### **Seeing New Opportunities**

**Exploiting Thinking About Thinking** 

Presented by

Dr. Bill Bellows

**President** 

In2:InThinking Network, Canoga Park, California

Phone: 818.489.3005, Email: bill@in2in.org

2 June 2006

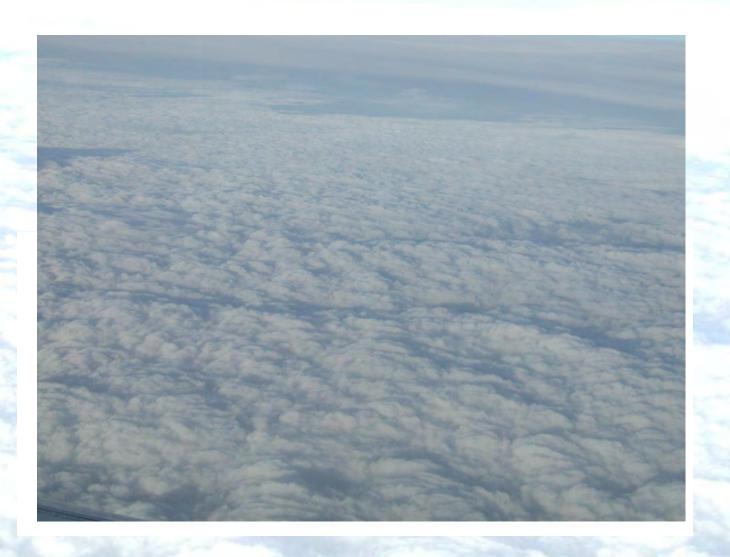
Understanding the Cost of Non-Quality in a Hi-Tech Enterprise Southampton, England

A Free Open-House Event Sponsored by Philips Semiconductors Southampton



Abstract: The aim of this session is to offer insights on how Dr. W. Edwards Deming's "new economics" and the underlying system of profound knowledge has been expanded upon by a "thinking network" within Pratt & Whitney Rocketdyne to initiate both "InThinking" and "Enterprise Thinking" networks. The "thinking expansion" includes the "variation management principles" of Dr. Genichi Taguchi and the thinking tools of Dr. Edward de Bono, among others whose thinking has been explored and united with profound knowledge. In doing so, the presentation will offer an introduction to ongoing activities within Pratt & Whitney Rocketdyne to convert the principles of Dr. W. Edwards Deming into practical ways that "reduce losses" to both society and improve corporate profitability.







### **Agenda**

- Aim
- Quality
- Interchangeable Parts
- Better Thinking About Thinking
- Better Value
- Imagine the Possibilities...



### **Aim**

# Introduce the *potential energy* of integrating the management theories and thinking of

Dr. Genichi Taguchi



Dr. W. Edwards Deming





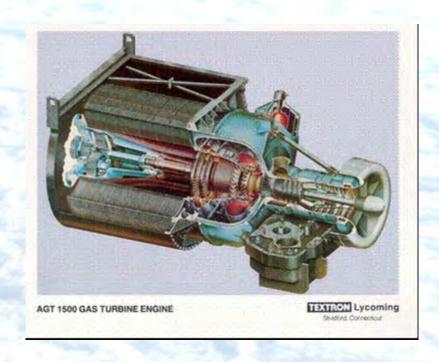
Dr. Russell Ackoff

Dr. Edward de Bono

and many others...



# Tank Engines and Rocket Engines







## InThinking

InThinking is about a transformation of the ways people think into effective predetermined patterns and sequences of thinking. The organization of thinking itself and the awareness that there is a choice of alternative ways of thinking when creating better solutions, presents a significant and exciting departure from traditional approaches.



## InThinking & Enterprise Thinking





## **Utilization of Thinking**

- Where are we going?
- Where does this fit in ?
- Where did this come from ?
- What is my role?
- What is this part of?
- Where should we invest?



