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Quantum Quality Part II

Solving Technical Problems: Questions Drive The Tactics

Laboratory Based Shainin® Training

Official Publication of the ASQ Automotive Division

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Features

2013 Division Council Roster

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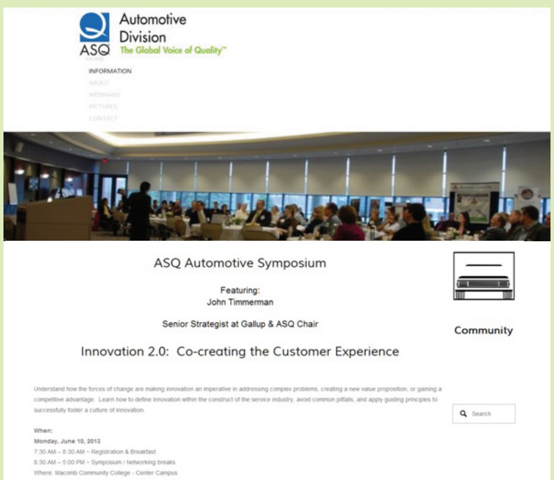

ASQ Automotive webinars

Automotive EXCELLENCE

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ASQ AUTOMOTIVE DIVISION

VISION: To be the worldwide automotive industry's leader on issues related to quality

MISSION: To facilitate continuous improvement and customer satisfaction by identifying, communicating and promoting
• Quality knowledge • Management's leadership role • Industry comparison • Professional development • Recognition • Opportunities to network

CUSTOMERS PRIMARY: Automotive division members • Automotive suppliers - all tiers • ASQ sections • Division sustaining members • Potential Automotive Division members

SECONDARY: Automotive original equipment manufacturers (OEMs) • Other ASQ divisions • Strategic alliances - SAE, AIAG, SME, ESD, ASI, organized labor • Community colleges/universities • ASQ headquarters/Board of Directors/Technical Council

TERTIARY: Quality award initiatives (federal/state/local) • Standard activities • Automotive dealerships • International global markets • Aftermarkets/service parts • Third party registrars • Recruiters / consultants

FROM THE PUBLICATIONS CHAIR

Letter from the Editor

Rob Langdon,
2013 Publications Chair

Dear ASQ Automotive Members,

Welcome to the Spring edition of Automotive Excellence. Thank you once again to those who have supported the publication by providing articles to share with our membership and those outside our membership. Our publication aims to provide a forum for the sharing of ideas, technical and non-technical, as well as highlight the activities and accomplishments of our membership. To be able to accomplish this we need your support.

I would like to thank Judson Estes, John Lindland, and Jayne Vise for their contributions to this edition. This edition as well as past publications can also be found on our website at ASQ-auto.org.

I look forward to hearing from you.
Ideas, questions or comments can be forwarded to me at ralangdon58@hotmail.com

My best wishes to everyone,

Rob Langdon
ASQ Publications Chair 2013
ralangdon58@hotmail.com

Our New Website

We have completely revamped and upgraded our new website.

www.asq-auto.org

ASQ Automotive Division: Letter From The Chair

Kush Shah
Chair, ASQ Automotive Division
asq.automotive@gmail.com

I hope you enjoy reading the informative 2013 issue of Automotive Excellence. I want to take this opportunity to update you on recent activities and what we have planned for the rest of 2013 for ASQ Automotive Division.

In 2012, we had initiated a major undertaking of development and delivery of core tools training that was specifically designed for automotive OEMs and suppliers. I am happy to report that we have successfully completed development of training for FMEA, PPAP, SPC and MSA. This training was recently delivered to one of the clients and the feedback we have received is very positive. We have also been contacted to deliver this training not only in U.S. but globally. This speaks highly of the quality of the training we have developed. We are very particular about the delivery of these training classes by validated instructors. If your organization is interested in any of this training, please contact me.

ASQ Automotive Division Award Event in 2012 was a great success with a record attendance from industry leaders and quality professionals. I hope you enjoy the article and pictures that provide more details on this event.

