

Automotive

■ Summer 2015

E X C E L L E N C E

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letter from the editor



Mohammad Hijawi
Publications Chair

Dear ASQ Automotive Members,

In the recent years, the automotive industry went through many drastic changes due to reduction in the field defects acceptable by the customer coupled with the compressed time for product development. Such dramatic changes require a smart way of the product development and validation. Also, proactive Quality through failure mode avoidance is an efficient and cost effective way to avoid failures and satisfying the customers starting with the concept phase. In this edition, we have a welcome letter from the chair of ASQ Automotive Division, two articles, and some exciting news about the ASQ Automotive Symposium as a well as a new Automotive Reliability Symposium. The first article, provided by Shin Taguchi, identifies how we, in the automotive industry, can work on Quality at early stages of the design. The focus is not only on meeting requirements or finding the sweet spot for the design, but it also goes beyond that. The validation process is very critical for the success of launches and avoiding field issues. The second article, provided by Bernie Stubitsch, explains how to improve the efficiency and effectiveness of reliability test plans in order to achieve that.

I would like to thank Jennifer Schneider, Shin Taguchi, Bernie Stubitsch and Bill Murphy for their contributions to this edition.

This edition as well as past publications can also be found on our website at www.ASQ-auto.org.

I look forward to hearing from you.

Ideas, questions or comments can be forwarded to me at mshijawi@yahoo.com.

Mohammad Hijawi
Publications Chair

letter from the chair



Jennifer L. Schneider
ASQ Automotive
Division, Chair

Here's another interesting and exciting edition of Automotive Excellence. Our mission is to be the recognized global network of automotive quality professionals helping individuals and organizations to achieve personal and organizational excellence. I would like to thank you, our members, our sponsors and our ASQ Enterprise Members for all of your support towards the Division.

We're half way through 2015, and it has been great year for the Division. Here are some highlights:

At the 2014 ASQ WCQI in Dallas, TX May 5-7 the Automotive Division revealed a big new booth that featured the 2014 GM Camaro SS Convertible. Beautiful!!! Adding a few more features at the 2015 Nashville WCQI, Automotive had the biggest booth displaying the 2015 BMW X4 and X5 vehicles. People always ask if we will raffle off the vehicles instead of die cast models. One day I'd like to say we will. We will carry our tradition on to the ASQ WCQI in Milwaukee, WI May 16-18, 2016 for the 70th Anniversary. Start planning and come out and join us!

Testimonials from 2015 WCQI:

"It is an experience like no other—great learning and networking opportunities."

"This was the first time I attended and got my inspiration back, I can honestly say it's been a life changing experience. I believe in quality and how it can change people, lives, relationships, and so many other things, and this conference was very satisfying."

"I was very impressed by the caliber of speakers and was generally surprised by my feelings of inspiration and admiration. Each speaker had given me things to take back to share with co-workers, family, and friends."

In 2014 we combined the Annual Automotive Division Symposium and the Automotive Awards Event and received good feedback. Award recipients appreciated being honored in front of their peers, colleagues, family and friends. Based on last year's feedback we kept the format and held the event at Macomb Community College on June 8, 2015.

The ASQ Certification Board awarded the ASQ Automotive Division the 2014 Leadership Award for having the highest percentage of ASQ certified members at 48.27%

letter from the chair, continued

Thank you for those that participated in the Voice of the Customer survey. Automotive Division appreciates your feedback. We have read them and used them as input to our 2015 Strategic Plan. Please continue to give your feedback.

2015 Events to Date:

- **March 2-3** – Lean and Six Sigma Conference titled “Leading the Quality Journey through Lean and Six Sigma.” Pointe Hilton Tapatio Resort Phoenix, AZ
- **April 27** – Free Webinar titled “An Integrated Mgmt System” by Elizabeth Burns, ASQ Fellow and CQE
- **May 4-6** – ASQ World Conference on Quality Improvement in Nashville, TN titled “Transforming the World through Innovation, Inspiration and Leadership”
- **June 8** – Annual Symposium “Transforming the World through Innovation, Inspiration and Leadership in the Automotive Industry” and Automotive Awards Event, Macomb Community College, Clinton Twp., MI.

2015 Upcoming Events:

- **Sept 27-28** – ASQ Service Quality Conference in Orlando, FL titled “Your Brand, Your Service, Your Success”
- **Oct 22-23** – 2nd Annual ASQ Joint Technical Communities Conference (JTCC) in Orlando, FL titled “Expanding the Gift of Quality”; (Oct 19-21 Pre-conference Tutorials) – Gold Sponsor <http://asqtconference.com>
- **Oct 29-30** – 24th annual ASQ Audit Conference in Reno, NV titled “AUDITS: Improving Performance, Managing Risk and Driving Customer Satisfaction and Revenue” – Bronze Sponsor <http://asqauditconference.com/index.html>
- **Nov. 4-6** – Member Leader TCC/SAC Conference Milwaukee, WI

I look forward to a great rest of 2015 and look forward to your inquiries and involvement in the Automotive Division.

Sincerely,

Jennifer L Schneider
ASQ Automotive Division, Chair
jennifer.schneider@continental-corporation.com

May 2015 ASQ Board of Directors Meeting Highlights

ASQ leadership remains committed to keeping you well informed of ASQ's strategy and key initiatives, our progress, and our results.

At its May 2015 meeting, the ASQ Board of Directors reviewed the Society's 2015 Q1 business performance and progress on the 2015 six strategies. Highlights included:

- To better adapt and respond to member needs, the Board supported accelerated exploration of new membership models that will better fit current and future needs of our members. Next steps include benchmarking other associations and enacting pilot programs.
- The Board was updated on ASQ's Emerging Quality Leaders Program (EQLP) work and progress in its first full year, and discussed continued interest and support for the initiative now in its second year. The EQLP program addresses a business concern facing many organizations—transferring executive knowledge and leadership experience to the next generation of leaders.
- The Board approved holding membership dues steady for 2016.
- The Board supported the due diligence study related to computer-based testing (CBT) for ASQ certifications. Completed results will help determine next steps and will be discussed at the September Board meeting.
- Under the guidance of the new QBOK® Advisory Board, a robust multi-dimensional taxonomy scheme is in development that—combined with the planned technology enhancements—will allow members to find relevant information and resources quicker and easier.
- The Board approved the new social responsibility technical community that will ensure ASQ continues to lead quality and social responsibility (SR) efforts while contributing SR knowledge, research, and best practices to the QBOK®.

