Automotive EXCELLENCE

Spring 2017

Inside this Issue

ASQ

Letter From The Editor

Mohammad Hijawi
Publications Chair

Dear ASQ Automotive Members,

Welcome to another edition of the Automotive Excellence Newsletter. In this exciting edition, we have two technical articles, as well as recent and future activities and news. A letter from the chair, David Butler, has a welcome message and some updates.

The first article is titled "Vehicle Telematics Big Data Analysis" by Dennis Craggs. The second article is titles "Accelerated Life Test -Simulation Integration" by James McLeish.

The 2017 Guangbin Yang Reliability Symposium will be again this year at Ford Motor Company. Details are included in this edition.

I would like to thank Dennis Craggs, James McLeish and David Butler for their contributions to this edition.

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

I look forward to hearing from you.

As always, thanks for your support of the newsletter. If there are any topics you would like to see, anything that we could do better, please let us know by forwarding your questions or comments to mshijawi@yahoo.com.

Mohammad Hijawi
Publications Chair

ASQ Automotive Council

David Butler - Chair
Ken Coll/ Chair-Elect
MaryBeth Soloy- Secretary
Elizabeth Hanna- Treasurer
John Katona- Membership and CSR
Roderick Munro- Historian
Jaynie Vize- Certification
Lisa Rosenbaum- Webinars/Marketing
Walt Oldeck- Communications/IT
Jennifer Schneider- Past Chair
Mohammad Hijawi- Newsletter/Publications

Letter From The Chair

David Butler

ASQ Automotive Division Chair

Dear ASQ Automotive Division Members,

Wow! It is 2017 already; time really does fly!! A lot has changed with our industry and there is a lot going on at ASQ and within our Division.

New IATF 16949 Standard

I'm sure everyone is well aware of the new industry requirements. This is by far the most complex, most demanding and the most difficult standard I have seen in the 40+ years I have been in automotive quality. And with the very compressed timing and the specific rules to transition to the new standard....well, we are all going to be very busy the next year or so.

The ASQ Automotive Division is currently preparing webinar information and publications to send to our members to help with answering some of the questions and to offer a forum for discussion. I will be sending details about this in the next few weeks.

The ASQ is also changing with plans for a new website, new processes, more visibility and a plan for growing our membership significantly by 2020. The ASQ Automotive Division has aligned our goals and objectives to support the ASQ initiative, but our primary focus is on enhancing our member value. I am well aware; as is our full council we have not been providing as much value as we can/should for you, our customer. Some of that was due to "restrictions" and truthfully misunderstanding of what we can and cannot do. I am very happy to let you all know we have resolved all those issues and are very actively planning training sessions for Core tools that members can attend and also basic training for Core Tools via webinars. We are also focusing on training materials for IATF 16949. We should be providing you with these opportunities in the next month or so. I will announce via email and via our Automotive Division website when these are schedule. And as Chair of our Division, I want to personally apologize to all of our members about the delays and inability to provide this to you as many have requested. We are also working on providing these training materials in other regions of the world.

And as mentioned in previous communiques, we are very interested in having more members involved in our discussions and our council. If we can get more volunteers and more people involved, we can continue to expand and grow our member value options. Please let us know if you would like to get involved.

Letter From The Chair

2017 Upcoming Events:

February 25-26
Social Responsibility Activity: The Michigan Blind Athletic Association 33st Annual USABA Midwest Regional Goalball Tournament Warren Mott High School, Warren, MI

March 16
ASQ Detroit Section Meeting- I will be presenting the topic "The Quality Control Handbook- The Missing Chapter- "Trust". This is a humorous discussion about a very serious set of concerns facing our industry and our profession. If you are in the area, we would love to have you attend.

April 30-May 3
ASQ World Conference on Quality Improvement (WCQI) which will be held in Charlotte, North Carolina. "Grow your influence in the Profession, Through the Organization and Around The World"

We will have a booth with BMW vehicles on display and will have staff there to discuss all division opportunities, changes and upcoming events.

April 30
Annual ASQ Automotive Division Meeting- at WCQI in Charlotte at 2:30 PM

September 14-15
Inspection Division- Grand Rapids we will have speakers at this event and will be supporting this conference.

October
Audit Division - Dallas, Texas again, we will have speakers at this event and will be supporting the Audit Division with this conference.

Our primary focus for 2017 and 2018 is to improve our member value and to provide the training, opportunities and information you have been asking for and to provide more benefit to be a member of our division.

Sincerely,

David D. Butler
Chair, ASQ Automotive Division
chair@asq-auto.org.

Vehicle Telematics Big Data Analysis

By Dennis Craggs

INTRODUCTION

During the product development process, components, systems, and vehicles are tested for function, reliability and durability to verify that requirements are being met. Functional test are relatively quick, however reliability and durability tests are time consuming and expensive. Validating the testing requirements is necessary to avoid excessive testing, which results in more expensive product development costs. It also avoids inadequate testing which may allow faults resulting in field failures and excessive warranty cost.

So how are requirements established? Frequently, the test specifications from prior products are carried into new products. After many years, the basis of the requirements may have been lost. In todays' global market, customer usage varies with local customs, but requirements that were developed for a specific market and may not apply to other markets. Sometimes, engineers or management set the test targets based on their expert opinion or to minimize cost and timing. The targets set will not be consistent with personnel or management changes. This approach may result in over or under testing. A modern approach is to survey customers to determine how the product is being used. However, customer memories are flawed and people don't have automatic counters built into their head. Also, many vehicle functions are transparent to the customer.

A better approach is to set requirements from the analysis of vehicle data.

TELEDIAGNOSTICS

In the automotive arena, telematics data may be called telediagnostics data because vehicles are monitored primarily to collect diagnostic data. Currently, there are about 1000 CAN channels containing counts of events, state data, and parametric data that can be monitored. There is lifetime usage data that is collected about once per second and stored as a record with a time stamp. At intervals, avoid module memory overflow, or in response to vehicle fault events, the data is communicated via Wi-Fi or cell phone technology to a facility for long-term storage and later analysis.

Examples of counts of events include the engine starts/stops or door open/close cycles. State data may include the current gear, the PRNDL position, or different switch states. Parametric data may include the vehicle speed, engine speed, engine torque, battery voltage, and many others of interest to the design and development engineer.

It is important to select vehicles that represent the target market and vehicle type. Fleets usage is very different from retail customer usage. For example, a sporty car may be modified for police pursuit customers. However, one does not expect the same police customer usage.

If 1000 channel are recorded at a rate of 1 per second, then the amount of data to be stored in the module, transmitted, and stored on servers is massive. Some modules preprocess the vehicle usage into histograms. This prevents any future detailed analysis of the raw data time series as the process of creating a histogram removes information.

ANALYSIS

While individual vehicle data is important for fault diagnostics, the stored telematics data for a fleet can be analyzed statistically to characterize vehicle lifetime use. This allows the intelligent development of component, system, and vehicle requirements.

Since different data types are collected, different statistical models will apply and affect the analysis. However, there are some common analysis steps. The data needs to be screened for validity. Bad sensors create bad data that can be detected and removed. Memory overflow and transmission problems may create intermittent data. After the data has been screened, it is converted into standardized metrics to compensate for different mileages, operating time, or other factors. After these steps are

Vehicle Telematics Big Data Analysis, Cont.

accomplished, a quick analysis can be used to determine the statistical distribution that provides the best fit to the fleet data.