We also recently updated our website (www.asq-auto.org) and its content in the spirit of continuous improvement. I very much encourage you to take advantage of many webinar presentations that are available to the ASQ Automotive Division members.

ASQ Automotive Division will have the largest booth of all ASQ divisions at 2013 ASQ WCQI Conference Exposition in Indianapolis. We will have two eye catching vehicles on display. If you are planning to attend this conference, please come and see us.

We have scheduled our annual symposium on June 10th at Macomb Community College Center Campus. Theme for this year's symposium is leading change. We are going to have great speakers at this event including key note speaker John Timmerman, ASQ Chair and Senior Strategist at Gallup. Please do not miss the opportunity to participate in this event as it is a very popular event with limited seating.

In 2013, we had four volunteers from ASQ Automotive Division recognized through prestigious ASQ Testimonial Award. I would like to congratulate Jennifer Schneider, Chair-Elect, John Katona, Secretary, Jay Zhou, Treasurer and Jaynie Vize, Co-Chair of 2012 Award Event. These individuals have spent numerous hours in volunteering and contributing to ASQ Automotive Division. We are always looking for more volunteers globally so if you are interested, please contact me.

I look forward to a great rest of 2013 for ASQ Automotive Division. We look forward to your active participation in ASQ Automotive Division activities.

Sincerely,

Kush K. Shah

Chair, ASQ Automotive Division

asq.automotive@gmail.com

ASQ Automotive Division
The Global Voice of Quality™

2013 Symposium
11th Annual

Featuring:

John Timmerman

Senior Strategist at Gallup & ASQ Chair

Innovation 2.0: Co-creating the Customer Experience

Understand how the forces of change are making innovation an imperative in addressing complex problems, creating a new value proposition, or gaining a competitive advantage. Learn how to define innovation within the construct of the service industry, avoid common pitfalls, and apply guiding principles to successfully foster a culture of innovation.

Where: **Macomb Community College** - Center Campus
University Center - Assembly Hall (UC 1)
44575 Garfield Road, (N of 19 Mile, S of M-59)
Clinton Township, Michigan 48038-1139

- Continental Breakfast and Lunch included
- Limited Seating
- Door Prizes

When: **Monday, June 10, 2013**
7:30 AM - 8:30 AM ~ Registration & Breakfast
8:30 AM - 5:00 PM ~ Symposium / Networking breaks

Cost: Before May 20th: **$35**

After May 20th: **$50**

Registration: Online at: http://www.regonline.com/asqauto2013

RU's: Recertification Units: 1.0 RU for all ASQ Certifications

ASQ members can become ASQ Automotive Division members by contacting ASQ at 800.248.1946 ($10 annual division members fee)

Contacts: Kush Shah: asq.automotive@gmail.com
Ken Coll: ken.coll@continental-corporation.com
Dennis M. Drabik: DMDrabik@wideopenwest.com

ASQ Automotive Division Mission

To be the recognized global network of automotive quality professionals helping individuals and organizations to achieve personal and organizational excellence

For more information, visit:
http://www.asq-auto.org

Training Courses

Measurement Systems Analysis

Course Description

Measurement Systems Analysis (MSA) is a set of methods that are used to assess the variability inherent in gages and other measurement systems so we can know whether or not we can trust a given system in a given application. Similar to our other core tool courses, this course balances theory and practice. It is based on the MSA 4th Edition manual published by AIAG.

Our two-day MSA course describes the language, methods, calculations, and evaluation techniques to assess bias, linearity, stability, repeatability, and reproducibility. Why wouldn't you want to be able to trust your measurements? This course provides answers to very specific questions. In it, you will learn ask the right questions. You'll learn what each of the MSA studies will assess, where they should be applied, and how to execute them.

Course Outline

1. Quality Statistics Review
2. Fundamental MSA Concepts
3. Preparation for MSA Studies
4. Mathematics of MSA Studies
5. Evaluation of MSA Studies

Key Course Objectives

- ✓ Correctly use common MSA terms.
- ✓ Identify measurement system elements.
- ✓ Evaluate effective resolution.
- ✓ Select appropriate sample sizes.
- ✓ Assess measurement system stability.
- ✓ Assess measurement system bias.
- ✓ Assess measurement system linearity.
- ✓ Quantify gage repeatability.
- ✓ Quantify gage reproducibility.
- ✓ Quantify measurement uncertainty.
- ✓ Perform ANOVA gage R&R studies.
- ✓ Identify extreme sources of variation.
- ✓ Assess attribute measurement systems.