The Board was updated on the Leadership Communications Plan, introduced in February. In addition to sharing these Board reports, we are disseminating timely and

relevant communications through ASQ leaders to the Society's diverse stakeholders around the world with messages that matter to them. For example, communications training was held at the member leader Ideas to Actions Gathering (ITAG) event, part of the World Conference on Quality and Improvement. This enables member leaders to better communicate with members and customers about key ASQ initiatives, including Investing in ASQ Member Value and ASQ's Investment in Technology.

The Board congratulated the ASQ Conference Board on creating a "conference tool kit" to help ASQ member units with their conferences and provide a consistent ASQ experience for attendees. The toolkit resources will be shared with member leaders through Friday Fast Facts.

Full meeting minutes can be accessed at www.asq.org

2014 ASQ Board of Directors Summary

At its meeting, the ASQ Board of Directors reviewed the Society's 2014 annual business performance, and focused considerable time and attention on the 2015 strategies and key projects to better serve members and customers in the fulfillment of our Society's mission.

Highlights of ASQ's 2014 performance include:

- Operating Fund Revenue: \$39.0M in 2014 (compared to \$37.2M in 2013), a 4.6% increase year-over-year.
- Global Revenue of \$6.9M—an 11.4% increase over 2013.
- Significant Revenue Drivers and Detractors (actual vs. 2013): Conference Revenue (+28.7%); Training Revenue (+12.3%); Royalties and Licensing (-14.6%); Retail Sales (-6.7%).
- Individual Members numbered 74,194 at the end of 2014 (compared to 75,781 in 2013).
- Enterprise Membership grew to 74 in 2014 (from 68 in 2013).

The Board continued our support of the 2014 six strategies for 2015. Key projects, timelines, and deliverables were discussed.

Highlights included:

- Progress and next steps on ASQ's strategy to improve Member Value. The Voice of the Customer Committee (VoCC), formed last year, refocused ASQ on our member/customer needs. Using a QFD approach, projects for 2015 and beyond were aligned to meet these needs. A new Board role, the Voice of the Customer Champion, was established. Board Member Kush Shah was appointed to serve in this critical role that will coordinate with the VoCC, ASQ staff, and the Board, to systematically improve customer satisfaction and create greater customer loyalty.
- The Board reviewed our Leveraging Technology strategy, a key priority that involves significant investment for much needed technological improvements to our technology infrastructure. This strategy addresses our Web experience shortcomings, and will provide a more stable and flexible IT infrastructures to better serve our members and customers. Enterprise IT projects of this size and importance take time to successfully deliver. Key elements of the three-year roadmap were shared with the

Board including establishing a Project Management Office under our CFO. Ongoing communications regarding our timeline and key IT deliverables will be shared with members.

- The Board agreed that ASQ's Quality Body of Knowledge (QBOK®) remains critical to our future success. A new QBOK® Executive Advisory Board is being established with Stephen Hacker, our ASQ Board past chair, to lead the QBOK® strategy that will encompass comprehensive knowledge delivery through tailored customer experience to drive member satisfaction and engagement, customer acquisition, and ASQ's sustainability.
- CEO Bill Troy shared with the Board the initial approach to ASQ's "Master Global Integration Plan," intended to streamline and improve operational performance across ASQ to better serve our global member and customer base.
- The Board learned of progress on initiatives to improve member leader training as well as efforts around strategic alignment and deployment, performance measurement, and support of member units.

2014 ASQ Board of Directors Summary, Continued

- The Board reviewed moving to computer-based testing (CBT) for ASQ certifications. The most significant benefits of CBT are flexibility in testing times/dates, more candidates, and greater worldwide access to ASQ certifications. The Board approved Development Fund money to perform due diligence to validate key assumptions. The results will be reviewed at the May Board meeting.

The Board approved the acceptance of the Jordan Society for Quality as ASQ's 23rd World Partner. The official signing ceremony will take place at ASQ's WCQI in Nashville, TN, this year, where many of ASQ's

other World Partners® are expected to be in attendance.

The Board of Directors voted to approve Sister Mary Jean Ryan, Board chair of SSM Health Care, as an ASQ Honorary Member for her distinguished contributions to the profession by significantly extending the reach of quality into healthcare.

Finally, the Board supported steps toward greater transparency and communication throughout the Society. To that end, your chair, with support from the Board and our ASQ staff, are developing a Leadership Communications Plan for ASQ leaders that is being rolled out this year. ASQ's global expansion, the growth in

enterprise and organizational members, and the expectations of our members and customers, have accelerated the need for ASQ leaders to communicate with diverse stakeholders around the world. ASQ leaders want our members, and the global quality community, to know that ASQ is a vibrant and relevant society. We want to share what ASQ is doing: to invest in our future and meet the needs of our members and our communities; to grow our Society and its influence; and, to enhance the use and impact of quality throughout the world.

Full meeting minutes can be accessed at www.asq.org.



Automotive Division Receives 2014 PAR Performance Silver Award

The Performance Awards & Recognition (PAR) committee awarded the Automotive Division with the PAR Performance Silver Award for 2014. This level was achieved by meeting the good standing requirements as well as meeting or exceeding the Member Value and Member Leader Engagement metrics. The Division received this recognition at the Member Leader Events on May 2, 2015 at WCQI Nashville, TN

13th Annual Symposium & Automotive Awards

On June 8, 2015 the Division held the 13th Annual Symposium and Automotive Awards at Macomb Community College in Clinton Township, MI. The Symposium theme aligns to the ASQ WCQI. This year's theme was "Transforming the World through Innovation, Inspiration and Leadership in the Automotive Industry." The discussions were thought provoking and the networking priceless as attendees visited with sponsors to learn more about their products and services, checked out the race car on display sponsored by TI Automotive and held discussions amongst each other. For your interest, we have included information on the speakers, award and scholarship recipients.