Consider a simple trip count analysis. A fleet consisted of a mixture of 100 vehicles, cars/trucks and retail/commercial vehicles. The trips were standardized to trips/day for each vehicle. The trips/day were analyzed and it was found that a lognormal distribution provided the best fit to the fleet data with a 98.5% correlation. The 95th percentile vehicle was used for 9.441 trips/day, figure 1.

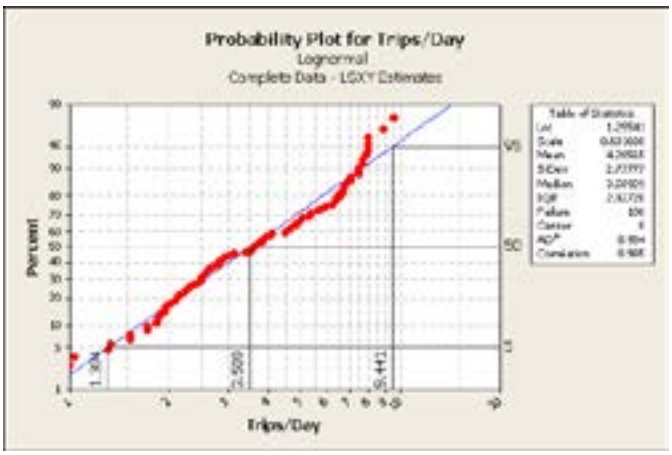


Figure 1

This would be rounded up to 10 trips/day and scaled to the corporate targets. If the target is 10 years of operation, then the components and systems verification target is 36,500 trips. This would apply to engine starting system and component verification targets, stop-start vehicles excluded. Simple assumptions allow other system targets to be determined. For example, by assuming 2 drive side door cycles per trip (one to enter and one to exit the vehicle), then driver door system would have a target of 73,000 cycles. Of course, door open/close cycle counts could be measured on the CAN bus.

The analysis of variable parameters, like vehicle speed, engine torque, voltage, is much more difficult than the analysis of counting data. The standard engineering approach is to display the data as a histogram. However, comparing different vehicle histograms for a fleet results in a plot that is far too busy. An approach is to standardize each vehicle's usage as a fraction of its total usage, then convert the histogram into a cumulative histogram. The result is a plot that captures speed histograms for individual vehicles in the fleet.

For example, consider a typical standard engine speed histogram, figure 2:

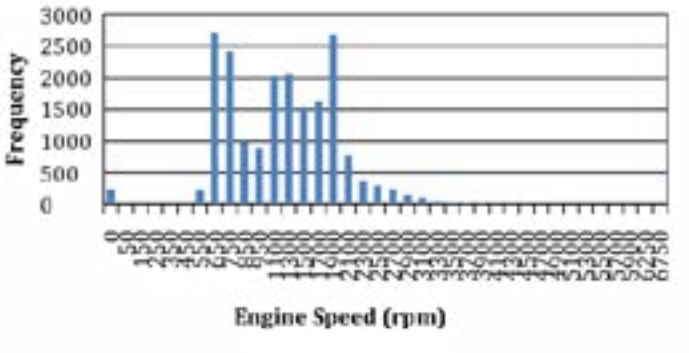


Figure 2

Then, the cumulative percent total usage plot is shown below, figure 3:

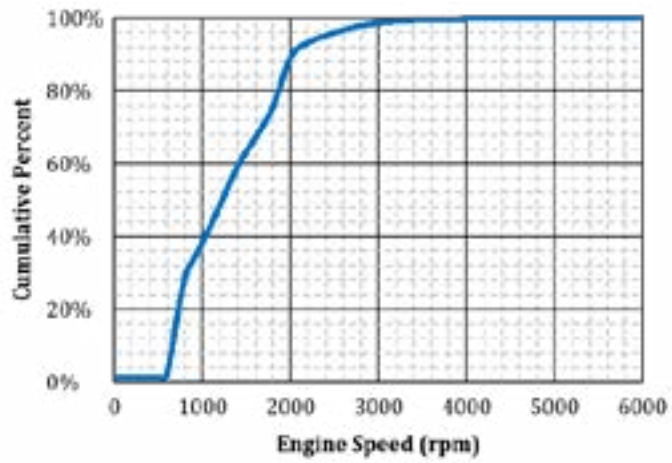


Figure 3

After a few more vehicles, the cumulative vehicle usage plot again becomes unreadable, as shown for 100 vehicles in Figure 4.

Vehicle Telematics Big Data Analysis, Cont.

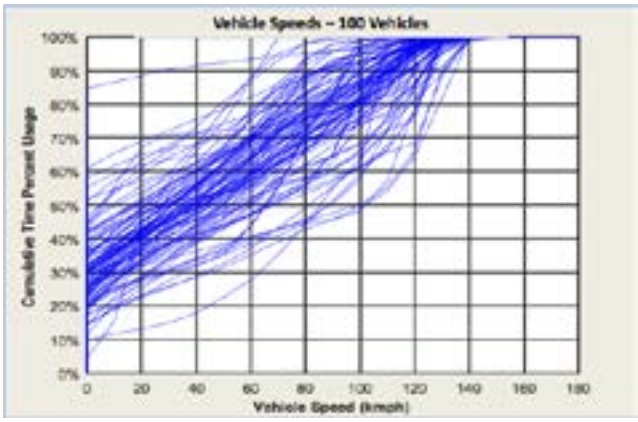


Figure 4

When analyzed statistically to determine usage percentiles, in this case, the 5th, 50th, and 95th, and plotted, the plot is simplified as shown below, figure 5.

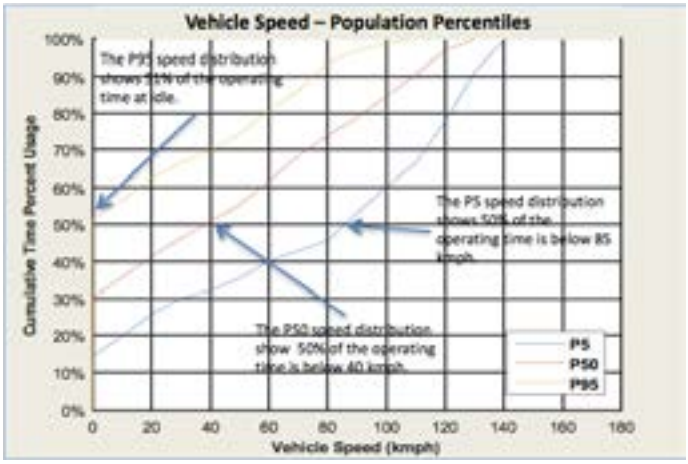


Figure 5

Consider the 95th percentile line. It intersects the vertical 0 speed line at about 52%, which represents 52nd percentile idle time. This is reasonable as the 100 vehicles included some commercial vehicles, which experienced significant idle times. When the data was filtered to include only retail customers, median trace drops and the gap between the 5th and 95th percentile idle times narrowed considerably.

This is the first level data analysis. A cooling engineer would need to understand the distribution of idle times for a vehicle application to revise the reliability test requirements to include long idle times.

This type of analysis may be used for any single parameter time in the telematics data. If the time, vehicle speed, and a parameter are extracted, then the parameter time series may be converted to a distance traveled series by integrating the vehicle speeds. The parameter may be evaluated vs. distance traveled. For engines and transmissions, the distance traveled may be related to engine and transmission revolutions for a cumulative damage analysis.

Other opportunities for analysis are available.