Production Part Approval Process

Course Description

Production Part Approval Process (PPAP) is a common set of requirements intended to ensure that all product requirements are understood and that the manufacturing process is capable of meeting these requirements. It is presented as a one-day course, which is based on the AIAG publication: PPAP 4th Edition.

The first half of our course focuses the PPAP process, including specific requirements for the significant production run. The second half reviews the intent and requirements for each of the 18 PPAP content requirements.

One key take-away from this course is simple descriptions for each of the 18 PPAP documentation requirements.

Course Outline

1. Introduction to PPAP
2. PPAP Process Requirements
3. PPAP Content Requirements
4. Simple Words for the Elements

Key Course Objectives

- ✓ Explain How the PPAP Process Work.
- ✓ Understand Quality System Requirements.
- ✓ Select Good Participants - Build a Team.
- ✓ Identify Weaknesses in PPAP Processes.
- ✓ Explain 18 Key PPAP Deliverables.
- ✓ Manage PPAP Documents.
- ✓ Manage PPAP Records.

Advanced Product Quality Planning

Course Description

Advanced Product Quality Planning (APQP) is structured process that includes critical tasks from concept approval through production. The process follows the AIAG Quality Planning model as described in the AIAG publication, APQP 2nd Edition. In this one-day course we discuss the five phases, together with their tools and techniques. The five phases are:

1. Planning
2. Product Design and Development
3. Process Design and Development
4. Product and Process Validation
5. Production, Feedback, and Continuous Improvement

Our focus then turns to effective and efficient implementation of control plans. We also include a checklist approach for some of the more common quality planning methods.

The goal of this quality planning process is to bring products to market more quickly, at lower cost, greater customer satisfaction, and reduced risk for the customer, supplier, and product.

Course Outline

1. Working within a Quality System
2. Fundamentals of Quality Planning
3. AIAG Model for Quality Planning
4. Implementation of Control Plans
5. Checklists for Quality Planning

Key Course Objectives

- ✓ Bring products to market more quickly.
- ✓ Protect against severe failure modes.
- ✓ Develop efficient inspection strategies.
- ✓ Gain product approval with less time and effort, and at lower cost.
- ✓ Implement methods to control processes, solve problems, and reduce variation.
- ✓ Make better use of lessons learned to improve future product launches.

Training Courses *continued*

Statistical Process Control

Course Description

Statistical Process Control (SPC) is a method that uses control charts as a principal tool in the process of continual improvement. Control charts provide a scientific basis as to the presence or absence of special causes of variation. This two-day course balances theory and practice. It is based on the SPC 2nd Edition manual, but one of the things that make our course unique is the opening chapter called Setting the Stage. This chapter uses the words of Shewhart, Deming, Juran, and others to give participants a perspective that comes directly from the masters.

Our approach teaches SPC in the context of solving three classes of statistically based problems: (1) problems of instability, (2) problems of too much variation, and (3) problems of being off target. Each of these three classes of problems will have their own set of causes. If taken in order, this structured analytical approach leads to effective problem solving. In those cases where none of these three problems exist, SPC simply provides a preventive method of process monitoring.

This course presents commonly used control charts for variables and attributes data, as well as other less common methods for process control. By the end of the course participants will be able to select the correct chart for a given application, plot the data, calculate control limits, and assess stability. They will be able to determine when to look for special cause, and when not to bother looking.

Course Outline

1. Setting the Stage
2. Continual Improvement and SPC
3. Shewhart Control Charts
4. Other Types of Control Charts
5. Understanding Process Capability

Key Course Objectives

✓ Discuss implementation and management issues associated with SPC.
✓ Select and use the best-suited control chart.
✓ Establish control chart limits.
✓ Detect out of control occurrences.
✓ Demonstrate an understanding of troubleshooting using SPC.
✓ Recognize how SPC helps determine process capability.

