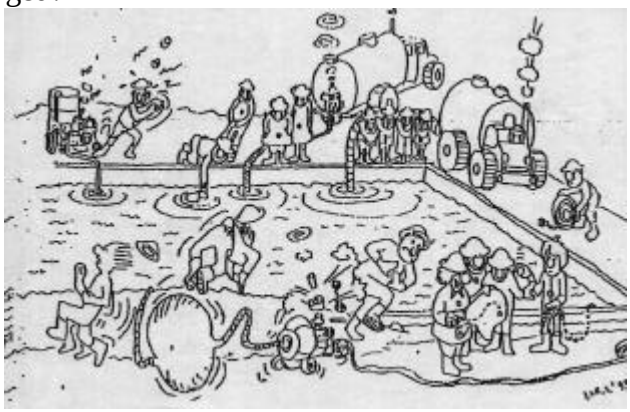
Do not confuse problems with opportunities. This gets a lot of people in trouble, kind of like 'foot in mouth' disease. You must be able to distinguish between the two at once and then formulate a series of steps for each. The same formula does not work in both cases.

A problem is where something worked well, and then it does not.

An opportunity is something we see in our mind's eye but has not happened yet. There is no history and therefore difficult to prove there may be a return on investment.

In chapter 2 you saw the step by step process of solving a problem with the Centaur combustor. Production had been under control when suddenly the units failed under testing. What had changed? That is the first question one must ask when facing a problem.

If all worked well and we got good parts and suddenly we're out of control, what has changed?



As obvious as this statement may seem, it is the one most often not asked or ignored by management when an underling suggests the reason. You see, when a problem occurs, a lot of management people like to take the limelight and 'solve' the problem by issuing directives and orders.

Remember this famous cartoon? The bosses study plans and issue all kinds of orders. One little guy tries to get their attention.

Out of desperation and at the risk of being fired he pulls the plug and solves the problem.

There is no need to discuss problem solving when discussing innovative manufacturing. There are tons of books and lots of graphs that have been developed for this purpose. I usually start with a fishbone then launch a treasure hunt using as many people as I can get to look for anything that has changed since we last made good parts in this process.

So let's jump right into innovative manufacturing.

At Rohr I was fortunate to be a part of a 22 genius team made up of manufacturing innovators from many disciplines. Gill Cadwell had pioneered explosive fabrication, hydro-forming, capacitor discharge explosive hydroforming and lastly superplastic forming of Titanium. Bob DeBischop had been chief engineer at Piper. Some had worked with Kelly at the Skunkworks, others had pioneered breakthroughs from the use of plastic tooling, automated riveting, abrasive waterjet machining and so on. Our mission was to explore innovative manufacturing technologies from all over the world and see what could be used to make better/cheaper airplane nacelles, thrust reversers and the like. These were the days before the water supply for the Rohr executive suites became contaminated with God-knows-what that dissolved gray cells at extremely high velocity. Almost overnight manufacturing technology lost the right to be heard and it's funding. Within six months the company lost 60% of it's business because of it. Within a year employment fell from 12,000 to some 3,000. This should be a case study for those who feel that innovation is not cost effective.

Enough sour grapes, there are a zillion other examples like this in today's world. Our loss is China and Mexico's gain.

This chapter deals with successful innovation and how to achieve it if you don't already have it or do it.

My first assignment was to help bring abrasive waterjet sheet metal cutting into the real world of manufacturing. Up to that time waterjets had been used to cut diapers and make salmon filets. With the assistance from the Air Force through funding, we bought the first model of a Flow Systems AWJ systems, put it on a two-axis gantry controlled by an Allen-Bradley 8200 CNC. Like any other go-getter in those days I 'stole' time to walk the

many buildings from machine shop to final assembly looking for ‘trouble’. It’s what most of us did when not working directly on a project or task. I took notes and slowly began building a Pareto analysis of most likely opportunities.

The key was in identifying where the most manpower was being used, where the most scrap was coming from and where you heard the greatest number of complaints. Our salvage yard was a gold mine for me. It was easy to see the kind of parts that were the most difficult to make and created the tallest scrap heaps. I eventually developed a lead-through programmable robot shooting abrasive waterjet at all kinds of odd angles to replace dozens of trimming operations and a material condition analyzer to test material’s ability to be formed before being smashed into shape. Neither was ever used in production. We lost the ball before receiving the kick-off.

Here are the steps I use in discovering and developing better ways to do things; i.e. innovative manufacturing.