Innovation Never Stops



Peter Merrill
Innovator

ABSTRACT

Innovation has become a major focus for the C-Suite. This is due to the perfect storm of change which business is experiencing through digitization and globalization. The best organizations respond to change through innovation.

ASQ has responded to change through forming its Innovation Division in 2014 and in 2015 launching a series of innovation

projects. These projects are designed to strengthen the ASQ Body of Knowledge (BoK) including the BoK for Innovation.

This Keynote will explain the perfect 'fit' of Innovation and Quality together with the innovation process and its 'fit' in the organization. The cultural difference between the creative phase and the execution phase of innovation are also explained.

You will learn the steps for initiating Innovation in your own organization and some of the immediate actions you can take.

BIOGRAPHY

Peter Merrill is a Keynote Speaker on Innovation and has keynoted at events such as the World Conference on Quality

As Chief Executive of one of the leading Design Brands in the Europe he has been an Innovator in one

of the most demanding markets. He is an Engineer, an Artist and a Writer and has led Innovation in the fields of both Graphic Art and Engineering.

KEYNOTE ADDRESS

He led the International Working Group which developed the Guideline on 'People Involvement' in Management Systems and is one of North

America's foremost authorities on Management Systems which he has implemented in such innovative companies as IBM, A.I.G., and R.I.M.

He chairs the ASQ Innovation Division and is also a member of ISO/TC279 the technical committee developing the new international standard on innovation

He is author of the books "Innovation Generation", "Innovation Never Stops", "Executive Guide to Innovation" and "Do It Right the Second Time." He writes the Innovation Column for Quality Progress.

13th Annual Symposium & Automotive Awards

The Power of Silent Brainstorming



Jd Marhevko

VP Quality/Lean Management
Systems & EHS
Accuride Corporation
MBB, ASQ CMQ/OE, CQE, CSSBB,
Fellow

ABSTRACT

Supporting: Building & Sustaining a Culture of Quality

Why: This hands-on session includes every participant in the room! The brainstorming process in the analysis portion of DMAIC is not often a well-leveraged technique. Silent brainstorming unlocks many advantages not typically available when done the “regular” way. The session walks through a real example while conducting a parallel silent brainstorming event. This tool enables the fostering of a quality culture while pulling innovative ideas from those whose voices might not

be heard. Session feedback from other conferences has been very positive. This session ranked in the top 10% at ASQ’s WCQI in 2012.

• **Session Description:** This engaging and hands-on session demonstrates the effectiveness of silent brainstorming during the Analysis phase of DMAIC. As the interactive demonstration is conducted, a live sample of how one training team saved over a \$250K is modeled. Attendees participate in a group simulation of how a team might conduct a silent brainstorming activity. This thought-provoking session will enable attendees to take home ideas on how they might use similar tools and techniques in their own environments and apply DMAIC to:

o **Define:** A review of how the training team used define to isolate and understand the scope of the problem that was impacting the process. This takes participants through the journey of being creative when identifying root cause as well as the necessity of being willing to try a unique approach.

o While working in the DMAIC format, participants will learn how key **Measures** were identified to monitor and manage the process. Before and after metrics are shared. Metric formats utilize the Pareto chart, an individuals moving X chart

and others. The definitions of input and output metrics will be provided and discussed. Input metrics impact the performance of an output metric.

The Measures portion will enable participants to learn about transparency. There will be a discussion on the pros and cons of trend review: Sharing graphed data tends to minimize over-reactiveness and temper under-reactiveness. There will also be a discussion on the key characteristics that are considered helpful in metric review. These are the inclusion of: Performance Data, Historical Data, Comparison Data and Target Setting. Discussions will also be held regarding the logic of collecting too much data.

o Several **Analyze** processes will be included. There is a high level review of a few common quality and lean tools that were applied during this process. Specifically, live samples of Silent Brainstorming, a Cause and Effect Diagram and a Value Stream Map (VSM) are reviewed. Results are shared as the effects of the implementation of the solutions are applied. This concurrent session will provide a hands-on simulation of the silent-brainstorming activity to demonstrate the effectiveness of various types of brainstorming analysis.

13th Annual Symposium & Automotive Awards

o The **Improve** phase of DMAIC are clearly observed via objective and measurable results. Based upon the analysis portion, the lessons learned are applied and substantial results are observed. This session provides the participants with ideas and concepts of how to validate the effectiveness of actions that have occurred and to ensure that those results are sustained.

A review of the concept of Control is shared as live actions are assessed. Live samples of how to follow-up to ensure that the executed improvements continue to achieve and/or hold the gains

that were made are discussed with participants. Discussion will also include the criticality of an effective and transparent scorecard system.

BIOGRAPHY

Jd Marhevko is the Vice President of QLMS and EHS for Accuride Corporation. She is a business and operational excellence executive with over 25 years of operations, QA and lean experience in a variety of industries including Automotive, Aerospace, Plastics and Machining.

Jd is an ASQ Fellow, a Certified Manager of Quality and

Organizational Excellence (CMQ/OE), a Certified Quality Engineer (CQE) and a Certified Six Sigma Blackbelt (CSSBB). She is also a trained Master Black Belt (MBB). Jd has been a senior Baldrige System assessor for the state of Michigan for several years. She holds a Bachelors of Science in Engineering (BSE) from Oakland University in Michigan and a Masters of Science Administration (MSA) from Central Michigan University. Jd is a Past-Chair of ASQ's Quality Management Division (QMD), a 25,000 member global professional organization.

Lessons from the Masters



Mark Morris
M&M Consulting
ASQ Fellow

ABSTRACT

Sir Isaac Newton was right. We see a bit further when we stand on the shoulders of giants. When our goal is to build and sustain a culture of continuous quality improvement, it is good to consider the lessons of the masters. Certainly there are giants in the field of quality. Shewhart, Deming, Juran, and so many others, leaders who have given today's quality professionals a legacy of knowledge upon which to build.

Annually, ASQ Ann Arbor Section 1010 has offered a Read and React course, studying the writings of some really smart people. The authors we've studied include

Shewhart, Deming, Juran, Bajaria, Goldratt, and Covey. This presentation engages through thoughtful dialog, sharing some gems of genius we've uncovered over the years.