## **Utilization of Thinking**

- …about managing variation
- …about seeing systems
- …about psychology
- ...about the utility of theories
- …about managing resources





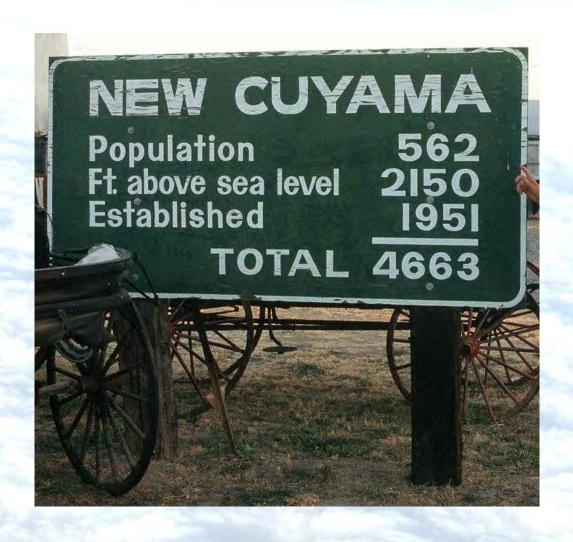






## Quality







## W. E. Deming on Quality

"A product or a service possesses quality if it helps somebody and enjoys a good and sustainable market"

Source: The New Economics, W. Edwards Deming, 1993



## **Genichi Taguchi on Quality**

"Quality is the minimum of loss imparted to the Society by a product after its shipment to a customer"

Source: Introduction to Quality Engineering, G. Taguchi, 1983







## Edward de Bono on Quality

"The quality of our thinking will determine the quality of our future."

Edward de Bono



## Philip Crosby on Quality

- "Zero defects is another way of saying 'do it right the first time"
- Quality is defined as conformance to requirements

Source: Let's Talk Quality, P. Crosby, 1989



## The Boeing Company - Vision 2016

- Core Competencies
  - detailed customer knowledge
  - large-scale systems integration
  - lean enterprise

- Values
  - leadership
  - integrity
  - quality
  - customer satisfaction
  - people working together
  - a diverse and involved team
  - good corporate citizenship
  - enhancing shareholder value







## **Expectation Dynamics**





## InThinking

InThinking is about a transformation of the ways people think into effective predetermined patterns and sequences of thinking. The organization of thinking itself and the awareness that there is a choice of alternative ways of thinking when creating better solutions, presents a significant and exciting departure from traditional approaches.

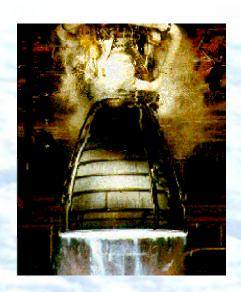
## Interchangeable Parts



## Interchangeable Parts ??







Space Shuttle Main Engine



## Interchangeable Parts ??





## **Quality Improvement**

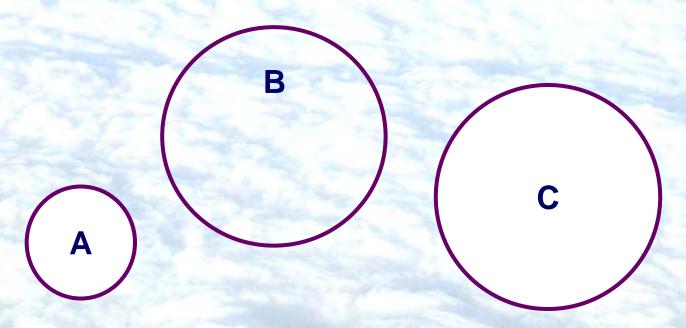
Background: On July 21, 1995, Toyota was reported by the WSJ to have received catalysts from AlliedSignal Catalysts that were "100% defective-free".

Question: Could AlliedSignal deliver catalysts that are even higher quality?



## **Sorting Circles**

Connect the 2 of these 3 circles that are closest to being the same.