- Two Parameter vs. Time, example: engine torque x engine speed.
- One Parameter x State vs. Time, example: engine or transmission torque x time for each gear state
- Markov analysis, example: transmission gear transitions of start vs. gear end state transitions counts; accelerator pedal transitions; steering wheel angles,...
- Operating time distributions, example: idle time durations

CONCLUSION

The acquisition, storage, and analysis of raw telematics time series data provide a basis to validate vehicle level requirements. A detailed analysis of the multi-parameter data when combined with engineering models allows intelligent subsystem and component level targets to be set. Intelligent targets allow one to determine if a product is fit for use.

Dennis Craggs
810-964-1521

Dennis Craggs has a Masters in Engineering Mechanics and a Masters in Industrial Engineering from Wayne State University. He is a Professional Engineer and a Quality and Reliability Engineer. He worked for NASA, Aerospace, and Automotive companies. At Chrysler's, he was a statistical specialist in the Electrical and Electronics Engineering; analyzed warranty and test data in the Quality Office; and analyzed vehicle telematics data in the Duty Cycle Group.

As a member of the SAE Electronics Reliability Committee, he has participated in the development robustness validation standards. He represented Chrysler to USCAR and helped develop lead-free electronic solder standards.

He taught statistics and reliability at Wayne State University. As an independent trainer, he taught Minitab seminars.

Accelerated Life Test - Simulation Integration

By: James McLeish
Midwest Regional Manager, DfR Solutions

Applying Reliability Physics science based CAE durability simulations to optimize and accelerate product development and validation of automotive electronics.

There are a number of standards and approaches for accelerated durability-reliability testing of Electrical/Electronic (E/E) equipment such as SAE J1455[1], MIL-STD-810[2] and IEC 60068[3]. These standards define general usage and environment conditions and test types and settings that E/E devices are expected to endure when packaged in various vehicle locations. The longest or most demanding validation tests apply physical stresses related to temperature, vibration and shock to evaluate the material and structural durability and integrity of the E/E device to evaluate reliability.

But these standards do not contain complete test requirements, each of them note how their general test procedures are guidelines that need to be tailored in terms of test stress levels and test time or cycle duration to match the needs of a specific application. The classical approaches to test to field correlation are either:

- The "Test Time Compression/Higher Usage Rate" approach where expected usage times at each environment stress level are determined. Then the stress test sequence is run continuously until the desired operation time, miles or cycles have been accumulated. For example, if an engine runs an average of 1.5 hours a day, 10 year of usage can be accumulated by running the engine with all of it components on a dyno for 5475 hours over 228 days.
- Higher degrees of test acceleration can be achieved by testing at stress levels higher than normal operating conditions. Test to field correlation of over stress tests typically involve harvesting of field aged parts either from vehicles still in use or from junk yards. These parts are evaluated to identify signs of aging and usage degradation or wear. New parts and materials are then incrementally exposed to stress conditions until the degree of degradation or wear matched that of the field aged parts. This approach typically produces accelerated life tests that run much faster and at lower cost than time compression tests. However, the test to field correlation effort is much longer and more expensive. An example of this process is the Delphi Lab-Field Correlation Program for Automotive Electrical Connections [4].

RELIABILITY PHYSICS CAE DURABILITY SIMULATION

A better, science based test to field correlation approach is now possible by using Reliability Physic based Computer Aided Engineering (CAE) durability-reliability simulations to determine the rate and accumulated amounts of damage that correlates to when the failure point of a device is reached.

Reliability Physics (RP) is a **Reliability by Design methodology** that leverages the knowledge and understanding of the processes and mechanisms that induce failure to predict reliability, durability and to improve product performance. This knowledge is derived from **Physics of Failure (PoF)** research that employs formalized, enhanced failure analysis techniques to identify the conditions that initiate and propagate failure mechanisms until they manifest into a detectable failure mode issues. The incorporation of failure mechanism knowledge into math model enabled their uses in CAE reliability-durability simulation tools.

The math models of aging-wear out mechanisms of E/E components and materials is based on the material science principles of Stress Driven Damage Accumulation which is also known as "Stress Aging" (Figure 1). These methods are very effective when used as part of "Reliability by Design" efforts during product development. Knowledge of potential failure mechanisms can help guide a designer to avoid potential problems in order to optimize a product's design to be robust, highly reliable and durable.

Finite Element Analysis (FEA), Computational Fluid Dynamics (CFD) and Multi-Physics CAE simulation tools have long been used for performance and durability simulation by mechanical

Accelerated Life Test -Simulation Integration, Cont.

and structural engineers for fatigue, crash and other types of stress analysis and durability simulation [5]. Physics of Failure research that has characterized the materials and micro-structures of electronics components have now made it possible to also apply these tools to electronic products and systems.

Figure 1: Physics of Failure Wear out Failure Mechanism Models are based on the Material Science Principle of Stress Driven Damage Accumulation in Materials (aka Stress Aging).

Physics of Failure CAE modeling of E/E equipment perform dynamic life cycle stress analysis of usage and environmental conditions, the life time stress profiles then become input to the failure mechanism models that perform a durability simulation on the virtual model of an electronic device. The durability simulation then calculates damage accumulation until a failure point is reached in order to determine the mean durability life of each component and feature in the electronic device [6].

Then a library of Weibull distribution for each component type and failure mechanism (also for PoF Research) is reference to calculate the failure distribution about the mean. This enables identification of times to first failure and the failure growth rate of each component and feature in the electronic device, along with the tabulation of the component curves to produce a reliability life curves for the entire electronic device and Pareto Table of what components are calculated to fail first, second, third...etc.

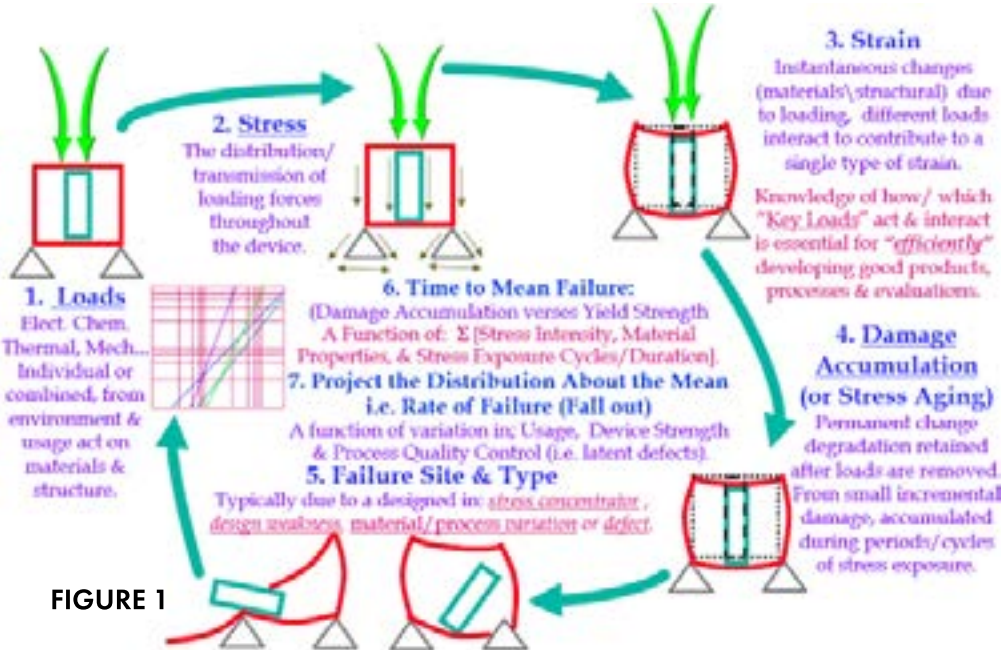


FIGURE 1

relative to the desired durability-reliability objective and why.

