A Quality, Reliability and Continuous Improvement Institute in Central New York: QRCII-CNY

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Outline

- The QR&CI problem statement
- Problem consequences & alternatives
- Proposed solution: the Institute
- The Assessment component
- The Education component
- Implementation, costs, and income
- The Board of Directors
- Summary and Conclusions

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Basic Definitions (Q,R&CI)

- Quality: “descriptions of excellence in goods and services, and how they do conform to requirements of customers.” (From: Encyclopedia of Quality Terms; McGraw-Hill)
- Reliability: the probability of a failure-free operation, under stated conditions and during desired mission time (from: Reliability theory)
- Continuous Improvement: on-going analysis and streamlining of organization operations.

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The QR&CI Problem

- Difficult to define and to measure
- Not always well understood or seen
- Fallout not immediately perceived
- Relatively expensive to detect/remove
- Competes with other “better” activities
- Requires highly specialized workforce
- Difficult to support as full-time activity.

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Illustrative Example

- The “paper cup” syndrome:
  - Brown, dull, slow-leaking paper cup
  - Decreasing sales; company in difficulties
  - Budget limit: only one decision is possible
    - A: Improve the appearance of cup design
    - B: Apply QR&CI to investigate the leaking
  - Cup design: immediate sales improvement
  - Leak removal: long term sales improvement

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QR&CI Dilemma

- Given limited amount of company capital
- Invest in short term Design improvement
  - Immediate survival of the company is required
  - Design change will immediately improve sales
  - But long-term customers may not develop
- Invest in long-term leak problem: QR&CI
  - There may never be a customer tomorrow
  - Without the company's survival of today!

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Examples of QR&CI Importance

- Highly Recognized by the DOD
  - Required from DOD contractors
  - Multiple Handbooks and Manuals
  - RIAC: Reliability Information Analysis Center
- Highly Recognized by Big Industry
  - QR&CI Divisions and Departments
  - Improvement Programs and Plans
  - TQM, SPC and Six Sigma programs
- ASQ Professional Certifications in:
  - Quality, Reliability, Six Sigma, etc.

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Small Trickle Effect

- RIAC and Government QR&CI Centers or
- Large Corporations QR&CI Departments
  - Do not share their expensive services
  - With small and medium size companies
  - Who cannot afford these QR&CI services
- There is a need to find practical approach
  - For small companies to implement QR&CI
  - So they can also survive in the marketplace.

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Some CNY QR&CI Fallouts

- Carrier Corporation all but left Syracuse
- General Electric no longer in the area
  - Its successor, “Thompson”, also left CNY
- Automobile (MAGNA) has serious crisis
- Exodus of industry to China and the East
- Much of this is occurring because of:
  - Productivity and cost issues
  - Quality and reliability issues

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Possible Alternatives

- Do nothing: maintain status quo
- Use Independent Consultants
- Create internal QR&CI function
- Create Centers of Excellence:
  - Applied Institutes for QR&CI
  - Industry-Prof. Organizat.-Academe
  - Joint/Cooperative QR&CI work

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The Status Quo

- Small, medium size companies:
  - Continue without QR&CI functions
  - Approach QR&CI problems as “fires”
  - With resources within the organization
  - Occasional crisis brings in a Consultant
  - Long term solutions seldom developed
  - No established QR&CI permanent plan

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Independent Consultants

- Limited/dispersed throughout USA
  - Not easy to locate (or assess)
  - Expensive: over $1000 a day plus …
- Must travel to the customer site
  - Adds to their cost and availability
- Hence: used sparingly during crises
  - Put out fires -not long term solutions!

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Research Centers for QR&CI

- Highly Specialized and Expensive
- Require Big NSF and other Grants
  - And Large Industry support
- Located in Important Industrial Centers
- Work on Basic Research problems
  - Not on small/midsize organization problems
- Examples: http://coewww.rutgers.edu/~ie/qre/
  - http://cqpi.engr.wisc.edu/research

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Our Proposed Solution

- Smaller, specialized, applied centers
- Supported entirely by grants/donors
- Two Main Components or Functions:
- I) Develop a “free” assessment function:
  - Service to small/medium size organizations
- II) Train practicing engineers in QR&CI
  - Enhances undergraduate education
  - Prepares H.S. students for engineering

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We Stress: for Organizations!

- In the past, Quality and Reliability
  - Implemented in hard-core industry
- The Modern implementation:
  - For General Organizations
  - Including Service organizations
  - Health Care, Education
  - And others of this type.