Failure Mode and Effects Analysis

Course Description

Failure Mode and Effects Analysis (FMEA) is a quality planning tool used to identify, prioritize, and mitigate risk. Our course is presented as a two-day workshop-based course based on two AIAG publications: FMEA 4th Edition and Machinery FMEA 2nd Edition. Participants learn by performing real analyses on real projects. The workshops are focused on applications relevant to specific needs of participants.

Our course addresses three common types of analysis - Design FMEA, Process FMEA, and Machinery FMEA - and compares and contrasts the purpose, scope, and motivation of each. Worksheets and a structured process of sequential screening identify significant risks and screens-out the trivial. This results in shorter FMEA reports that highlight actionable items for design change, mistake-proofing, or improved control.

FMEA can be an effective tool for risk management. FMEA can be used to manage failures before they occur, as one key element in achieving flawless launches. Unfortunately, FMEA is too often seen as a nuisance and an administrative burden, getting in the way of real work. This course will improve both efficiency and effectiveness of your FMEA efforts.

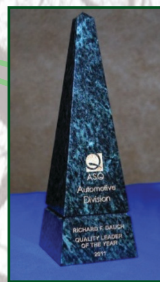
Course Outline

1. Introduction to FMEA
2. APQP and R&M - FMEA in Perspective
3. Step by Step - The FMEA Process
4. Managing Recommended Actions
5. Managing Requirements via Control Plans
6. Documentation to Support FMEA

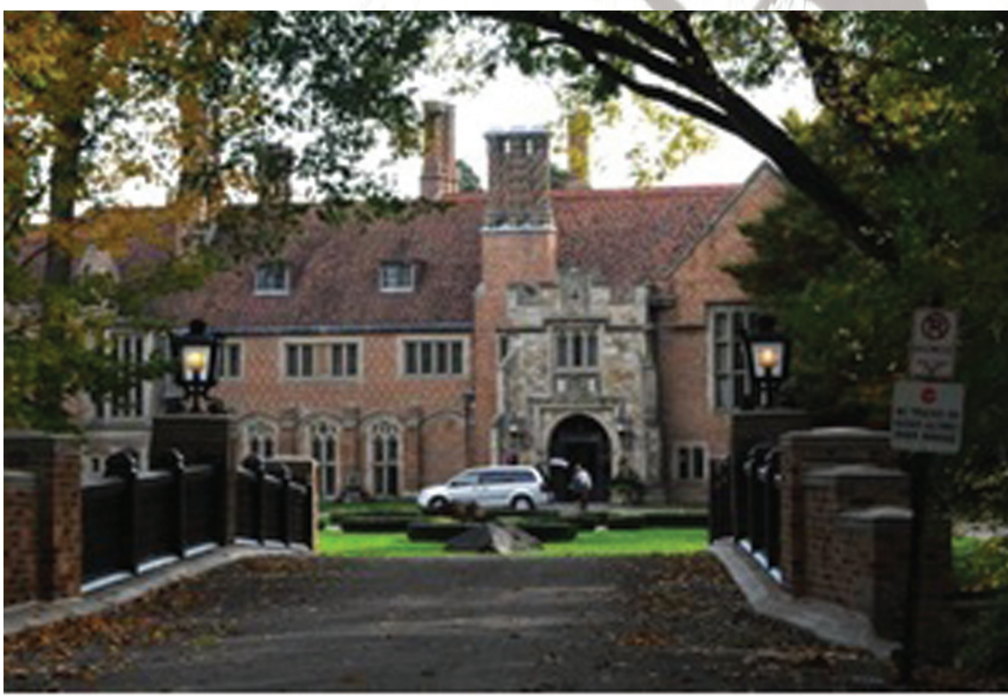
Key Course Objectives

✓ Document the Process Flow.
✓ Perform an Initial Risk Assessment.
✓ Develop an FMEA Strategy.
✓ Perform the FMEA.
✓ Prioritize Risk.
✓ Develop Action Plans.
✓ Understand Control Plans.
✓ Contribute Significantly to Future FMEAs.