I always carry a piece of paper in my shirt pocket along with a four colored pen. Whenever I see an opportunity I jot it down in one or two words, just like in mind mapping. Every time I see the same opportunity I put a tick next to it on my note. Slowly the list gets longer and longer, but only two or three items seem to be growing tick marks. Before you know it you have an automatic Pareto analysis in your hand.

When time permits I write ideas of how to approach an improvement on the other side of the paper. Often I end up with two or three sheets. One will be my calendar. Rather than watch television when I get home I will doodle with the items on my list. I will most likely put these doodles into my cloth bound invention note-book along with dates and witnesses. My prior employers have registered dozens of my ideas from these notes.

At some point in time, usually around 2:30 in the morning, I will wake up with a tremendous insight and will jot it down on a piece of paper on my bedstand where I keep a pen-light, pen and paper. Nine times out of ten when I read my brainstorm in the morning it gets a chuckle and tossed into the round file. One time out of nine it will receive serious consideration and further research. In nine times out of ten successful innovations I got the key idea from these nocturnal insights. And it is so true what they say; invention (innovation) is one part inspiration, 99 parts hard work. Because once I have the key idea I simply can’t let go. I must bring the idea into the real world. And that’s the hard part.

Why? Because now you are about to threaten the way people do things. You are going to upset their apple-cart. You are bringing revolution where none was asked for. We’ve been doing it this way for years…!

Even when my job description was to innovate, the hardest part was convincing my supervisors and their managers and directors that the idea was worth pursuing. On the Charo project (robot cutting compound irregular shapes) it took 24 presentations before getting CEO approval for the project. Each presentation was an adventure in Dante’s Inferno or Torquemada’s court.

Of course this is not a fair statement for all companies. In five years at Rohr I managed to get three project through the system. At Caterpillar’s Solar Turbines I got 16 projects through in less than two years; one of them worth a cool $25 million a year in savings later to become a separate division of the company.

The major difference between these companies had to do with corporate culture and the fact that I had a very powerful sponsor at Solar but not at Rohr where I twice got

reprimanded for bypassing the chain of command. Keep this very important element in mind as you become George and challenge the dragons.

Ideas by themselves take you nowhere. The best ideas in the world were at first ridiculed. Braille suffered in darkness all his life, not just from being blind, but by the experts in writing for the blind who kept him in the basement. The Wright Brothers flew around Dayton only to be ridiculed by the citizens. Ford cars were outlawed in many towns because it scared the horses. The list is endless. Yet the inventor firmly believes their idea is the salvation of mankind and cannot understand why others don't see it also. Get used to it! Learn how to deal with it. It is the single greatest road-block to innovation of any kind.

You need tools, key tools to prove what has not been done, as a distinct possibility and benefit to the company.

If there is enough interest in this subject I will post 12 chapters which contain the tools I have used to innovate and create improvements. It boils down to a process of continuous improvement where observations are converted into the language of money, sold to management to get the resources, develop and lead projects, implement the change and make it a part of the new business.

You can take the first step by exploring the idea of experimentation. Well documented experimentation is a fundamental tool in building the kind of arsenal you will need to convince management that your innovative idea is worth pursuing.

An experiment could be a proof of concept or an actual trial run outside of the mainstream of profitable activities. Experiments may be designed in traditional scientific methodology or with some variety of grouping variables approaching a Taguchi format, or anywhere in between.

Traditional experimentation must be well documented in such a way that anybody else can repeat the experiment with the same results you have obtained. Usually you will conduct a series of tests or steps to establish some kind of standard. Then you will change one variable and document the changes under differing conditions of that variable. Then you repeat the process with other variables, recording the change in performance from the standard for each variation. It may take years!

A variation of the Taguchi method lets you use the normal curve and statistical probabilities along with your change in variables so that you can change two or more variables, run the experiment, write the changes, run a calculation and see which variable caused the greatest fluctuation. Proper use of this technique may reduce experiment costs and time by quantum leaps.

Sometimes you don't have to do anything but get a couple of people from the line, give them a mockup of your idea, and let them brainstorm it.

My favorite way to innovate is to get on the floor and listen or to create quality circles and lead the workers into the world of fantasy, dreams and hopes. I always find opportunities when actively listening to the people closest to the opportunity. Still, their ideas must be tested in reality or through modeling.

The reason an experiment is vital to your success in implementing innovation is that it gives you a believable platform from which to proclaim a positive return on investment. If this causes that, then ten ifs will cause one hundred thats. It gives you the basis for using the

proportional formula, king of kings among our many ruling tools. Nothing comes close. But to feed it, you must have data. Remember? In God we trust, everybody else bring us data!