We begin and end at the DIA, the Detroit Institute of Arts, contemplating 25 years of insight as a quality professional. How to distill these many experiences down to a few lessons worthy of the 2014 ASQ Automotive Division Symposium's participants? It's an entertaining journey, adventure and intrigue, giving credit where it is due, thinking with clarity, telling the truth.

"Masters" are people, both living and passed, who have influenced

13th Annual Symposium & Automotive Awards

my life's story in some significant way. Our goal is to provoke introspection, where participants consider mentors who have impacted their lives, and maybe take action, send a note, say a prayer.

BIOGRAPHY

Mark A. Morris is an ASQ Fellow. He has more than 30 years experience in tooling and manufacturing as a skilled machinist, toolmaker,

college instructor, technical writer, and quality professional in roles from Quality Engineer to Director of Continuous Improvement. His expertise lies in quality engineering, solving dimensional issues, reliability, maintainability, and quality systems. Mr. Morris' credentials include undergraduate degrees in manufacturing engineering technology, industrial education, and metalworking; Master of Education degree from the College of Technology at

Bowling Green State University; CQE, CRE, and CQA certifications from the American Society for Quality; and Senior Level Geometric Dimensioning and Tolerancing Professional (GDTP) certification from the American Society of Mechanical Engineers. Mr. Morris is an ASQ Validated Instructor. He presently serves as Deputy Regional Director for ASQ Region 10 and Secretary for the Ann Arbor chapter of SME.

Zen and the Science of Problem Solving



Richard Shainin
Executive Vice-President
Shainin LLC

ABSTRACT

We are all experienced problem solvers. It's how we get through each day. Most problems are minor and easily addressed. Some are more difficult and require a more formal approach. Some seem to be unsolvable; so we live with the situation and try to minimize the consequences. As with many skills, we've become comfortable with performing the skill to the point that we no longer think about how we do it, we just do it.

This presentation will examine the essence of problem solving, from problem avoidance through the use of work-arounds to discovering surprising root causes. The goal is to help you see problem solving in a different light and apply the most appropriate approach to the situation at hand.

BIOGRAPHY

Richard Shainin is an executive with Shainin® – The Red X® Company. Prior to joining Shainin, Dick worked in the delivery of long distance service for AT&T; where he led high-performance teams in engineering, operations, marketing and sales.

Dick earned a Bachelor of Engineering degree from Stevens Institute of Technology in Hoboken, NJ and an MBA from American University in Washington, D.C.

Dick is the author of the "Multi-vari Charts" chapter in the Encyclopedia of Statistics in Quality and Reliability (Wiley 2008). He has also published papers in Quality Engineering and Six Sigma Forum.

Dick has trained thousands of engineers in statistical engineering concepts, strategies and techniques.

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Culture of Quality - Forbes



Laurel Nelson-Rowe
ASQ Managing Director

ABSTRACT

A strong culture of quality is integral to accelerating growth and performance in the enterprise. It starts with a common language an organization uses to talk about how it meets the needs of its customers. But too often, senior executives and

quality professionals have differing opinions about their organization's culture of quality and its key components, like vision, value, leadership and the inclusion of the customer.

Based on the ASQ and Forbes Insights research "Culture of Quality: Accelerating Growth and Performance in the Enterprise," this presentation explores the differences between quality professionals and senior executives and provides actionable insights into how a quality-driven culture can accelerate business performance. The presentation will make you think about your organization and its culture of quality, and how you can help enhance your organization's quality culture.

BIOGRAPHY

Laurel Nelson-Rowe has held senior leadership roles in communications, marketing, editorial, publishing, Internet commerce and association management. In May 2003, Nelson-

Rowe joined the American Society for Quality as managing director. She has served at Greenspun Media Group, Las Vegas, as Internet media vice president, and worked for CMP Media/United Business Media, Perot Systems and United Airlines. At ASQ Nelson-Rowe is focused on individual and organizational membership development, products and services worldwide; strategic communications and brand development; industry research and global partnerships. She is instrumental in ASQ's brand visibility and is charged with championing ASQ's global brand transformation. A Marquette University graduate, Nelson-Rowe is a member of ASQ, the Public Relations Society of America, the American Society of Association Executives, the Council of Engineering and Scientific Society Executives, and Professional Dimensions Milwaukee; and is active in leadership roles in several local non-profits.

Thank You to our Symposium and Automotive Award Sponsors

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SPECIAL THANKS TO



13th Annual Symposium & Automotive Awards

2014 Awards

Quality Leader of the Year:

Presented to an executive who has led the organization to journey of quality excellence

Richard D. Shainin

Quality Professional of the Year:

Presented to individuals in the automotive industry who have made significant contributions in the following areas: Leadership, Community Service, Pursuit of Excellence & Team Results

Robert Perkins

Cecil C. Craig Award:

Presented to the best technical/management papers relating to quality and reliability written by Division member "Lifetime Achievement Recognition"

R. Dan Reid

William P. Koth Award:

Presented to Division member who has given outstanding personal service for the promotion of the Automotive Division

Kush Shah

Judson C. Jarvis Award:

Presented to the individual who makes the most significant contribution to the success of the Automotive Division

Elizabeth Hanna

Scholarships and Criteria

Dr. Joseph M. Juran Endowed Scholarship at Ferris State University

1. Full time student enrolled in Quality Engineering Technology
2. Minimum GPA of 3.2
3. Financial need is not required but may be considered
4. Additional requirements: Must have at least six credit hours in degree program, demonstrated student involvement in

professional organizations and leadership abilities. Must show intention of entering automotive industry upon graduation

To be awarded later this year

W. Edwards Deming Scholarship at Oakland University

1. Awarded to Graduate Students in Statistics Degree program in the Department of Mathematics and Statistics
2. Academic performance
3. Potential as a practical statistician

Christina Patel

Robust Design Shelf to Reduce Time-to-Market

By: Shi Taguchi, Chief Technical Officer, ASI Consulting Group, LLC

Introduction



In June 2012, we lost our Executive Director Dr. Genichi Taguchi. Hundreds of condolences have been received from quality and engineering societies all over the world and memorials were held in both Japan and the United States. So the torch has been passed to us to continue to increase quality of

goods and services and minimize the loss to society.