This is significant step forward for reliability analysis since traditional reliability predictions use actuarial failure rate history data to estimate a mean time to failure, the point where 50% of your products are expected to have failed, a point when it is too late to implement meaningful improvements. However, identification of time to first failure along with what will fail and why provides the ability to identify "weak link" failure susceptibilities that can start to occur during the device's desired usage life. The design can then be enhanced to eliminate the failure risks while the design is still under development on a Computer Aided Design (CAD) screen. PoF analysis is typically referred to as a durability simulation or reliability assessment to differentiate it from actuarial reliability prediction methods.

Finding potential failure risks on the CAE screen, interactively with design creation allows corrective action design improvements to be developed and implemented quickly, prior to a design freeze when corrective action costs are low. So instead of traditional design, build, test and fix physical durability-reliability growth testing cycles that each require 4-8 months and hundreds of thousands of dollars, problems can be found in a few days of CAE modeling at a fraction of the cost of physical testing.

CAE APPS

Originally CAE stress and structural analysis and later PoF modeling was performed using classical numerical evaluation techniques such as Finite Element Analysis (FEA) for mechanical stress issues and Computational Fluid Dynamics (CFD) for thermal stress issues. However, these multi-purpose CAE tools require a significant amount of expertise and time to create and run models of a complex electronic device that has hundreds of E/E components that each need to be modeled. Often their use stops with stress analysis because the expertise to use the stress condition to perform failure mechanism modeling is not available. These issues

Accelerated Life Test -Simulation Integration, Cont.

have inhibited the use of stress and structural analysis during the design of electronics, which explains why the majority of failures in E/E equipment are mostly mechanical and structural issues [7].

The effort, time and cost of PoF CAE analysis have now been significantly reduced and simplified by the development of a knowledge based CAE App tool suite called Sherlock ADA (Automated Design Analysis). This CAE tool semi-automate the creation of a 3D virtual model of an electronic device from standard circuit board design files [8]. Once the usage/environmental stress conditions (which can be configured to either the test of expected field conditions (Figure 2)) are defined, the CAE App then performs a stress analysis based durability simulation on a virtual model of an E/E module (Figure 3). Finally, it calculates the durability life and reliability for the applicable failure mechanisms for the electronic components and structural elements on the circuit board(s) of the module. This is similar to the way structural durability analysis is performed for vehicles, aircrafts and other structures or mechanical systems.

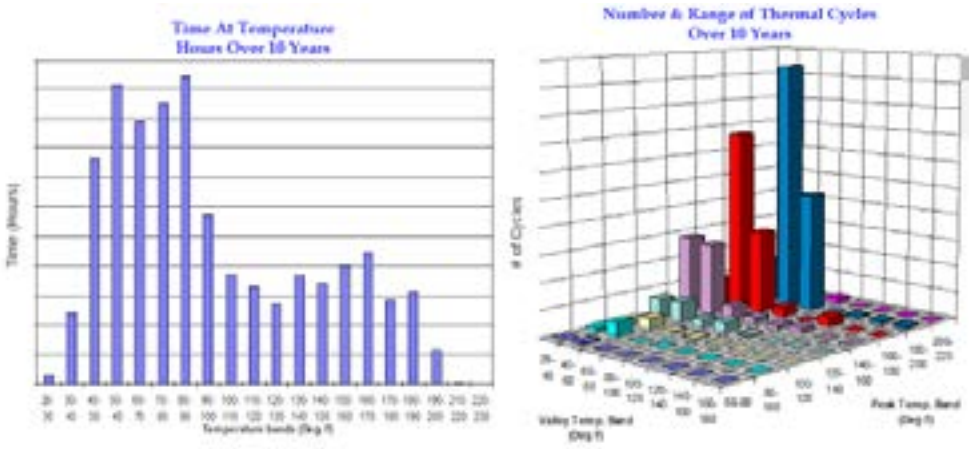


Figure 2: Example of Thermal Temperature Exposures and Thermal Cycles over a 10 Year Service Life.

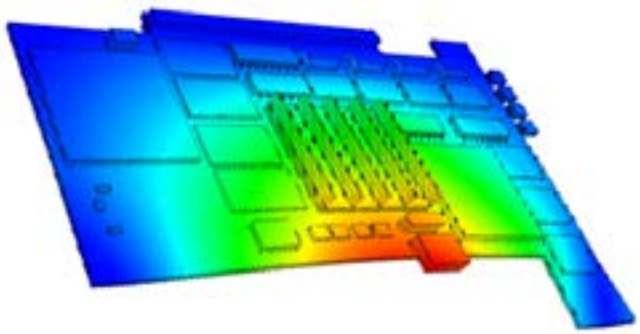


Figure 3: A CAE virtual Model of an Electronic Circuit Board Assembly Under Vibration Stress

Accelerated Life Test -Simulation Integration, Cont.

TEST -SIMULATION INTEGRATION

The use of CAE durability simulations is a valuable tool for producing robust designs, however there is still a need to verify that all E/E components selected for the device meet design expectations. Therefore, some validation testing is still needed, however more focused, project specific validation test can be employed by reusing the existing CAE model.

As previously mentioned a durability simulation can be performed on a virtual product model using either the normal load and stress conditions expected over a field service life or the overstress conditions of an accelerated test. This enables the ability to perform a virtual design of experiments to accurately correlate test to field conditions by developing an accelerated test with stress levels and test durations to match the degree of damage accumulation that would be accrued in the device under a life time of in service field usage. This is important since there is no universal acceleration factor for electronics. Every electronic product has its own unique stress aging-durability characteristics related to its materials, overall robustness of the design and the type of E/E component used. Furthermore, each component type has its own stress aging profiles as illustrated by the thermal cycling durability life difference of 3 types of commonly used integrated circuit shown in Figure 4.

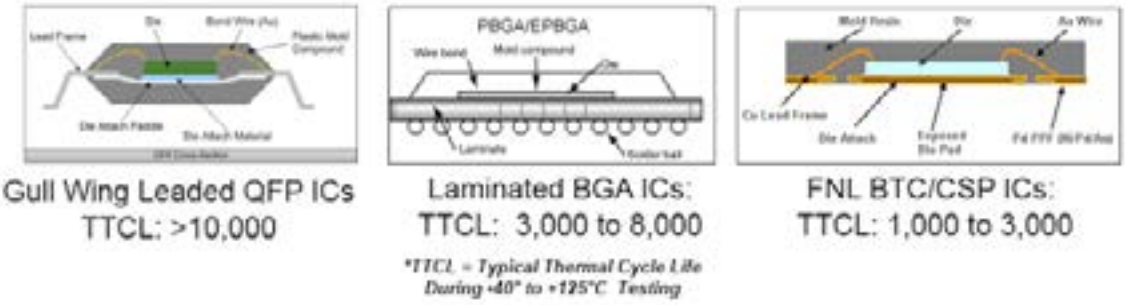


Figure 4: Differences in Typical Thermal Cycling Life of Common ICs Types during -40°C to +125°C Thermal Cycling Testing

The process where a PoF durability simulation of field conditions is used to design an accelerated life test is known as Simulated Guided Testing (SGT) (Figure 5). The inverse process for situations where the results of an existing or previously performed durability test needs to be correlated to field conditions is known as Simulation Aided Testing (SAT) (See Figure 6).