## **Sorting Circles, Part 2**

Which 2 of these 3 circles are closest to having the same diameter.





## **Cutting Wood**

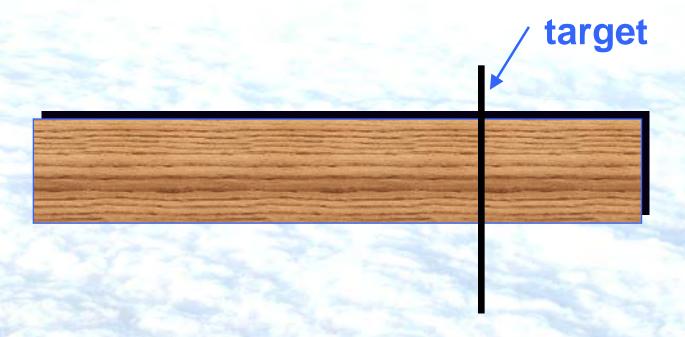
Given a piece of wood that will be cut into 2 pieces....



how many lines will be drawn across the top face before the cut is made?

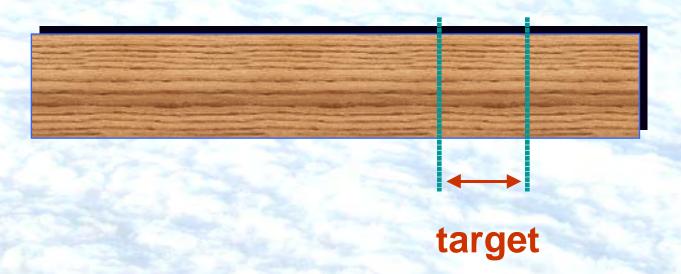


## **Cutting Wood**





## **Cutting Wood**





## Philip Crosby on Quality

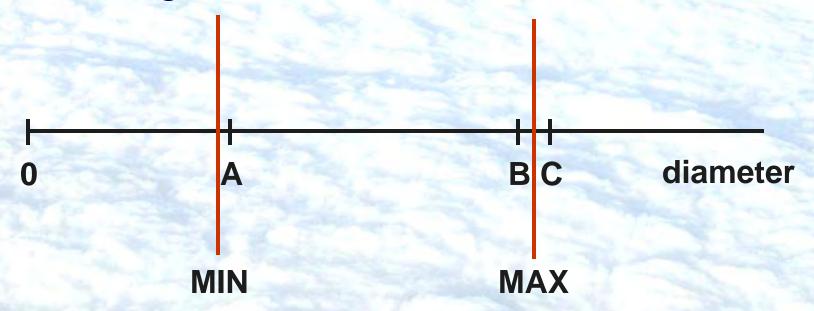
- "Zero defects is another way of saying 'do it right the first time"
- Quality is defined as conformance to requirements

Source: Let's Talk Quality, P. Crosby, 1989



#### **Decisions Decisions**

Which 2 of these 3 circles are closest to having the same diameter.





## **Quality Improvement**

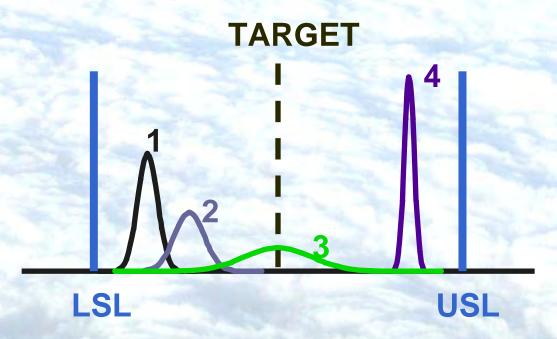
Background: On July 21, 1995, Toyota was reported by the WSJ to have received catalysts from AlliedSignal Catalysts that were "100% defective-free".

Question: Could AlliedSignal deliver catalysts that are even higher quality?