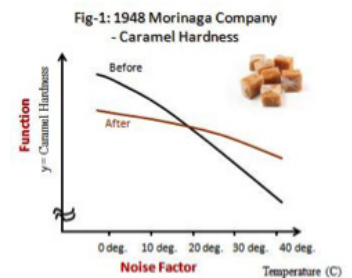
Recently, new approaches/methods have been developed including:

- Numerous Types of Ideal Function for Robust Optimization
- Standardized S/N for Non-linear Ideal Function
- Mahalanobis Taguchi Systems for Pattern Recognition
- T-Method for New Way of Modeling with more variables than number of sample
- System Behavior Testing using Orthogonal Array and Two-way Response Tables
- Use of Indicative Factors for Simultaneous Optimization
- Robust Design Shelf as a Corporate Strategy
- This short article will focus on Robust Design Shelf as a Corporate Strategy.

Parameter Design/Robust Optimization & Signal to Noise Ratio to assess "Robustness"

Since 1940's, Dr. Taguchi has been focusing on "Robustness" to achieve high performance, quality and reliability. Fig-1 shows the results of a study done at Morinaga Co., in which hardness of caramel candy

was optimized to become insensitive to ambient temperature. This allows you to chew caramel in the winter without breaking your teeth and also allows you to have the candy in your pocket in the summer without it melting. We can safely state that hardness is one of the critical functions of caramel candy. Ambient temperature is a noise factor. Noise factors are variables that we cannot control or do not wish to control. Three main categories of noise factors are: Environment, Aging, and Manufacturing. When a system's function is robust to noises, it will maximize system performance and reliability, and minimize quality problems/defects/failure modes, in other words: minimize the loss to society.



Therefore it is critical to optimize the "Function" of a system for robustness. Failure modes of a paper feeder system within a copier such as 'paper jam', 'paper mis-feed' and 'paper multi-feed' happen because of lack of robustness of the system's function which is to displace single sheets of paper. The idea is to "Optimize the function for robustness so that we will meet all requirements" or "Engineering for the ideal function, not for not for symptoms of poor function". Robustness is assessed by Signal-to-Noise Ratio which is conceptually given by:

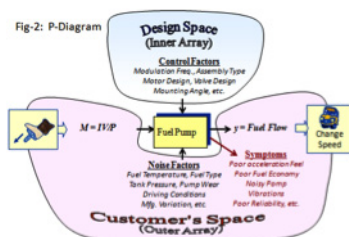
$$S/N = \frac{\text{Efficiency}}{\text{Variability}} \quad \text{or} \quad S/N = \frac{\text{Performance}}{\text{Variability}}$$

P-diagram

Of course, the challenge is to maximize the 'S/N' ratio cost effectively. Fig-2 shows a P-diagram (parameter diagram) for an automotive fuel pump. In the middle of P-diagram is the system in scope. Input and output

Robust Design Shelf to Reduce Time-to-Market, continued

shown horizontally define the function of the system in scope. The function of the fuel pump is to generate fuel flow and pressure from its electric input power voltage and current. Theoretically, fuel flow generated by the fuel pump must be proportional to current, voltage and pressure. This relationship is referred as the "ideal function".



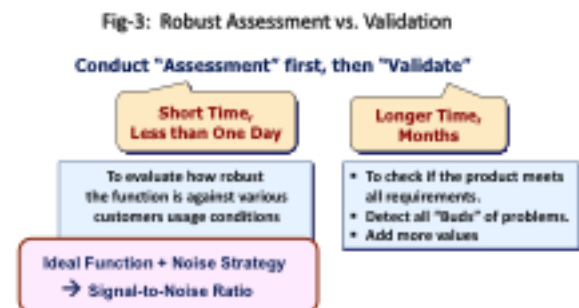
The ideal function of a system is developed by using the concept of 'energy thinking' when the system is hardware. Energy thinking is simply the idea that you want as much energy that goes into the system as possible to be used for the intended function of that system. When the system is software or a service, its ideal function is developed by using a similar concept, namely focusing the ideal function on the work generated by the system.

The P-diagram shows potential noise factors from the previously mentioned three categories. It also shows factors called 'control factors' which are design parameters that engineers have control of within the design space. Finally, the P-diagram shows symptoms of a poor function. Robust Optimization is a systematic method of determining the best combinations and settings of what we can control, i.e. control factors, such that the function of the system is robust to noise factors.

Robust Assessment vs. Validation, Shorter Testing/Experimenting Time

The concept shown in Fig-3 is extremely critical. Traditionally, when engineers develop a new design, they start testing the design against requirements. This is often the reason that engineers end up with unnecessarily long 'time-to-market' and have to resort to 'whack-a-mole-engineering' and never ending 'fire fighting' when the product is being manufactured. Testing to see if the design meets the requirements belongs to "Validation" but requirements are not always aligned with the function of the system.

Because of this, we must then develop a test that can assess "Robustness of function" in a short time, both efficiently and effectively. This, we call Robust Assessment. A robust assessment test must be developed so that a quick judgment can be made on how well the design(s) performs under various noise conditions. Moreover, we want to detect and reject a poor design with confidence as early as possible. Robust assessment is done by measuring the previously mentioned "Ideal Function" under a selected 'Noise Strategy' and S/N is computed to assess "Robustness."



If a computer simulation is used for optimization, it is okay to use a relatively simple simulation, as long as the simulation result has a reasonable correlation with reality and its tendency can be trusted. As an example, a 36-hour CAE is typically used for its accuracy, but a crude 10-minute simple simulation can be used to explore trillions of design configurations using Orthogonal Arrays. In case of a physical test, a simple jig to mimic the function can often be used. Validation is still an important step though. Validation insures that a product meets requirements and more importantly, checks if any issues are overlooked. The market place should never be used to validate a product. However, validation should be done after Robust Assessment has been conducted on the optimized design. This way, we are more confident that the design will validate.