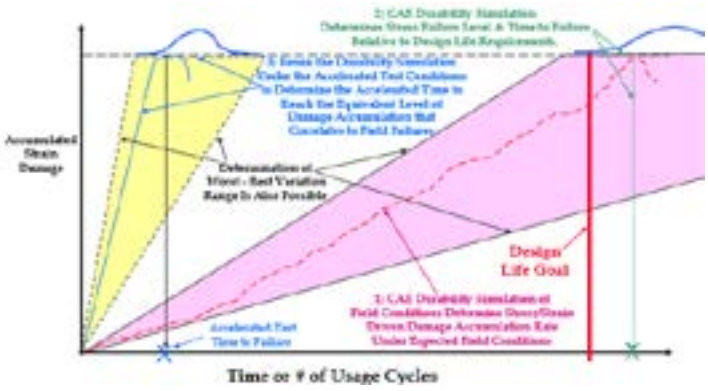


Figure 5: Simulation Guided Test to Field Correlation Process

Figure 6: Simulation Aided Test to Field Correlation Process

Accelerated Life Test -Simulation Integration, Cont.

SAT CASE STUDY EXAMPLE

A Simulation Aided Test (SAT) correlation case study is shown in Figure 6. This case involved an automotive OEM increasing the number of thermal cycles for a 10 year validation test of a passenger compartment mounted electronic module. The acceptance criterion was for a usage like field reliability of at least 97% (i.e. no more than a 3% failure risks). This was required to be demonstrated in a success test format by experiencing no failure in the thermal cycling test, which was intended to equate to 10 years for a vehicle operating in a of hot climate. From past experience the supplier felt that the number of thermal cycles was excessive for a 10 year equivalence, but performed the test per the OEM's spec.

During the test, no failures occur. However in the post test tear down procedures per the Mizenboushi (Problem Prevention) Design Review By Test Result (DRBFM)[9] requirements, an approach that aligns with Accelerated Degradation Testing[10], cross sectioning of some of the modules E/E components revealed signs of attachment solder fatigue that exceeded the OEM's life consumption/ degradation requirements. This led to concerns that some percentage of the module's production population could be a field failure risks, which led to reviewing of the accuracy of the original test to field correlation.

A SAT analysis was first performed using the test's thermal cycling conditions on a CAE model of the electronic module. The simulation which included both environment thermal cycle and power dissipation self-heating of the E/E module's circuitry, calculated that over the entire test the module had a 13.9% failure risks and the 3% failure risk point was reached after 59% of the test's thermal cycles had been applied (Figure 6 upper plot).

The SAT simulation was rerun using the OEM's 10 year, hot climate, thermal cycling field profile of thermal cycles (Figure 6 Lower plot). The field condition simulation found that 20.2 years of hot climate field usage was required to reach the 13.9% failure risk found on the test simulation. The 3% failure risk required 11.9 years of hot climate field usage and the 10 year field failure risk was only 1.85% which correlated to 49% of the thermal cycles in the test.

The SAT analysis found that the increase in test thermal cycle resulted in an equivalence to 20.2 years of hot climate vehicle field life usage. Instead of a 10 year success test, the validation process was actually a test to failure evaluation, over 2 life times of field usage. After the test to field correlation as accurately determined, it was concluded that since the degree of solder degradation was acceptable for a life equivalent of 20 years of field usage and the simulation prediction of a 10 year reliability of 98.15% which exceeded the 97% requirement resulted in meeting the requirement which the module program to move into production. The test was later redefined to reduce the time and cost of testing to ~20 year of service instead of a 10 years equivalence.

As an added bonus the CAE Apps Pareto table of most likely to fail components (Figure 7) identified the components with the greatest failure risks which provided useful information of future continuous improvement projects.

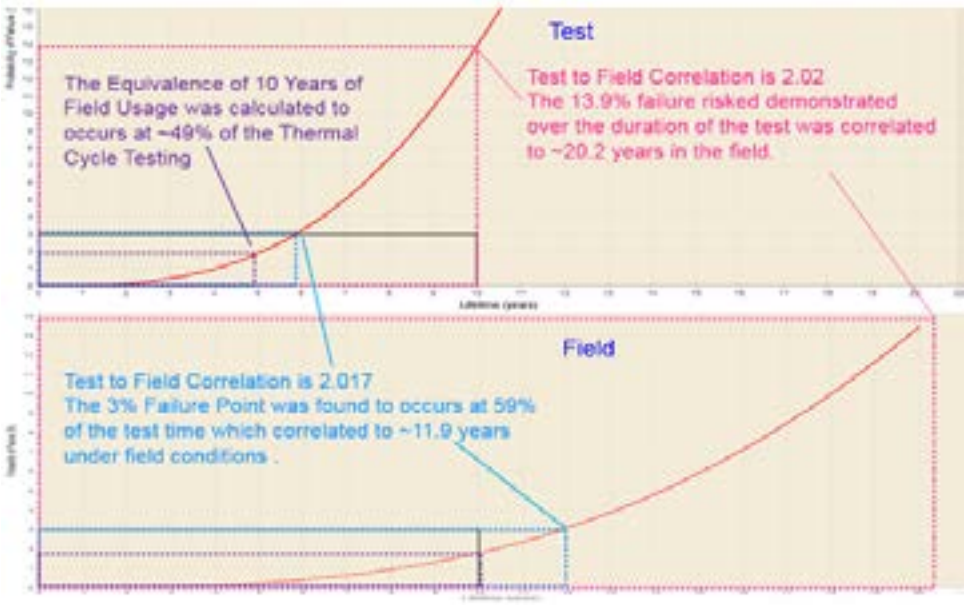


Figure 7: Comparative Reliability Life Plots from the Simulation Aided Test (SAT) Correlation Case Study.

Accelerated Life Test -Simulation Integration, Cont.

RefDes	Package	Part Type	Model	Side	Material	Solder	Max dT (C)	Max TSF	Damage	TTF (years)
IC11000	CBGA-760	IC	CBGA	BOT	BGA-FR4	SAC305	62.6	1.00	6.4E-1	18.41
Q2400	OSC-0000	OSCILLAT	CC	BOT	ALUMINA	SAC305	62.6	1.00	2.3E-1	43.02
IC14200	BGA-169	IC	BGA	BOT	OVERMOLD-B...	SAC305	62.6	1.00	2.0E-1	51.28
IC10500	BGA-324	IC	BGA	BOT	OVERMOLD-B...	SAC305	62.6	1.00	1.7E-1	57.65
IC11100	BGA-96	IC	BGA	BOT	OVERMOLD-B...	SAC305	62.6	1.00	1.6E-1	60.62
IC11101	BGA-96	IC	BGA	BOT	OVERMOLD-B...	SAC305	62.6	1.00	1.6E-1	60.62
IC11200	BGA-96	IC	BGA	BOT	OVERMOLD-B...	SAC305	62.6	1.00	1.6E-1	60.62
IC11201	BGA-96	IC	BGA	BOT	OVERMOLD-B...	SAC305	62.6	1.00	1.6E-1	60.62
Q2600	2010	OSCILLAT...	CC	TOP	ALUMINA	SAC305	62.6	1.00	1.5E-1	66.52
IC14201	BGA-153	IC	BGA	BOT	OVERMOLD-B...	SAC305	62.6	1.00	1.5E-1	68.20
IC10505	BGA-63	IC	BGA	BOT	OVERMOLD-B...	SAC305	62.6	1.00	1.3E-1	74.07
IC3600	QFN-40 (M...	IC	QFN	TOP	OVERMOLD-G...	SAC305	62.6	1.00	1.2E-1	80.06
L2604	2424	Inductor	CC	TOP	FERRITE	SAC305	62.6	1.00	1.2E-1	81.03
R2623	1206	RESISTOR	CC	BOT	ALUMINA	SAC305	62.6	1.00	1.2E-1	82.09
R2807	1206	RESISTOR	CC	BOT	ALUMINA	SAC305	62.6	1.00	1.2E-1	82.08