To end this chapter I'm taking the liberty of including a piece that has been floating around the newsgropus and email lists for some time now. It has to do with innovation and the fear and ridicule it so often attracts. Just remember that they all persevered and eventually won.

QUOTES FROM THE EXPERTS!

"Computers in the future may weigh no more than 1.5 tons."
--Popular Mechanics, forecasting the relentless march of science, 1949

~~~~~~

"I think there is a world market for maybe five computers."
--Thomas Watson, chairman of IBM, 1943

~~~~~~

"I have traveled the length and breadth of this country and talked with the best people, and I can assure you that data processing is a fad that won't last out the year."
--The editor in charge of business books for Prentice Hall, 1957

~~~~~~

"But what...is it good for?"
--Engineer at the Advanced Computing Systems Division of IBM, 1968, Commenting on the microchip.

~~~~~~

"There is no reason anyone would want a computer in their home."
--Ken Olson, president, chairman and founder of Digital Equipment corp., 1977

~~~~~~

"This 'telephone' has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us."
--Western Union internal memo, 1876.

~~~~~~

"The wireless music box has no imaginable commercial value. Who would pay for a message sent to nobody in particular?"
--David Sarnoff's associates in response to his urgings for investment in the radio in the 1920s.

~~~~~~

"The concept is interesting and well-formed, but in order to earn better than a 'C,' the idea must be feasible
--A Yale University management professor in response to Fred Smith's paper proposing reliable overnight delivery service. (Smith went on to found Federal Express Corp.)

~~~~~~

"Who the hell wants to hear actors talk?"
--H.M. Warner, Warner Brothers, 1927

~~~~~~

"I'm just glad it'll be Clark Gable who's falling on his face
~~~~~~

and not Gary Cooper."
--Gary Cooper on his decision not to take the leading role in "Gone With The Wind."

~~~~~~

"A cookie store is a bad idea. Besides, the market research reports say America likes crispy cookies, not soft and chewy cookies like you make."
--Response to Debbi Fields' idea of starting Mrs. Fields' Cookies.

~~~~~~

"We don't like their sound, and guitar music is on the way out."
--Decca Recording Co. rejecting the Beatles, 1962

~~~~~~

"Heavier-than-air flying machines are impossible."
--Lord Kelvin, president, Royal Society, 1895

~~~~~~

"if I had thought about it, I wouldn't have done the experiment. The literature was full of examples that said you can't do this."
--Spencer Silver on the work that led to the unique adhesives for 3-M "post-it" Notepads.

~~~~~~

"So we went to Atari and said, 'Hey, we've got this amazing thing, even built with some of your parts, and what do you think about funding us? Or we'll give it to you. We just want to do it. Pay our salary, we'll come work for you.' And they said, 'No.' So then we went to Hewlett-Packard, and they said, 'Hey, we don't need you. You haven't got through college yet.'"
--Apple Computer Inc. founder Steve Jobs on attempts to get Atari and H-P interested in his and Steve Wozniak's personal computer.

~~~~~~

"professor Goddard does not know the relation between action and reaction and the need to have something better than a vacuum against which to react. He seems to lack the basic knowledge ladled out daily in high schools."
--1921 New York Times editorial about Robert Goddard's revolutionary rocket work.

~~~~~~

"You want to have consistent and uniform muscle development across all of your muscles? It can't be done. It's just a fact of life. You just have to accept inconsistent muscle development as an unalterable condition of weight training."
--Response to Arthur Jones, who solved the "unlovable" problem by inventing Nautilus.

~~~~~~

"Drill for oil? You mean drill into the ground to try and find oil? You're crazy."
--Drillers who Edwin L. Drake tried to enlist to his project to drill for oil in 1859.

~~~~~~

"Stocks have reached what looks like a permanently high plateau."
~~~~~~

--Irving Fisher, Professor of Economics, Yale University, 1929.

~~~~~~

"Airplanes are interesting toys but of no military value."
--Marechal Ferdinand Foch, Professor of Strategy, Ecole Superieure de Guerre.

~~~~~~

"Everything that can be invented has been invented."
--Charles H. Duell. Commissioner, U.S. Office of Patents, 1899.

~~~~~~

"Louis Pasteur's theory of germs is ridiculous fiction".
--Pierre Pachet, Professor of Physiology at Toulouse, 1872

~~~~~~

"The abdomen, the chest, and the brain will forever be shut from the intrusion of the wise and humane surgeon".
--Sir John Eric Ericksen, British surgeon, appointed Surgeon Extraordinary to Queen Victoria 1873.

~~~~~~

"640K ought to be enough for anybody."
-- Radio Shack 1980.
~~~~~~