Two-Step Optimization

Another critical strategy is called "Two-Step Optimization":

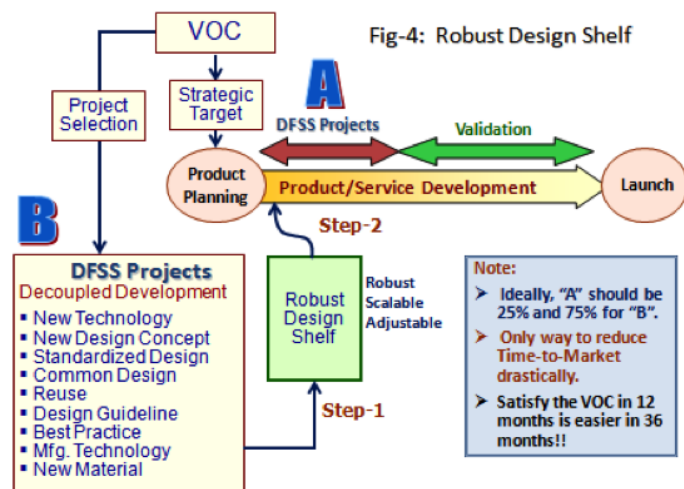
- Step-1: Optimize the function for "Robustness" by maximizing the 'S/N' ratio.

Robust Design Shelf to Reduce Time-to-Market, continued

- Step-2: Adjust the output to meet the specific target value, or target profile.

Robust Design Shelf

Fig-4 shows the concept of 'Robust Design Shelf'. 'Robust Design Shelf' optimizes the design in advanced development (or, decoupled development -- decoupled from specific product development) so subsystems, modules, components, materials, and manufacturing technology are already optimized for robustness from



'Step-1' of 'Two Step Optimization'. These optimized designs are then put on the robust design shelf and can be adjusted for varying size and scalability requirements to be used on multiple products. 'Robust Design Shelf' is the most effective way to reduce 'time-to-market' drastically. The following case studies will help to demonstrate this concept.

Example-1: Engine Mount

The function of engine mount is to isolate vibration and harmonic energy produced by the engine to create a quiet, smooth feeling inside the vehicle. 'Robust Design Shelf' was used to optimize the engine mount design and its locating scheme for all future small and

midsize sedans. These vehicles were anticipated to have 4-cylinder, V6 and Diesel engines. Although the optimum design could have been unique for all three types of engines, a common design was used for the I4 and V6 engine sizes although attachment locations were a constraint. The following approach was used --

- Assign Factor V: Engine Type V1=I4, V2=V6, V3=Diesel which was placed in the outer array (of the experimental layout) along with signal and noise factors. Judgments were then made on how much common design space there was within these three engine types. The I4 and V6 optimum designs were so close that it required only small scaling adjustments on control factors which made the overall design cost effective. The optimum design for Diesel was very different. Note that 'control factors' and levels needed to be defined carefully to reflect the constraints of the system.

Example-2: Steering Feel

Steering feel can be expressed as 'Steering Torque Profile' as a function of 'Rate of Steering' and 'Vehicle Velocity'. Decoupled optimization was done to optimize for 'Robustness' and to develop 'know how' to match any profile of steering feel: Good Old American Large Sedan Feel, High Performance Luxury Sedan Feel, Mid-size Family Sedan Feel, Sporty Two-seater Feel, etc. The optimum design and the 'know-how' for adjustment are put on the 'Robust Design Shelf'. At least two automotive companies have done this. One of them was on the new "e-Steer" system.

Conclusion

'Robust Design Shelf' optimizes designs of multiple systems and subsystems. Once they are put on the robust design "shelf", they can be adjusted for varying size and scalability requirements and be used on multiple products. 'Robust Design Shelf' is the most effective way to drastically reduce 'time-to-market'.

Improving the Efficiency & Effectiveness of Reliability Test Plans

By: Bernie Stubitsch, Senior Project Engineer, AVL Powertrain Engineering, Inc



Bernie Stubitsch has over 17 years of professional experience, mostly in the automotive industry. He is currently a Senior Project Engineer at AVL Powertrain Engineering, Inc., where he works as a consultant with a focus in quality and reliability. His previous experience was at Detroit Diesel Corporation, where his roles included Senior Reliability Engineer, Six Sigma Black Belt, Packaging and Material Handling Engineer, as well as several other roles in engineering and manufacturing. Bernie has a BSIE from the University of Wisconsin- Madison, 1996, and is an ASQ Certified Reliability Engineer, IQF Certified Six Sigma Black Belt, Shainin Apprentice, DaimlerChrysler Green Belt and Critical Thinking Coach.

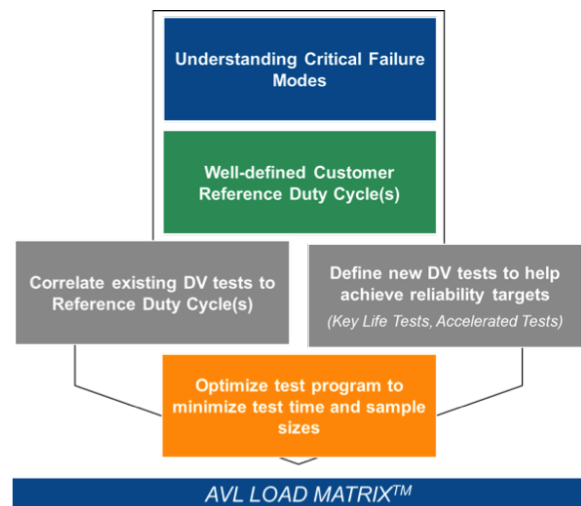
Challenges With Reliability Demonstration Plan Development

When developing a reliability demonstration plan, it is common for companies to use standard test cycles which have been used for many years. There are several benefits to this approach: results can be compared to prior programs and products, expected results over the duration of the test are known, and test development and validation time is eliminated, to name a few.

However, there are also risks associated with relying solely on these legacy reliability test cycles. Existing test specifications were likely developed on surrogate products or systems, and there may be weak or even no correlation to current customer usage. Without correlation to customer usage, there is a potential to either over- or under-test, based on useful life requirements. Over-testing has obvious negative implications related to higher development costs and over-designing of products. Even worse, if products are under-tested, critical failure modes may be found too late or missed entirely during reliability testing, resulting in high warranty and customer dissatisfaction.