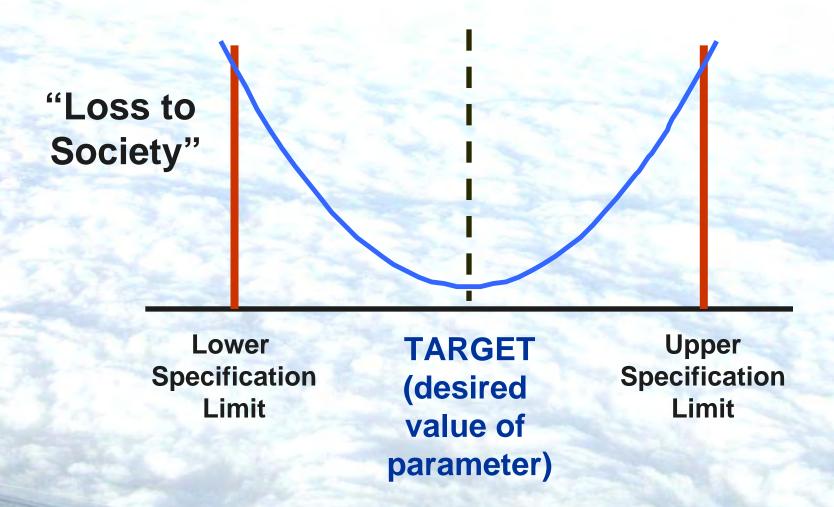
### **Decisions Decisions**

Background: Consider the following two processes and the specification limits and target provided.



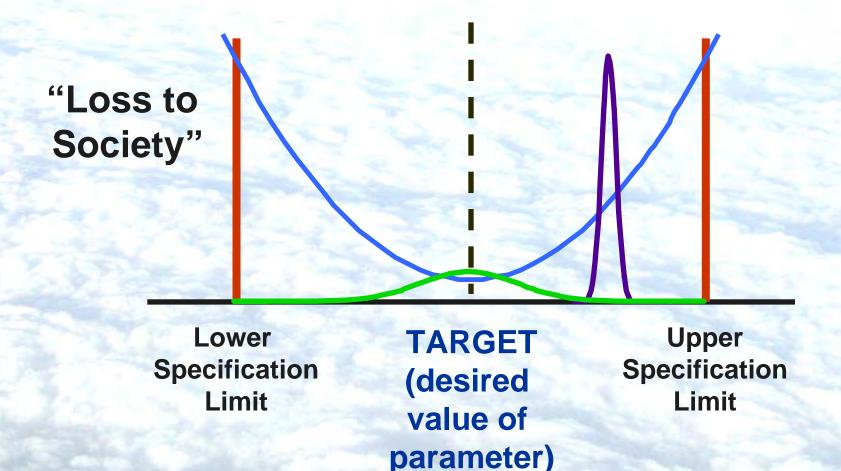


## Taguchi's Quality Loss Function





# Taguchi's Quality Loss Function





#### **A Better View**

"The Taguchi Loss Function is a better view of the world."

W. Edwards Deming

Source: Out of the Crisis, W. Edwards Deming, 1986



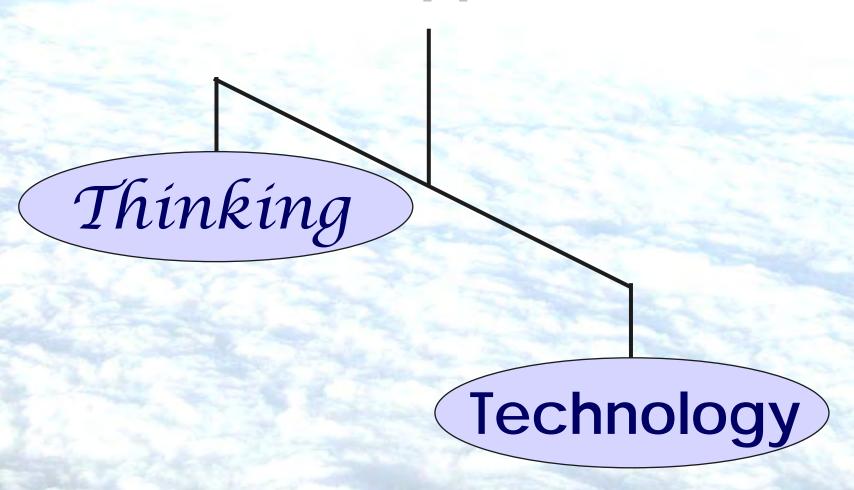
### Interchangeable Parts ??