Figure 8: Durability Simulation Produced Pareto List of Most likely to Fail Components

CONCLUSION

This article discusses how Physics of Failure based failure mechanism damage accumulation models used in CAE App Durability Simulations can be used to accurately correlate and optimize accelerated Life validation tests. This process also resulting in faster test with greater accuracy for detect failure susceptibilities. These benefits are addition to the value of CAE simulation in optimizing the Reliability-Durability characteristics capabilities of an E/E Product in a Reliability by Design process.

James McLeish (jmcleish@dfrsolutions.com) heads the Mid-West (Rochester Hills Mich.) regional office of DfR Solutions, a Failure Analysis/ Lab Services / Quality-Reliability-Durability (QRD) consulting firm and developers of the Sherlock ADA Durability Simulation/Reliability Assessment CAE App Software. He holds a MSEE degree, is a senior member and the Michigan regional director for the American Society of Quality Reliability Division, a member of the SAE-Automotive E/E Reliability Standards and ISO-26262 Functional Safety Committees. He has over 30 years of automotive, military and industrial E/E design engineering and product assurance experience. Mr. McLeish started his career as an electronics product engineer who helped invent the first microprocessor based engine computer at Chrysler. He has since worked in systems engineering, design, development, product, validation, reliability and quality assurance of both E/E components and vehicle systems at General Motors and GM Defense-Military Vehicles. He holds 3 patents in embedded control systems, is an author or co-author of 3 GM E/E Validation Test / Reliability-Durability Demonstration standards. He is credited with the introduction of Physics of Failure/Reliability Physics methods to GM while serving as an a QRD Technical Expert, Advanced Reliability Methods and E/E Reliability Engineering Manager.

REFERENCES

1 SAE J1455 "Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications"

2: MIL-STD-810G, Us Department of Defense Test Method Standard: Environmental Engineering Considerations and Laboratory Tests

3: IEC 60068 "Environmental Testing", International Electrotechnical Commission Standard

4: F.W. Malia, C.M. Cope & G.P. Martin, Delphi Corp. "Lab-Field Correlation Program for Automotive Electrical Connections" Published in: IEEE Electrical Contacts, 2000. Proceedings of the 46th IEEE Holm Conference on Electrical Contacts. http://ieeexplore.ieee.org/document/889930/

5: H. C. Crabb "The Virtual Engineer – 21st Century Product Development", American Society of Mechanical Engineer Press, 1998, Dearborn Michigan, USA.

6: R Schueller & C. Tulkoff, Design for Reliability with Computer Modeling", Printed Circuit Design Fab and Circuit Assembly, March 2014. http://ourdigitalmags.com/publication?i=198135

7: D.D. Dylis, M.G. Priore, "A Comprehensive Reliability Assessment Tool for Electronic Systems (Prism)", IIT Research/Reliability Analysis Center, Rome NY, RAMS 2001

8: R. Haeberle, Magna Electronic "Moving Automotive Electronics from Reliability/Durability Testing to Virtual Validation Modeling Using a Physics of Failure CAE App" SAE World Congress 2014-01-0233.

9: SAE Guidebook – "Design Review Based on Failure Modes (DRBFM) and Design Review Based on Test Results (DRBTR) Process", SAE International PD251136, 2012.

10: Guangbin Yang, Chrysler, "Accelerated Degradation Tests for Rapid Reliability Evaluation" RAMS 2013.

2016 ASQ Automotive Division Awards Banquet

The ASQ Automotive Division Awards Banquet honors outstanding leaders, quality professionals and dedicated volunteers who have made significant contributions to Automotive Quality. The 2016 ASQ Automotive Division Awards Banquet took placed on December 7, 2016.
Congratulations honorees!

Judson G. Jarvis Award

The Jarvis Award was established by the Automotive Division to honor Judson G. Jarvis in recognition of his many years of service to the Automotive Division, especially Program Planning Committee.

The Jarvis Award is presented to the individual who earns recognition by others, participates in the functions of the Automotive Division and makes the most significant contribution to the success of the Automotive Division events.

This year's ASQ Judson G. Jarvis award is presented to:

David D. Butler

David has been a member of the ASQ Automotive Division for 40 years and is currently serving as Chair. Over the past 40 years he has been on several committees, served on the council in various capacities and has represented the division at 30+ World Conferences; usually manning the booth. He has written papers and presented at ASQ Automotive events and is currently representing the division on two different AIAG committees.

David has also been honored as an ASQ Fellow this year; representing the only member from our division this year. He is also a Certified Quality Engineer, Six Sigma Black Belt and Shainin Red X Master.

David is currently Global Director Corporate Quality Systems at TI Automotive headquartered in Auburn Hills, Michigan. He and his wife Ellen preside in Canton, Michigan. Side Note: They have been married as long as David has been in Quality, 40 years.

2016 ASQ Fellow

On November 03, 2016, the board of directors of ASQ elected David D. Butler a Fellow of the Society in recognition of his significant contributions to quality. His citation reads as follows:

> *"For outstanding leadership in advancing quality tools and methodologies in supplier quality development in the automotive industry facilitated by AIAG and direct supplier leadership. For long term support of the Society at the Divisional-level with impact on many quality professions through talks, papers and teaching"*

An ASQ Fellow is an individual who has an established record of contributions, both to the quality profession and to the Society. The grade of Fellow is an earned distinction. Your achievement of this status is a symbol of respect from your colleagues that has been accepted by the highest officers of our organization.

2016 ASQ Automotive Division Awards Banquet, Cont.

Congratulations Honorees

Cecil C. Craig Award

The Cecil C. Craig Award has been established by the ASQ Automotive Division to recognize excellence in the development of outstanding technical and managerial papers. The award is granted to members of the Automotive Division. It is intended to acknowledge those who have authored papers, which enhance the knowledge and application of Quality and Reliability related topics. In support of the intent that these papers serve to further educate and enlighten the membership, they will have been presented at Automotive Division sponsored or affiliated events.

The award was named after Dr. Cecil C. Craig, Professor Emeritus, Mathematics Department and the Statistical Research Laboratory, University of Michigan in recognition of his many years of dedicated service to the Automotive Division. Dr. Craig was a close associate of Dr. Walter Shewart in World War II and worked to promote the use of statistical methods in quality control. He was one of the originators of the intensive SQC courses offered to industry each summer by the University of Michigan.

Dr. Craig made extensive contributions to the field of quality control as an original investigator, theoretical and applied scholar, teacher and consultant.

