

# Statistics, Productivity and Quality: Thoughts on Their Continuing Evolution

How things have evolved over the  
past 20 years and are still evolving

Ramón V. León  
University of Tennessee, Knoxville  
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# Presentation Outline

- Continuous improvement
- Process view of work
- Process quality replaces product quality as the core concept
- Dialectics of project and process view of work
- Justification of business improvement in terms of money
- Ownership of statistics and quality
- Training in tools subordinated to a problem solving strategy
- Evolving role of the university as a partner with industry in lifelong learning
- Bayesian statistics

# Continuous Improvement

- The Wall Street Journal in Deming's obituary credits him with making this idea central to modern management
- Others credit Juran with his book *Managerial Breakthrough* (1964)
- This is hard to believe but twenty years ago a common idea in business was "Don't fix it if it ain't broke"
- Today the need for continuous improvement in business is almost completely taken for granted

# Process View of Work

- In 1988 I was surprised when Ishikawa stated that “**All** work is a process”
- Today business people routinely talk about their business processes outside of manufacturing

# Process View of Work

- The Economist magazine (April 24, 2004) states that large businesses are good at improving processes not invention
  - Wal-Mart
  - Dell Computers
  - Ford with the assembly line is an early example
  - “During the late 1990s, Cisco Systems kept itself at the cutting edge of its fast-moving high-tech business (making internet routers) by buying a long string of creative start-ups financed originally by venture capital. The company's R&D was, as it were, outsourced to California's venture capitalists.”
- Productivity gains in the last twenty years owe much to improvements in transportation processes and communication and information processes

# Process View of Work

- Information technology and process improvement have had a synergistic relationship
- Notable exception: Health Care

“Unfortunately, health care providers are famously stingy investors in information technology. The primary reason is that when new technology reduces the duplication, errors and unnecessary care, most of the financial benefits don't go to the providers who generate the savings, but to insurers and patient.”

May 3, 2004 WSJ: “Operating in a Vacuum”  
by Newt Gingrich and Patrick Kennedy

“Billing systems discourage innovation and preventive medicine, instead rewarding doctors who prescribe long hospital stays and expensive procedures.”

May 15, 2004 Washington Post editorial:  
“Healing Health Care”

# Process Quality Replaces Product Quality as the Core Concept

- David Garvin of the Harvard Business School became famous by identifying eight dimensions of quality and clearing confusion with the concept of quality (1987)
- Today businesses concentrate on having high quality processes that have as a byproduct high product quality and customer satisfaction

# Dialectics of Project and Process View of Work

- Process management and improvement of soft processes introduced to AT&T in 1986 as a reaction to the project view of work
- Project and process view of work now flourish together in a new synthesis
  - “Process improvement occurs project by project, (and in no other way” according to Juran)
  - Project management in process improvement is seen as a process following the DMAIC strategy

# Justification of Business Improvement in Terms of Money

- Deming seemed to imply that statisticians should work as consultants without having to justify their value in terms of money.
- Quality improvement was the ultimate aim. We had faith that quality improvement would lead to higher profits and lower cost but we were careless about justifying this relationship
- Each Six Sigma project now must be justified in terms of money gained by the company
  - “The issue is one of priority. Most improvement ideas are worthwhile but some opportunities are worth more than others. Financial value is the best, commonly understood way to decide what projects to work on. Juran tells that money is the language of business!!” (Ron Snee)

# Ownership of Statistics and Quality

- Twenty years ago statistics was the domain of statisticians.
- We went berserk when Taguchi - an engineer - started to use statistics. We used **Miller's Law in Reverse** with him.
  - **Miller's Law:** "In order to understand what another person is saying, you must assume that it is true and try to find out what it could be true of."
  - **Miller's Law in Reverse:** We hear somebody say something that we react to negatively; we immediately assume that the utterance is *false*; and we stop listening because we're busy telling ourselves what's wrong with the person that explains why they'd say something so unacceptable to us.