AVL's LOAD MATRIX™ is our internal process for development of reliability demonstration plans. It begins with identification of critical component failure mode combinations, and utilizes a well-defined customer duty

cycle to evaluate the actual risk to the customer. Each existing reliability test cycle is then analyzed relative to how it addresses each critical failure mode, and cycles are modified, or new cycles are defined, to address any deficiencies in the reliability test plan. The end result is an efficient reliability test plan which exercises all critical failure modes to achieve reliability and confidence targets as efficiently as possible, considering both test time and sample sizes.



The AVL LOAD MATRIX™ Process Steps

1. Understanding Critical Failure Modes

Critical component failure modes are identified through the design failure modes and effects analysis (DFMEA) process. DFMEAs are a well-known and universally-used tool, particularly in the automotive industry. However, the LOAD MATRIX™ process includes an extension of the DFMEA process, called the Failure Parameter (FP) Sheet. The FP Sheet is a compilation of the most critical component/failure mode combinations from the DFMEA activity, but also addresses the following questions:

- What are the damaging operating conditions that could induce these failures?
- How can this damage accumulation be measured?

Improving the Efficiency & Effectiveness of Reliability Test Plans, continued

These critical damaging operating conditions, and what parameters are available to measure damage accumulation, are then used to compare the customer duty cycle to proposed test cycles. Examples of these damage models may be a count of events (such as cold starts), time accumulation at critical operating conditions (such as high speed/load), or cumulative

damage at varying loads over time. The following is an excerpt from a FP Sheet. The first section is data transferred directly from a DFMEA, and the second section is the FMEA “deep dive” into damaging operating conditions, measurement parameters, and damage model definition.

Subsystem / component	Failure mode	Failure Location	Cause of failure	Effect on system level	Criticality	Priority
AC Bracket	Oil leak at Oil Pan/Front Cover interface	AC Bracket	Insufficient load applied to oil pan/front cover flange interface	Customer Dissatisfaction (5)	4	1

Example 1: FP Sheet Data Input From DFMEA

Damaging Operating Conditions	Aggravating conditions	Measurable parameters	Classification method	Damage model	Remarks
AC compressor bracket resonance	AC compressor cycling	Frequency and amplitude, engine and BSG RPM	Time at level	Time at AC compressor bracket resonance	

Example 2: FP Sheet Damage Model Definition

2. Well-Defined Customer Duty Cycle

A well-defined customer duty cycle is a critical component to AVL’s LOAD MATRIX™ process. Optimally, data collected from the actual product to be tested, acquired over prescribed routes, would be available. However, simulation data, or data from past experience on similar products and applications can also be used. The customer duty cycle should contain all the necessary parameters as defined in the FP Sheet. These parameters are then analyzed to determine the expected damage accumulation over the useful life of the product.

3. Correlation of Test Cycles to Customer Usage: Acceleration Factors

Similar to the customer duty cycle, each candidate reliability test cycle is also analyzed for each damage parameter, and the cumulative damage for each component/failure mode over the duration of the test is quantified. These calculations are then used to

establish acceleration factors for each test, relative to each damage parameter and the customer duty cycle. An acceleration factor, defined as such, should not be confused with an accelerated life test (although these can be included in LOAD MATRIX™). An acceleration factor is merely defined as the ratio of damage accumulation, per unit time on test, relative to the damage accumulation in the field per unit time, and can be expressed in the following equation:

$$Acceleration\ Factor = \frac{\left(\frac{\sum Damage_{Test}}{Time_{Test}}\right)}{\left(\frac{\sum Damage_{Field}}{Time_{Field}}\right)}$$

These acceleration factors are then tabulated for each test cycle, as in Example 3. Each test can contribute to any or all damage models, and overall damage accumulation is summed for each damage model, depending on test type and quantity selections.

Improving the Efficiency & Effectiveness of Reliability Test Plans, continued

Example 3: Acceleration Factors

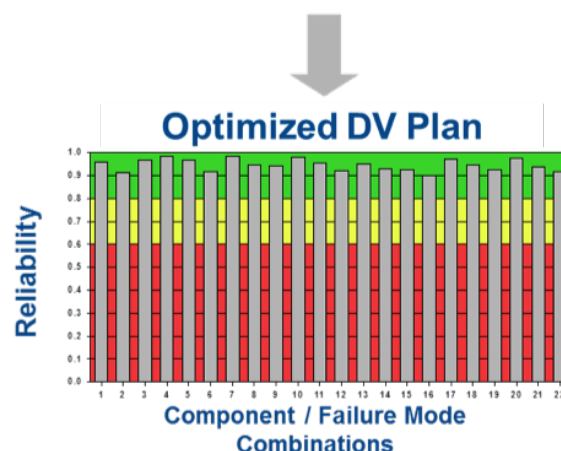
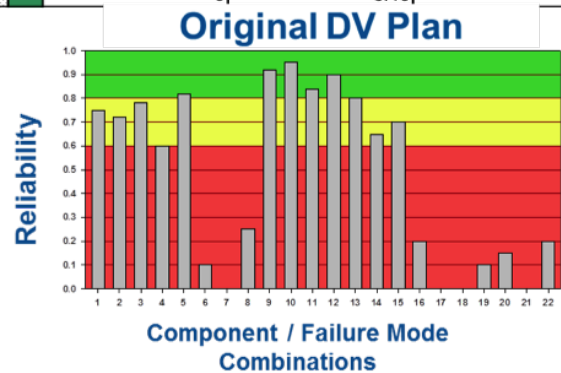


Matrix of Acceleration Factors					Critical Component / Failure Mode					
Reference Duty Cycle 1					1	2	3			
Demonstrable reliability at (mi)					150,000	AC Compressor or Bracket Resonance	Start/Stop Events	High Crankshaft Speed Cycling Events		
Speed (mph)					30					
Bx target (mi)					150,000					
x=					10					
			Select in context menu							
Tests	Nr	Test	Number	Duration (planned)	Unit	Category	Enabled	Class of Damage Model		
								A	A	A
								Columnwise scaling deactivated		
								1	1	1
	1	Test 1	0	625 h	1	1	0	0	0	0.65
	2	Test 2	2	433 h	1	1	0	0.02	0	0.7
	3	Test 3	2	750 h	1	1	0	0.05	0	0.3
	4	Test 4	2	801 h	1	1	0	0	0	13.2
	5	Test 5	0	900 h	1	1	0	0	0	6.06
	6	Test 6	2	550 h	1	1	50	0.06	0	0
	7	Test 7	0	555 h	1	1	0	0	0	0.73
	8	Test 8	1	2,000 h	1	1	0	3.16	0	0
	9	Test 9	6	1,000 h	1	1	0	3.16	0	0

4. Reliability Test Plan Optimization

Once all acceleration factors, for all candidate reliability tests, have been calculated, AVL's LOAD MATRIX™ then uses statistics to identify which tests, durations, and quantities, are required to address all critical component/failure mode combinations. Additionally, any "holes" that exist in the reliability test plan, where no test cycles can adequately test a failure mode to achieve the reliability and confidence goal, will be identified, indicating the need for a new or modified test cycle.