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Previous Project Presentations

- Mayor Roy Bernardi's letter of January 1998
- Syracuse City Hall: Development Commission
- Rutgers University: Dept. Industrial Engineering
- ASQ Syracuse Section: Meeting Presentation
- NYS/CNY Economic Development Agency
- Senator DeFrancisco's Office
- Syracuse Research Corporation
- TACNY Sweet Lecture Series

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Relevant Precedent: GI Bill

- Created After WWII, for Veterans
- Provided a Monetary Voucher
- Non-transferable; non negotiable
- Only Redeemable at a University
- Paid for college degree or training
- Of individual veterans who opted
- CREATED THE U.S. MIDDLE CLASS

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QR&CI Institutes

- Created for Small/Mid-Size organizations
- Also Provides a Monetary Voucher
- Non-transferable; non negotiable
- Only Redeemable at QR&CI Institute
- Pays for assessment or training
- Of midsized organizations who apply
- FOSTERS INDUSTRY RECUPERATION

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The Assessment Component

- Provide free or affordable QR&CI assessment & services, to small & medium size organizations
- Supported with grants from local, state and federal institutions, with focus on increasing product and process quality and reliability
- Use college engineering students as interns, to provide hands-on experience and expertise
- Use local expertise (ASQ, consultants, faculty) as assessment directors and implementers.

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Quality Assessment

- The Cost of Poor Quality (COPQ)
  - Appraisal, Scrap, Prevention, Warranties
- Standing in the Market Place
  - Benchmarking, field studies
- Quality Culture of the Organization
- Operation of the Quality Systems
  - ISO 9000 series; Balridge

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Cost of Poor Quality (COPC)

- Difficult to notice and/or recognize
- Product non conformities (defects)
- Inefficient production processes
- Lost opportunities (sales/revenues)
- Appraisal and Prevention Costs
- As well as Hidden Quality Costs:
  - Downtime, extra inventory, overtime

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Reduction of COPC

- Pays for Quality Improvement costs
  - Reduces customer complaints
  - Increases customer loyalty
  - Increases reputation/customer base
  - Reduces warranty costs
  - Reduces production cycle
  - Reduces production costs

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Quality Planning

- Identify Customers and their Needs
  - Benchmarking, surveys
- Develop the Product
  - Quality Function Deployment (QFD)
- Develop the Process
  - Design For Six Sigma (DFSS)
- Develop the Operational Phase
  - Implementation of the Quality Plan

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Quality Improvement

- Addresses Chronic Problems
  - Which are Not detected by SPC
  - Changes the Status Quo
  - Uses Design of Experiments,
  - Six Sigma Methodology,
  - Lean Manufacturing and
  - Continuous Improvement

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Reliability: Quality in Time

- Types of Reliability Analyses
  - Data Collection Needs
  - Reliability Assessment
  - Reliability Testing
  - Reliability Estimation
  - Reliability Growth

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The Education Component

- QR&CI-CNY addresses a Key problem of the education of current and future engineers.
- Two Key NSF reports were written about this:
- *A Nation at Risk* (1982): http://www.ed.gov/pubs/NatAtRisk/index.html
  - Provided an initial awakening call.
- *Moving Forward to Improving Engineering Education* (2007) (http://www.nsf.gov/pubs/2007/nsb07122/nsb07122.pdf)
  - Provides an update of the issue.

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Engineering Education “Situation”

- “Past” Situation (those in the field)
  - Practicing engineers lack in QR&CI training
  - Obtain it in workshops/evening/short courses
- “Present” Situation (those in college)
  - Current engineering students train in QR&CI
  - Obtain hands-on experience via internships
- “Future” Situation (prospective students)
  - High School students exposed to Engineering
  - High School teachers get Engineering training

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Our Research on the Problem:

- Romeu, J. L. (2006). Teaching Engineering Statistics to Practicing Engineers. *Proceedings of ICOTS-7*. Brazil. http://www.stat.auckland.ac.nz/~iase/publications/17/4A1_ROME.pdf
- Romeu, J. L. (2007). Enhancing the Statistical Education of Practicing Engineers. *Proceedings of the Fall Technical Conference*. JAX, FL. http://web.cortland.edu/romeu/FTCPaper07.pdf
- Romeu, J. L. (submitted to ICOTS-8, 2010). Professional Organizations http://myweb.whitman.syr.edu/jlromeu/EngEducPapIcots8.pdf Ljubljana, Slovenia.

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Issue 1: What statistics

Do practicing engineers learn in college?