# Better Thinking About Thinking



### **Investment Opportunities**





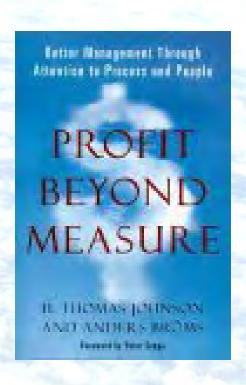
"The significant problems we face cannot be solved at the same level of thinking we were at when we created them."

Albert Einstein





#### **Profit Beyond Measure**



This book is dedicated to the memory of Dr. W. Edwards Deming 1900-1993

May the
Seventh Generation
after us know a
world shaped by
his thinking



### **Perception & Thinking**

"How the world we perceive works depends on how we think.

The world we perceive is a world we bring forth through our thinking."

H. Thomas Johnson











# Better Thinking... Using *Profound Knowledge*

- See systems
- Appreciate psychology
- Acknowledge variation
- Develop a theory of knowledge

Source: The New Economics, Dr. W. Edwards Deming



#### The First Step

Once the individual understands the system of profound knowledge, he will apply its principles in every kind of relationship with other people. He will have a basis for judgment of his own decisions and for transformation of the organizations that he belongs to.

W. Edwards Deming

Source: The New Economics, W. Edwards Deming, 1993



#### What's Old?

- Driving Change
- Reliance on Reforming
- Reducing Variation, Cost, Waste, Inventory, etc
- Talk about "Working Together"
- Striving for "Zero Defects" and "Zero Waste"
- Continuous Improvement
- Using Metrics for Alignment\*

\*without a thinking transformation



#### What's New?

- Leading Transformation
- Use of Reformation and Transformation
- Resource & Relationship Management (Striving for Balance)
- Thinking & Learning Together Then Working Together
- Continuous Investment
- Using Thinking for Alignment
  - InThinking and Enterprise Thinking



### **Togetherness**

- What does it mean to "work together"?
- What does it mean to "learn together"?
- What does it mean to "think together"?





### **Together**

"In or into contact or association"

"In or into harmony or coherence"

Merriam-Webster Dictionary



#### The First Step

The first step. The first step is transformation of the individual. This transformation is discontinuous. It comes from understanding of the system of profound knowledge. The individual, transformed, will perceive new meaning to his life, to events, to numbers, to interactions between people.

W. Edwards Deming

Source: The New Economics, W. Edwards Deming, 1993



#### **Assumptions**

- A better way to operate an organization is to invest resources with the ability to manage customer delight, satisfaction, and disappointment
- Better investment results from discovering opportunities to invest
- The discovery of opportunities for investment is limited by how thinking is conditioned



#### What is needed?

Thinking that promotes better discovery



### **Investment Thinking**

- Seeing connections
- Spending \$ to save \$
- Spending time to save time
- Spending resources to save resources
- Examples
  - a stitch in time, an ounce of prevention, college education, roof repair, time with kids



Picking Up Nails

Spending time (yours)

to

Save time (others)

Minimizing Loss to Society



### A Day With Genichi Taguchi

Since the early 1990's, Dr. Taguchi has made regular visits to southern California to both consult and appear at conferences. These visits often included "One Day" seminars, which

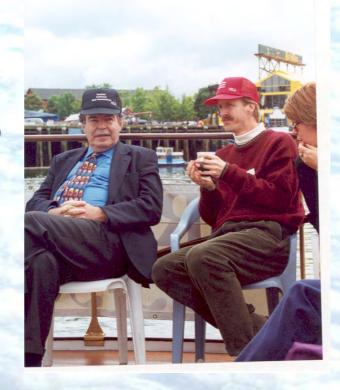


Boeing engineers have participated in on a routine basis. This photo was taken at the last workshop he offered in Los Angeles in 1999.