This year's ASQ Cecil C. Craig award is presented to:

Professor Kai Yang

Dr. Kai Yang is a Professor in the department of Industrial and Systems Engineering, Wayne State University. He is a world renowned expert in the area of Six Sigma, Design for Six Sigma and quality for service and an author of Seven books in the areas of Design for Six Sigma, Six Sigma and, multivariate statistical methods. Prof. Yang's book, Design for Six Sigma: A Roadmap for Product Development is an influential book that provides a framework to integrate both innovation methods, and traditional statistical quality assurance methods into the product development process. Dr Yang also published over 93 research papers. He has been awarded over 60 research contracts from such institutions as US National Science Foundation, US Department of Veteran Affairs , Siemens Energy Inc, General Motors Corporation, Ford Motor Company, and Chrysler Corporation. Dr. Yang obtained both his MS and PhD degrees from the University of Michigan.

2016 ASQ Automotive Division Awards Banquet, Cont.

Congratulations Honorees

William P. Koth Award

The Koth Award was established by the Automotive Division in recognition of William P. Koth, A. O. Smith Corporation for his many years of dedicated service to the division. The Koth Award is presented each year to a currently active Automotive Division member who has given outstanding personal service for the promotion of the division and the American Society for Quality.

This year's ASQ William P. Koth award is presented to:

Larry R. Smith

Larry R. Smith "graduated" (retired) from Ford in 2005 where he was quality coach of the Ford Motor Company's Heritage team, a team charged with revitalizing the Ford Rouge manufacturing complex. Larry's career emphasis has been in quality engineering and product development. He was instrumental in initiating a six sigma effort at Ford Motor Company and acted as deployment champion for the Super Duty Truck Platform, whose six sigma projects saved $49 million in the first year of operation. He was also champion of a volunteer Ford Environmental Idea Process Team, focused on developing ideas related to design and manufacture of vehicles whose use improves conditions for human beings and the environment. Larry has held a variety of quality management positions in his 27 years at Ford, primarily in Vehicle Operations, North American Truck, Powertrain Operations, and Casting Operations.

Since Ford, Larry has consulted and conducted training on quality and innovation methods with his own company, The Quality Smith, and for Ideation, GOAL/QPC, Global Productivity Solutions and the Juran Institute. He has worked with corporations such as Abbott, Delphi, Unilever, Raytheon, Apple, Bosch, organizations such as the American Society for Quality, the Public Health Foundation, the European Organization for Quality, and consulting firms in China, India, and Malaysia.

A fellow of the American Society for Quality and elected national director from 2004-2006, Smith is a past president of the Altshuller Institute for TRIZ Studies and has been involved in numerous applications of TRIZ since 1993. A member of the Board of Directors of GOAL/QPC from 1994 to 2007, Larry is also a past president of the Detroit Chapter of ASM International.

2016 ASQ Automotive Division Awards Banquet, Cont.

Congratulations Honorees

Quality Professional Award

The Quality Professional of the Year Award has been established to recognize individuals in the automotive industry who have made significant contributions in the following areas:

Leadership or managerial skills in implementing continuous improvement in quality, services provided to the community towards furthering the understanding of quality systems and techniques, support and encouragement of the new and innovative ideas leading to never ending pursuit of excellence, demonstrated high regard for team benefits and results.

This year's Quality Professional of The Year award is presented to:

Leandro Tambelini G. Domingues

Leandro Domingues is currently a Regional Supplier Relationship Manager in GTO, responsible for both Volvo and Mack brands. Working with a supplier portfolio of 660 million dollars during the past years, he has led activities to improve dispatch performance, minimize costs, increase flexibility and reduce lead-time to Volvo's manufacturing facilities. A former Automotive Mechanical Engineer, Leandro received an MBA in Logistics Management before moving to America in 2014. Born and raised in São Paulo, Brazil, a family move brought him new opportunities in Curitiba. It was here that he started his journey at Volvo Trucks. He has had different roles within Powertrain, Complete Vehicle, Commercial and Purchasing across more than 10 years. Major activities leading a fast response team called Quality Action Group and developing a complete new role in Brazil, called Supplier Delivery Assurance, were some of the highlights of his successful career at Volvo. Previous experience in the Automotive Business, such as working for Volkswagen and Renault have complemented Leandro's skills in high volume operations.

2016 ASQ Automotive Division Awards Banquet, Cont.

Congratulations Honorees

Quality Leader Award

The Quality Leader of the Year Award is presented to recognize the quality leadership contributions of an outstanding automotive industry leader who is not a member of the quality profession. The recipient will be an executive in any organization associated with the automotive industry who has consistently demonstrated a customer-faced quality philosophy and a defect-prevention oriented vision that is universally applied to every aspect of the business.

This year's Quality Leader of The Year award is presented to:

Harry B. Flotemersch

Harry B. Flotemersch is currently a Sr. Consultant at Shainin LLC providing problem solving coaching to North American Clients. He has been passionate about continuous improvement acting as facilitator for critical changes in a 32+ year career spanning tier 2, tier 1, OEM automotive, Defense Vehicles, aerospace components and a wide variety of other products. This passion has won awards for championing changes including the Delco Products Division of Delphi President's Council Award for overall quality system improvements, Best of the Best at DaimlerChrysler for coaching involvement in a $101 M warranty savings project, and the Chairman's Award at BAE ground systems for root cause analysis tool development and deployment. He is a certified Shainin Red X Master, Chrysler Master Black Belt, Certified Kepner-Tregoe coach, and BPI Critical Thinking coach. He earned a BSEE degree at Rose-Hulman Institute of Technology and Master's degree in Manufacturing Management from Kettering University. He is most interested in how structured Innovation methods are leveraged to aid quality problem solving in practice. He has delivered 2 ASQ webinars as well as multiple quality conference speeches on the structured innovation subject and uses these methods to develop innovative corrective actions when needed for his clients.

2016 ASQ Automotive Division Awards Banquet, Cont.

Thank You Sponsors

Sponsors

TI Automotive

Enterprise Members

General Motors

Ford

BMW Manufacturing Co.

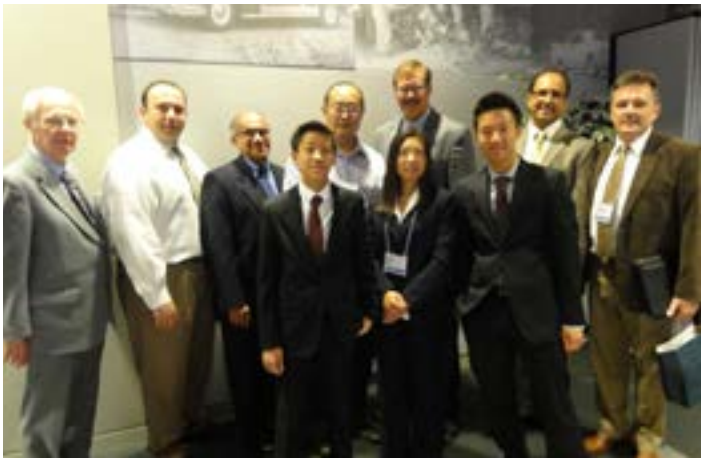
2017 Guangbin Yang Reliability Symposium

Thursday, August 10, 2017

8 am – 5 pm

Ford Motor Company
Dearborn, Michigan

Sponsored by Ford Motor Company and FCA, in conjunction with the American Society for Quality Automotive Division, the 2017 Guangbin Yang Reliability Symposium will be hosted by Ford Motor Company. This forum honors our late friend and colleague Guangbin Yang by sharing the latest in Quality, Reliability, and Statistics in the automotive industry. This year's free event features lunch, a panel discussion, and a networking opportunity. Distinguished Professor Dr. Bill Meeker of Iowa State University has participation as an invited speaker. If you are interested to present a case study or attend the symposium please contact Mohammad Hijawi at mohammad.hijawi@fcagroup.com.