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Examples of Undergraduate Engineering Curriculums:

- Mechanical Engineering
  - One course, Math Dept.
- Civil Engineering
  - One course, Math Dept.
- Electrical Engineering
  - One course, Math Dept.
- Computer Science
  - One course, taught internally

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Undergrad Statistics Course Example

•Descriptive Stats (Chs. 1& 2): Examples of uses of statistics in problem solving Frequency distributions, Pareto, Dot, Stem-and-leaf and other diagrams and graphs; descriptive measures and their calculations. Case study.
•Probability (Ch. 3): sample spaces, events, counting rules, axioms of probabilities, elementary theorems, conditional probability, Bayes theorem, mathematical expectation. Case study.
•Distributions (Ch. 4): random variables, discrete distributions: Uniform, Binomial, Hypergeometric, Geometric, Multinomial, Poisson. Approximations. Chebyschev' theorem. Applications.
•Densities (Ch. 5): continuous random variables and distributions: Normal and its approximation to the Binomial, Uniform, Exponential, Log-Normal, Gamma, Weibull. Joint distributions. Checking for Normality. Variable Transformations.
•Sampling Distributions (Ch. 6): populations and samples, distributions of the mean and the variance; Student t, F and Chi Square distributions.
•Inferences Concerning the Mean (Ch. 7): point and interval estimation.
•Some applications in Reliability engineering (Ch. 15). Text: Johnson's.

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Issue 2: What statistics

Do practicing engineers need, to perform in their work?

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Certification Statistics B.O.K.

- Certified Quality Engineer
  - statistical content of the exam (50%+)
  - http://www.asq.org/certification/quality-engineer/bok.html
- Certified Reliability Engineer
  - statistical content of the exam (40%+)
  - http://www.asq.org/certification/reliability-engineer/bok.html

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Problem Root-Cause:

College engineering education:

Insufficient.

There is a large gap between:

Statistics college curriculum

And engineering needs

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Problem Solution:

Help the practicing engineer

Bridge the gap:

After graduation,

On their own,

Via self-study,

with Mentoring.

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How can engineers bridge the Gap between these two distinct levels?

A survey on how engineers Learn Statistics on their own (see):

http://web.syr.edu/~jlromeu/SurveyICOTS.html

Provides some answers regarding the means used in this endeavor.

We can then expand, improve, etc.

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Survey Methods of Self-Learning

(1) reading books, journals, manuals or other hard copy,

(2) reading Web and Internet materials,

(3) following on-line courses or learning software, etc.,

(4) attending conferences and chapter meeting talks,

(5) pursuing preparation for professional certifications,

(6) taking short training courses,

(7) receiving mentoring from more experienced colleagues

(8) other sources: e.g. hands-on (practical) working experiences, and taking Six Sigma training

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College Statistical Training

I) Among all surveyed, 16% have not taken any statistics courses in college (33% among BS), 38% took only one (38%) and 26% have taken 2 courses (24%).

II) 1/3 of those with a BS degree only, have never taken a single statistics course in college; another 1/3 of them have taken only one course. Hence, 2/3 engineers of all surveyed had either none, or very little statistical training (i.e. taken a single course).

III) Engineers that pursue graduate school have a larger opportunity of taking statistics. Only 7%, in our sample, have never taken a statistics course.

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Methods Preferred

I) ***"Readings" constitute the preferred means of learning: books and journals, as well as web tutorials, provide 38% of statistics knowledge. The use of web tutorials (10%) is increasing with time: older engineers prefer hard copy, whereas younger ones read web-based material.***

II) Short courses, exam preparations for the professional certifications, and Black Belt training, are also important methods of learning statistics (33%).

III) mentoring received from more experienced colleagues and hands-on (learning by doing), also constitute frequent learning activities (22%).

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Hard Copy and Web Readings

- Most popular methods (almost 40%)
- Younger prefer Web; older, hard copy
- Web is faster, more economic medium
- Web tutorials: dispersed, unclassified
- Most material in English -third world?
- Access becoming complex (Browsers)
- Best option for the future, though.

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Professional Courses

- About 20% used these, as means in learning
- Intensive, short, to the point, practical
- Single topic, no inter-relationships, uneven
- Student body is also very heterogeneous
- Background and assumptions often missing
  - or checking them is poorly stressed
- Some courses teach SW and main formulas
  - that are then questionably implemented.