### A Day With Edward de Bono

Regular meetings with Edward de Bono began in 1999.





#### A Day With Russell Ackoff



In addition to meeting with Genichi Taguchi and Edward de Bono, we have hosted Russell Ackoff. Since 2003, he is invited annually to present 1-day seminars in Canoga Park and Huntington Beach.



### The In2:InThinking Network

The In2:InThinking Network was formed in 2001 by a group of students of the work of W. Edwards Deming and related theorists. The aim of our network is to make thinking about systems, variation, knowledge, and psychology, and their interaction - which comprises Deming's System of Profound Knowledge tm - more conscious. We believe that such thinking about thinking, which we call "inthinking," will allow people to better perceive relationships and interdependencies in human endeavors, and consequently act to make those endeavors more valuable, more satisfying, and more joyful.





### Dr. Taguchi and the In2:IN





#### 2006 In2: IN Forum: "Daring to Explore - Creating

Possibilities Together"

March 30 – April 2, 2006 in Los Angeles

The aim of the 2006 In2:IN Forum is to continue to elevate the consciousness of individual and collective thinking. We have asked "leading edge" thinkers to share with us their efforts to "Dare to Explore." Join us in learning, connecting, and preparing to provide leadership in exploration with better thinking in the 21st century. Learn more about the

forum at our website. The registration

fee is \$300 per person.



In2:InThinking Network - www.in2in.org



#### **Transformation**

Potential Energy "Better Thinking"

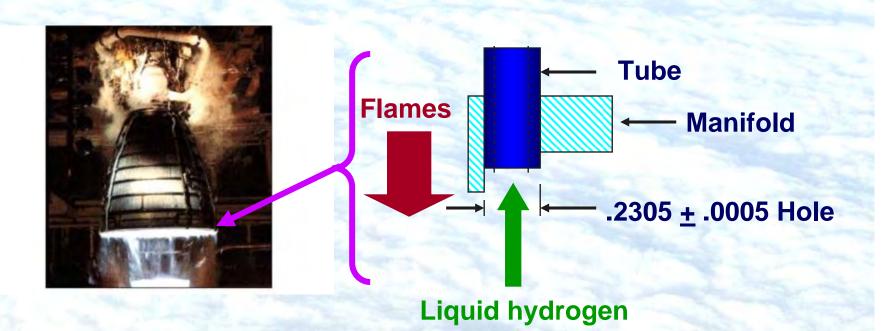


### **Better Value**



#### Better Value - Tube Fit in Hole

#### Consider a tube fit into a hole

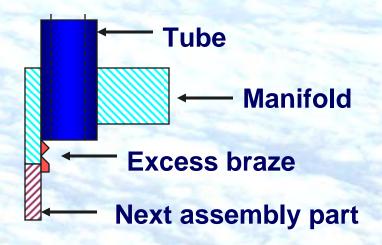




## Better Value – Tube in Hole - Next Assembly

#### **Traditional Approach**

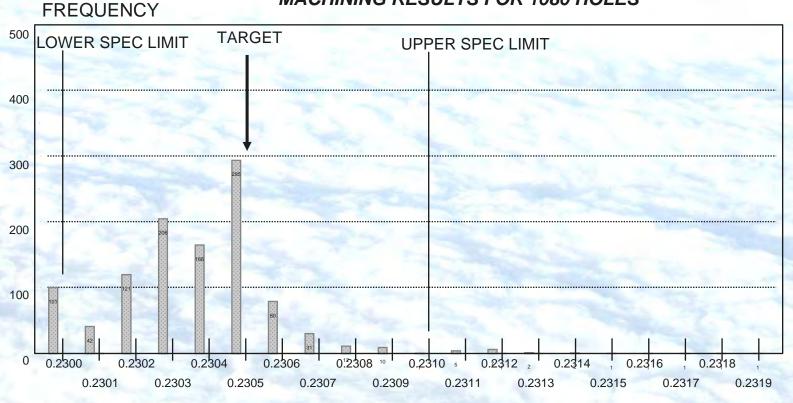
- Ream/ rework holes
- Braze flow thru holes
- Crack welds
- Add grind operation
- Add etch operation
- Add better etch operation