ASQ elearning

Metrology for Measurement Quality
Creating a Metrology Culture in your Organization

Does your company "get" calibration?

Metrology is the scientific study of measurement. ASQ's metrology training courses can teach you how to design and run measurement calibrations to determine accuracy, precision, reliability, and traceability.

A thorough knowledge of measurement science is key to maintaining ISO quality standards. Check out the following two courses to instill a Calibration and Metrology Culture in your organization:

Introduction to Measurement and Calibration

This course is designed to ensure that calibration terminology and practices are understood throughout the organization and especially by persons responsible for the contracting of calibration services

Audience: All persons at any level using measurement instruments, including **calibration coordinators, inspection personnel, quality** and **management;** it can serve as a refresher for experienced technicians; or as orientation for new hire

Metrology for Engineers and Scientists

This course is designed to familiarize Engineers and Scientists with Metrology, the science of measurement. A quantitative analysis of design based on sound metrology principles will help engineers and scientists to design better products and services.

Audience: Design, Quality, Manufacturing, and Reliability Engineers and scientists interested in Metrology.

Also Available: Dimensional, GDT, CMM's, Electrical, Measurement Uncertainty, ISO 17025

register @ asq.org/training/catalog/delivery/self-paced.html
or call (612) 308-2202

IT'S EASY!!!

BECOME AN AUTOMOTIVE DIVISION MEMBER TODAY

ASQ Section, Division and Forum Membership Guidelines

As an ASQ Member you are granted access to one Division or Forum for FREE!!! Additional Divisions or Forums are just $10 each. Sections are $20 each.

Students receive FREE membership in a local Section and Division or Forum. Read more for details.**

In this edition of the Automotive Excellence, we will go back to basics and explain the relationship between an ASQ Membership, Section, Division or Forum Membership.

First, we are going to focus on the correct completion of the ASQ Membership Form.

It is extremely important to always (every year) specify the Section Number, Division or Forum on the ASQ Membership Form.

Without a Division or Forum designation on the form, an individual becomes only an ASQ Member without any affiliation with the above mentioned.

This aspect surfaces frequently when individuals are trying to attend Division or Forum meetings, access member only technical information or secure assistance with Recertification's, and their names are not found on the select roster.

Many long time Members found out that they lost their Section, Division or Forum membership continuity by omitting the Section Number, Division or Forum designation during their membership renewal process.

When an individual calls ASQ HQ and asks for his/her name to be (reinstated) added to the Section, Division or Forum, that individual is counted as a "NEW" Member.

Remember, all current and future members with a Regular type membership, are eligible for a free membership in one of the Division's or Forum's. Please refer to the item # 3 on the Membership application, for this benefit.

As it will be shown later on the Divisions' list, as of December 31, 2015 there were 4,905 ASQ members, who did not select a Division or Forum.

How to check the ASQ Membership Status:
a) Sign into *www.asq.org*
b) Click on "My account"
c) Click on "My Community" , then scroll down and click on "View My Communities";

This page will display Sections and Divisions affiliations.

This table illustrates number of ASQ Members eligible for a Division or Forum membership.

	Membership Type	No. of Members
Waive Forum/ Division Benefits	Associate	4
Waive Forum/ Division Benefits	Fellow	45
Waive Forum/ Division Benefits	Full	2230
Waive Forum/ Division Benefits	Honorary	1
Waive Forum/ Division Benefits	Organization	4
Waive Forum/ Division Benefits	Senior	2128
Waive Forum/ Division Benefits	Site	33
Waive Forum/ Division Benefits	Student	460
	TOTAL	4905

***An ASQ Student membership also offers free memberships in a local Section and one Division or Forum. The student Membership application is shown below and explanation of other benefits can be found at:* http://asq.org/public/membership/enrolled-student-member-application.pdf

BECOME AN AUTOMOTIVE DIVISION MEMBER TODAY

1 Member Type:
❑ Full $159 ❑ Associate $99 $ _____

2 The one geographic Section included with Full membership will be determined by your primary address.*

Sections (geographic) may be added to any member type for an additional $20.00 each. Visit www.asq.org/sections/find.html for a listing of available Sections.

"1000"

Sections [1][0][0][0], [ ][ ][ ][ ], [ ][ ][ ][ ] $ _____

Contact ASQ to change your assigned Section.

3 Forum or Division Selection
As part of your Full membership, you are granted access to one topic- or industry-specific Forum or Division. Use the list below to indicate the Forum or Division number and name.

"Automotive" _____ included
Name

Additional Forums and Divisions may be added for $10 each.

Please indicate in the list below the additional Forums or Divisions you would like and total the number you have selected.

- ❑ Audit
- ❑ Automotive
- ❑ Aviation, Space and Defense
- ❑ Biomedical
- ❑ Chemical and Process Industries
- ❑ Customer-Supplier
- ❑ Design and Construction
- ❑ Education
- ❑ Electronics and Communications
- ❑ Energy and Environmental
- ❑ Food, Drug, and Cosmetic
- ❑ Government
- ❑ Healthcare
- ❑ Human Development and Leadership
- ❑ Innovation
- ❑ Inspection
- ❑ Lean Enterprise
- ❑ Measurement Quality
- ❑ Quality Management
- ❑ Reliability
- ❑ Service Quality
- ❑ Six Sigma
- ❑ Software
- ❑ Statistics
- ❑ Team & Workplace Excellence

BECOME AN AUTOMOTIVE DIVISION MEMBER TODAY

CUSTOMIZE YOUR MEMBERSHIP

1 Enrolled Student Dues $ 29.00

2 Your geographic Section included with your membership will be determined by your primary address. If you wish to choose a specific Section, please visit www.asq.org/sections/find.html for a listing of Sections.

Additional Sections (geographic or the e-Section) may be added for an additional $20.00 each.

Additional Sections ☐☐☐☐ , ☐☐☐☐ $ 0.00

3 Forum or Division Selection
As part of your Full membership, you are granted access to one topic- or industry-specific Forum or Division. Use the list below to indicate the Forum or Division number and name.

_____ included
Name

Additional Forums and Divisions may be added for $10 each.

Please indicate in the list below the additional Forums or Divisions you would like and total the number you have selected.

- ❑ Audit
- ❑ Automotive
- ❑ Aviation, Space and Defense
- ❑ Biomedical
- ❑ Chemical and Process Industries
- ❑ Customer-Supplier
- ❑ Design and Construction
- ❑ Education
- ❑ Electronics and Communications
- ❑ Energy and Environmental
- ❑ Food, Drug, and Cosmetic
- ❑ Government
- ❑ Healthcare
- ❑ Human Development and Leadership
- ❑ Innovation
- ❑ Inspection
- ❑ Lean Enterprise
- ❑ Measurement Quality
- ❑ Product Safety and Liability Prevention
- ❑ Quality Management
- ❑ Reliability
- ❑ Service Quality
- ❑ Six Sigma
- ❑ Software
- ❑ Statistics
- ❑ Team & Workplace Excellence

Additional Forum and Division selections: 0 (total) x $10 = $ 0.00

TOTAL OF ALL ITEMS (1-3). $ 29.00