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Professional Certifications

- About 20% of knowledge, learnt this way
- Professional Societies: ASQ, SME, IEEE
  - offer several statistically-based certifications
  - Quality (Control); Reliability; Logistics, etc.
- Self-study materials (manuals, questions)
- On-line and in-classroom short courses
- Require periodic updating/follow-ups

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Mentoring/Hands on

- Learning from older colleagues/engineers
- Learning from relatives (spouses, etc.)
- Trial and error/Hands on experiences
- Attending professional conferences
- Chapter meetings and presentations
- Other: e.g. use of on-line tutorials
- Enhanced with tutoring by consultants.

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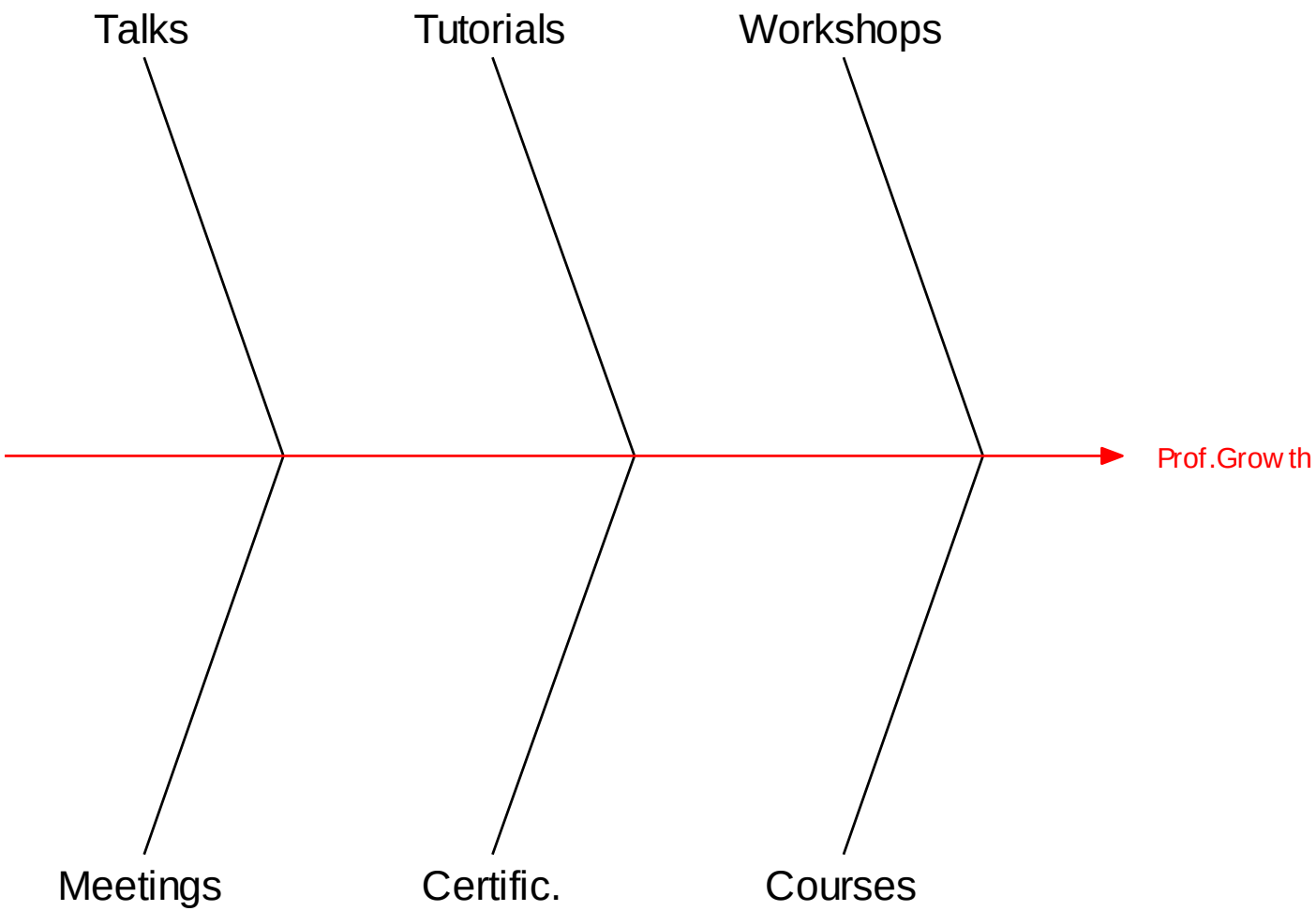
Professional Training



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“Present” Situation

- QR&CI Institute will train college students
  - Currently little or no training, in classroom
- Provide Hands-on Experience on QR&CI
  - Through Work Internships in the Institute
- Contacts with Local Organizations
  - Hiring eased: both get to know each other
  - One of the most expensive/frustrating costs
  - Quality engineering workforce stays here!