#### Better Value - Drilled Hole Data

#### **MACHINING RESULTS FOR 1080 HOLES**



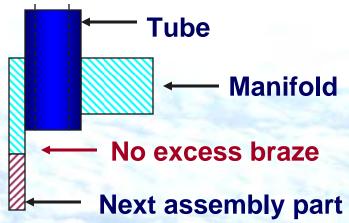
HOLE DIAMETER, INCHES



Better Value – Tube in Hole - Next Assembly

#### **Traditional Approach**

- Ream/ rework holes
- Braze flow thru holes
- Crack wolds
- Add grind operation
- Add etch operationAdd better etch operation



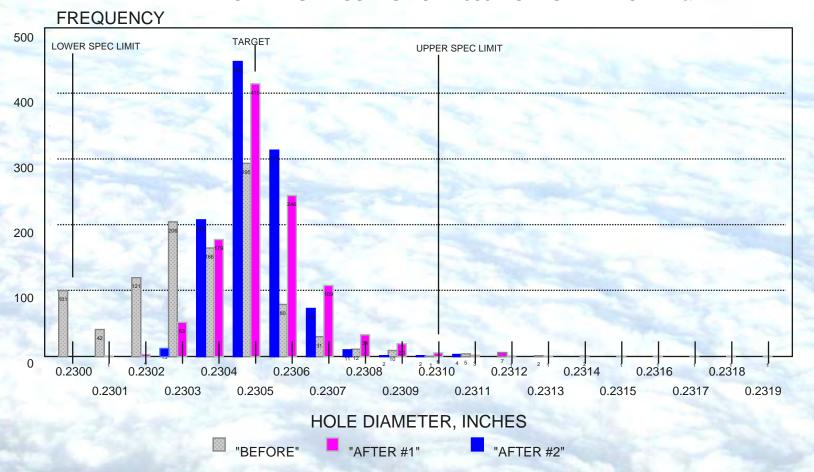
#### **Better Approach**

- Improve hole drilling
  - To target
  - Better distribution
- Successful first-cycle braze
- No excess braze



#### Better Value – Drilled Hole Data Post Taguchi Experiment

MACHINING RESULTS FOR 1080 HOLES - "BEFORE" & "AFTER"





#### Interchangeable Parts ??

#### Innovative thinking yields quality at low cost

Delta IV rocket-engine teams focus on reducing schedule time, building efficiency

By JAMES DENNING

Aiming to beat the competition, teams working on RS-88, the liquid fuel rocket engine that will power the Delta IV, have dedicated themselves to finding innovative ways to keeping costs down without sacrificing high quality.

Three areas where their efforts stand out in particular include the main injector interpropellant plate, the engine control unit and the turbopump speed sensors.

#### Main injector interpropellant plate team

The main injector takes highpressure liquid oxygen and hydrogen propellant feeds from the engine's turbopumps and injects them into the main combustion chamber. The interpropellant plate forms the central body of the injector and separates the propellants until they combine in the chamber.

The main injector interpropellant plate team supplemented their focus on standards with new, on-machine measuring techniques to dramatically improve first-pass acceptance of its machining and brazing operations. The approach is known as "variation control through the use of key characteristics and statistical process control data."

Preventing mistakes has saved more than \$300,000 and reduced the main injector interpropellant plate's unit cost by more than \$50,000.