The end result of AVL's LOAD MATRIX™ process is a reliability demonstration test plan which addresses all critical component/failure mode combinations to the desired reliability target, with the most efficient combination of test cycles and durations selected. In this manner, one can ensure the reliability test plan is adequately addressing all critical risks, while also minimizing the overall time and financial investment to execute the test plan.



Improving the Efficiency & Effectiveness of Reliability Test Plans, continued

Applications

AVL's LOAD MATRIX™ process can be applied to reliability demonstration plans at the product, system, or component level. Examples of automotive products and systems where AVL has successfully utilized LOAD MATRIX™ to develop test plans are the following:

- Gasoline Engines
- Diesel Engines
- Transmissions

- EGR Systems
- Diesel After-treatment Systems
- Fuel Systems

Example 4 below is a snapshot of a reliability test program which was evaluated using LOAD MATRIX™. As indicated, deficiencies were identified in the test plan, where failure modes were inadequately addressed. These "holes" were ultimately addressed through a combination of adding test samples and modifying existing test procedures.

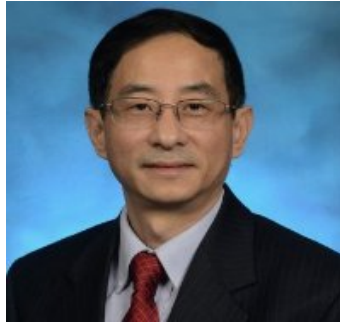
Example 4: Evaluation of Reliability Demonstration Test Plan

Unit confidence level show: planned		km		0.90		Demonstrable Reliability: 300000
Component Information				Reference Cycle 1 - City Application		
Sheet	Crit. Component / Failure Mode	Weibull Parameter Gamma	Weibull Parameter Beta	Maximum of Equivalent km in one single test	Sum of Equivalent km	Demonstrable Reliability (Weibull Distribution)
1	Catalyst coating (Pt, Pd) / Catalyst coating (Pt, Pd) / Poisoning of catalyst coating / Chemical aging (catalyst poisoning due to high oil consumption)	0.00	1.00	900,000	4,022,000	0.965
2	Catalyst coating (Pt, Pd) / Catalyst coating (Pt, Pd) / Poisoning of catalyst coating / Chemical aging (catalyst poisoning due to high sulphur content of fuel)	0.00	1.00	0	0	
3	Catalyst coating (Pt, Pd) / Catalyst coating (Pt, Pd) / Loss of coating conversion rate (thermal aging) / Thermal load (surface reduction, phase transformation)	0.00	1.00	300,000	1,464,000	0.914
4	Filter insulation (Material: Al2O3 fibre) / Filter mat / Erosion / Mechanical and thermal load				3,000	0.969
5	Filter insulation (Material: Al2O3 fibre) / Filter mat load				2,500	0.897
6	Filter insulation (Material: Al2O3 fibre) / Filter mat Mechanical load				3,500	0.867
7	Filter insulation (Material: Al2O3 fibre) / Filter mat Mechanical load (forces induced)				3,000	0.968
8	Filter substrate (SiC) / Filter substrate crack / Vibrations (engine excited)				3,500	0.867
9	Filter substrate (SiC) / Filter substrate Thermal load				2,500	0.897
10	Filter substrate (SiC) / Filter substrate / Thermal crack / Thermal load	0.00	1.00	300,000	1,252,500	0.897
11	Filter substrate (SiC) / Filter substrate / Reduction of filter volume / Ash content (storage)	0.00	1.00	900,000	4,022,000	0.965

Improvements can include:

- Higher acceleration
- New test procedure
- Longer test time
- Additional samples

2015 Guangbin Yang Reliability Symposium



**Walter P. Chrysler Museum
Auburn Hills, Michigan
August 13, 2015: 8:00 am – 5:00 pm**

The FCA Technical Council, in conjunction with the American Society for Quality Automotive Division, is proud to host the 2015 Guangbin Yang Reliability Symposium. This forum honors our late friend and colleague by sharing the latest in Quality, Reliability, and Statistics with like-minded individuals in the field and the automotive industry. In addition to an expanded speakers' roster, this year's free event features lunch, a panel discussion, and a networking period.

Schedule:

8:00 – 9:00	Guest Arrival
9:00 – 9:15	Opening Remarks
9:15 – 10:00	James McLeish – DfR Solutions: <i>Reliability Physics: The Science of Product Integrity</i>
10:00 – 10:45	Dr. Zissimos Mourelatos - Oakland University: <i>Reliability Assessment, Warranty and Design of Repairable Systems Using Reliability Topologies and Counting Processes</i>
10:45 – 11:00	Break
11:00 – 11:45	Dr. Vasilii Krivtsov - Ford Motor Company: <i>Bayesian Probability Papers</i>
11:45 – 12:30	Dr. Ahad Ali - Lawrence Technological University: <i>Failure Prediction and Performance Degradation in Automotive Manufacturing</i>
12:30 – 1:30	Lunch (Provided)
1:30 – 2:15	Bernard Stubitsch – AVL: <i>Using AVL's LOAD MATRIX™ Methodology to Develop Reliability Demonstration Plans</i>
2:15 – 3:00	Dr. Jay Zhou - Ford Motor Company: <i>Robust Engineering for Global Markets</i>
3:00 – 3:15	Break
3:15 – 4:00	Panel Discussion
4:00 – 5:00	Networking

Admission, lunch, and refreshments are free but you must be registered to attend. To register go to www.eventbrite.com and type in 2015 Guangbin Yang in the Search area.

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