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“Future” Situation

- High School students enticed
  - To follow science/engineering careers
  - Currently, levels unacceptably low!
- High School teachers better trained
  - Currently engineering knowledge is poor
  - As HS teachers do not know what we do
- Engineering is not just math and science
  - Nor solely for excelling math students!

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Institute Operational Profile

- Specialized: QR&CI applications
- Specific functions: professional training
  - and QR&CI assessments for organizations
- Supported: by stakeholders and grants
- Interns: work by engineering students
- Target: small/medium size companies
- Develop workshops and short courses.
  - And a “nurturing” environment for QR&CI.

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More Specific Functions

- QR&CI Assessments and Audits include
  - Web-based materials and questionnaires
- Develop additional QR&CI web tutorials
- Training of QR&CI technicians/engineers
- Development of new QR&CI short courses
- Periodic meetings, talks and presentations
- Special activities for High School Teachers
- Support activities for H.S. science students.

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Institute Networking Function

- With Other Industry-Academe Centers
  - Of different type, in the region
  - Of the same type, in the nation
  - To enlarge and refine their activities
  - To conduct synergetic activities
  - To exchange students and faculty
  - To teach synergetic QR&CI courses
  - And other mutually beneficial activities.

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Stake Holders/Benefits

- From Industry/Service Organizations
  - Increase competitiveness, profits, survival
- From Academe/University
  - Improve teaching and research
- From All Government Levels
  - Increase tax base and economic growth
- From the Public at Large
  - More Jobs, better services & quality of life.

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Possible Income Sources

- Federal Government grants
  - NSF: educational function (engineering)
  - Other agencies sponsoring job development
- State and Local Government grants
  - To help local industry remain competitive
  - Save local jobs; revert regional emigration
- Prof. Organization and Industry grants
  - Office space, phone, computers, interns.

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Institute Performance Measures

- Number of Assessments/Money saved
- Number of Interns/Placement rates
- Number of Tutorials/Reader Web Hits
- Number of Workshops/Number of students
- Number of Presentations/No. Attendees
- Number of Districts/Number HS Teachers
- Number of Schools/Number of Students

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Institute Board of Advisors

- Integrated by All Institute Stake Holders
  - State and Local Government
  - Assessment and education customers
  - Experts: academe and practitioners
  - Professional Associations
  - Institute Donors ($$$)
- Board helps define directions to pursue
  - Focusing on problem-solving activities
- Helps find new Customers and Services

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Institute is Not a Competitor

- Targets small/medium size organizations
  - Currently are not “paying customers”
  - Instead, it creates “new” customers
- Provides a catalyst for future customers
  - “Proof of concept” approach to QR&CI
- Creates more/better QR&CI specialists
  - And Increments the interest for QR&CI

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What we need and seek:

- We Want to Put this Institute in the Books
  - To start working and writing proposals
- We Seek support from ASQ National
  - Already an ASQ proposal is in circulation
- We Need Legal Advice and NYS Affidavit
- We Need to Create a Board of Directors
  - Write the By-Laws and Operations Manual
- We Need Volunteers to help with all this.

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Summary

- The Need (economic, labor issues) is here
- Customers (industry/services) are here;
- Prof. Organizations (consultants & experts)
- And Government Agencies, are also here.
- QR&CI will increase profits and tax base.
- Our Project, small enough to implement
- Prior Experience and other Models Exist
- We are seeking support to start it up!

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Feed-Back

- We seek your help and comments:
  - Reasons that support this idea?
  - Reasons against this idea?
  - Possible stumbling blocks?
  - Possible sources of funding?
  - Want to Volunteer joining the Board?
  - Or help us implement the next steps?
  - Please contact us.

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P.I. Professional Experience

- Jorge Luis Romeu, Ph.D.
  - Industrial Engineering and Operations Research
  - S.U. Research Professor: statistics, quality, O.R.
- Senior Member, American Society for Quality
  - ASQ Certified Quality and Reliability Engineer
- Chartered Statistician Fellow (Prof. Status)
  - Royal Statistical Society, United Kingdom.
- Fifteen years Senior Engineer/Stats. Advisor
  - Reliability Information Analysis Center (RAC/RIAC).

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