# Ownership of Statistics and Quality

- We now use Miller's Law with Six Sigma
  - Who really believes in the calculation that a six sigma process produces 3.4 defects per million opportunities of defects?
  - “Six Sigma is about improvement that can be measured on the bottom line. Six sigma is now used as a name for a specific approach to improvement. Six Sigma as 3.4ppm defects is a BIG distraction!!!!!!!!!!!!!!!!!!!!!!” (Ron Snee)
- Statistics is now used by many managers and engineers
- Data mining initially developed by computer scientists
- Six Sigma leaders are employees on the management fast track

# Training in Tools Subordinated To a Problem Solving Strategy

- A precursor problem solving strategy was the Plan, Do, Check, Act (PDCA) cycle
  - The PDCA Cycle was originally conceived by Walter Shewhart in 1930's, and later adopted by W. Edwards Deming.
- Now we train around the DMAIC strategy (Define, Measure, Analyze, Improve and Control).
  - Data collection tools
  - Data analysis tools
  - Knowledge-based tools
- “DMAIC is better than PDCA because it is more specific, and has the tools integrated into the phases of improvement. DMAIC is a refinement of PDCA which is easier to implement.” (Ron Snee)

# Training in Tools Subordinated to a Problem Solving Strategy

- Limitation of this approach is that the tools have to be relatively simple.
- A very successful approach to training for people who already work
- Very good approach to training MBAs
- Statisticians are better trained emphasizing data sets and experiments

# Training in Tools Subordinated to a Problem Solving Strategy

- Controversial for educating freshmen and sophomores who do not yet know what they want to be.
- It can be argued that the emphasis of their educations should be on core concepts that are not easily learned once they begin to work, e.g., central limit theorem, regression fallacy, Simpson's paradox, Bayes theorem, comparison of two populations, multiple regression
  - Core concepts taught using examples
  - Mind tools versus problem solving tools
  - Cardinal Newman in *The Idea of a University* (1873): “Higher education should primarily foster the ability to think”
  - Liberal/Conservative political impasse perhaps the result of a decline in liberal education

# Tension Between Two Philosophies of Business Education

- Two great textbooks:
  - *The Practice of Business Statistics: Using Data for Decisions* by David Moore, George McCabe, William Duckworth and Stanley Sclove
  - *Statistical Thinking: Improving Business Performance* by Roger Hoerl and Ronald Snee
- One of America's strengths is the diversity of its education
- One must decide what education should be
  - Before students get their jobs
    - Freshmen and sophomores
    - Juniors and seniors
    - Graduate students
  - After students graduate and have their jobs

# Evolving Role of the University as a Partner with Industry in Lifelong Learning: The University of Tennessee Example

- Short Courses
  - Process improvement
  - DOE
- Distance education in statistics
  - Centra Internet software
- Graduate certificate in applied statistical strategies
  - Four graduate courses available online
- Five year BS/MS program in statistics
- MBA
  - Full time program
  - Professional
  - Physician

# But Colleges Are Not The Solutions for Every One

- A federal commission estimates that up to 4.4 million Americans will be turned away from four-year colleges for financial reasons in this decade alone. (NYT Editorial, May 6, 2004)
- Junior colleges used for job training is part of the solution
- Need to reduce the supply of unskilled labor in the USA by partnering with Mexico to help it develop its economy
  - Thomas Friedman suggest NAFTA construct a highway connecting southern Mexico to the USA without passing through congested Mexico City

# Bayesian Statistics

- Markov chain Monte Carlo techniques like Gibbs sampling have made Bayesian methods sometimes the only practical methods to solve real problems
  - My own application: “Bayesian Modeling of Accelerated Life Tests with Random Effects”
  - Parallel processing will boost the applications of these methods

# Where We Are Going

- Processes neatly broken into subprocesses that can be readily outsourced
  - More emphasis on the quality of process interfaces versus the quality of processes
  - Subprocesses requiring personal contact will remain in the USA
  - Back end processes involving information may be done anywhere
  - Customer service and technical help already outsourced offshore in many cases
  - “Venture capitalists are prodding companies they invest in to hire workers overseas” (Business Week, May 17, 2004)
  - People will lose careers in addition to jobs
    - Labor arbitrage in addition to Ricardo’s comparative advantage
    - Risk management tools applied to these types of risk (Robert J. Shiller, *The New Financial Order: Risk in the 21<sup>st</sup> Century.*)
    - 401K like accounts to help finance retraining and reeducation

# Taguchi's "Loss to Society" Idea of Quality

## Three Areas Where The Application of the DMAIC Strategy Is Thoroughly Needed

- Health care (1/6 Americans have no health insurance)
  - Health insurance has to be divorced from the job so that the lost of a career will not be as catastrophic.
  - Good ideas coming from both the right and the left
- Employment and compensation of American unskilled labor
  - Since the 1970s real wages have declined (Scientific American, June 1999)
  - Must reduce the supply of workers that do service jobs that cannot be offshored
  - Reemergence of unions?
- Incarceration (2 million Americans in prison.)
  - Highest incarceration rate in the world according to Justice Department report.
  - "Eight times the rate of France and six times the rate of Canada" NYT Editorial, May 17, 2004.