"It's a matter of marrying the philosophy of targeting nominal design values and real-time, on-machine inspection technology," said Bill Brown, RS-68 main injector team lead. RS-68 " becomes the first Boeing Canoga Park, Calif., program to use this approach on a production level.

#### Engine control unit software team

Another team developing the engine control unit software also relied on standards to add quality to their work processes. The software controls the inlet valves on the engine, regulating the amount of thrust it produces.

For all this, the program is relatively small, comprising about 5,000 lines of code — about the amount you would find in a good washing machine.

To keep the development effort focused, the team adopted standards promulgated by the Software Engineering Institute. The team also made it a policy conduct frequent tests on their code. Testing the software program's 120 requirements required thousands of simulations.

But the proactive approach paid off.

"You expect to see about 10 defects per thousand lines of code in the final test stages," said Jerry Jackson, integrated product team leader on RS-68 control systems." "We cut that down to 1.2 defects per thousand." The team's effort yielded saved hundreds of thousands of dollars and shaved five weeks from the schedule. Flight instrumentation and

#### turbopump team The same level of innovative design is evident in the efforts of the RS-68 flight instrumentation and turbopumpteam, which developed a robust,

flight instrumentation and turbopumpteam, which developed a robust, economical sensor that collects crucial pump speed data without penetrating the turbopump housing or obstructing the flow of propellants.

Knowing the shaft speed of the rocket engine's turbopumps is very important to the health-monitoring system of the Delta IV rocket.

Obtaining the pump's shaft speed economically is a difficult design task.

The sensors rely on voltage pulses generated by magnetic materials in the spinning pumps to track shaft speed. The sensors are now a part of each BS-68 production engine and have proven themselves through seven hotfire tests. They cost less than \$2,000 each — inexpensive for parts that operate under cryogenic conditions.

In each of these cases, creative thinking and rigorous work resulted in improvements in quality and reliability. As Brown noted, "If you build quality into the product, you don't have to add it later."



The variation-controlled main injector interpropellant plate body is shown from the side as the injector is lowered to the main combustion chamber.



### Visioning

"it's not what the vision is that is important...

it's what the vision does..."

Robert Fritz

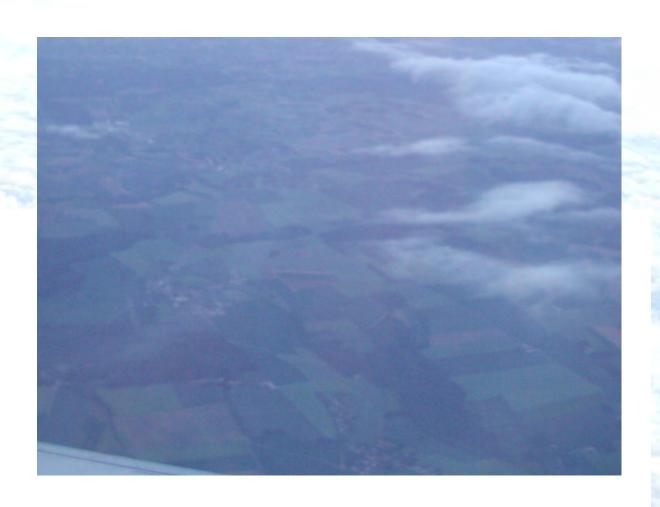
Source: The Fifth Discipline, Peter Senge, 1992



# InThinking & Enterprise Thinking







#### Imagine the Possibilities...

- when operating in an "Enterprise Thinking" environment
- if we could develop a broader appreciation of "continuous and connected learning"
- if we could develop a deeper appreciation of "working together", "learning together" and "thinking together"

#### Imagine the Possibilities...

and the markets we could create

```
Working Together
    Investing Together
       Designing Together
           Building Together
               Learning Together
                    Thinking Together
                        Leading Together
```

#### What's Next?

"The greatest discovery of my generation is that human beings can alter their lives by altering their attitudes of mind."

William James