**For futher information,
contact Kush Shah at
asq.automotive@gmail.com**

ASQ Automotive Division hosts 2012 Awards Banquet at the historical Meadow Brook Hall



Chrysler was the Host Sponsor for the 2012 Awards Banquet held on October 9, 2012 at the Meadow Brook Hall in Rochester Hills, Michigan. The Hall is considered to be one of the finest examples of Tudor Revival architecture in the country. One hundred guests were on hand to acknowledge the achievements of ten individuals who have contributed significantly to the success of their industry, their companies and their society.

Prior to the Presentation Ceremony, the Guests had an opportunity to tour Meadow Brook Hall and its many historical rooms. The Hall's 88,000 sq. feet and 110 rooms make it the fourth largest historical house in the United States. This was a first opportunity for many to experience the beauty of this magnificent mansion, conceived by John and Matilda Dodge, of the Dodge Brothers Motor Car Company, and later built by Matilda and her second husband, lumber baron, Alfred Wilson.

The catering service provided an excellent dining experience with Hors D'oeuvres and a Buffet as guests strolled the corridors and living areas of the Hall.

Everyone heartily welcomed our Keynote Speaker, Klaus Busse, Head of Interior Design, Chrysler Group, LLC, who demonstrated how Chrysler has changed its vehicles to meet the future desires of its customers.

At the conclusion of Klaus Busse's presentation, former Chair, Lou Ann Lathrop presented him with mementos of appreciation on behalf of ASQ.

Specific Automotive Awards were presented by the Awards Chairpersons as follows:

Our QUALITY PROFESSIONAL OF THE YEAR AWARD - established to recognize individuals in the quality field of the automotive industry who have made significant contributions in Leadership in implementing continuous improvement, services provided to the community to further understanding of Quality systems, support and encouragement of new and innovative ideas, and high regard for team benefits - was presented by Jaynie Vize to Mr. David Butler, Global Director - Supplier Management and Purchasing Systems, TI Automotive.

The QUALITY LEADER OF THE YEAR AWARD - established to recognize the quality leadership contributions of an outstanding automotive industry leader - was presented by Jd Marhevko to Mr. Rick Dauch, President and CEO, Accuride Corporation.

The WILLIAM P. KOTH AWRD - established to recognize currently active Division Members who have given outstanding personal service for the promotion of the division and the American Society for Quality - was presented by Cheryl Denman to Dr. Hira Fotedar, President of Fotedar Associates LLC

The JUDSON G. JARVIS AWARD - established to recognize individuals who make the most significant contributions to the success of Automotive Division Events - were presented by Harold Brubaker to Mr. Dennis M. Drabik, Director of Operational Excellence for Karmanos Cancer Center.

CECIL C. CRAIG AWARDS - established to recognize excellence in the development of outstanding technical and managerial papers - was presented by John Katona to Dr. Subir Chowdhury, Chairman and CEO for ASI Consulting Group LLC, for his book, "The Power of LEO." Dr. Chowdhury could not attend, so his award was accepted for him by Mr. Shin Taguchi.

In addition to these annual presentations, one scholarship was awarded by Hira Fotadar to Mr. Tim Olsen, of Oakland University, pictured here with his wife, Shelley. And additional scholarship was awarded to Mr. David Jimpkoski, of Ferris State University, who could not attend.

Elizabeth Hanna presented a Testimonials Award to Ms. Mary Beth Soloy, the division Membership Chair and to Mr. Walt Oldeck, the division Internet Liaison.

In addition, the division recognized two council members who have been awarded the status of Fellow by the American Society for Quality. Those members were Ms. Mary Beth Soloy and Mr. Kush Shah, the division Chair. Also receiving their FELLOW status were Automotive Division members, Mr. Denis Devos , Ms. Jan Tucker and Ms. Teresa Pratt.

Our thanks goes out to the Awards Chairs for their many hours spent in screening and selecting the award winners. Also, a thank you to the Awards Committee for their planning and executing a beautiful event.

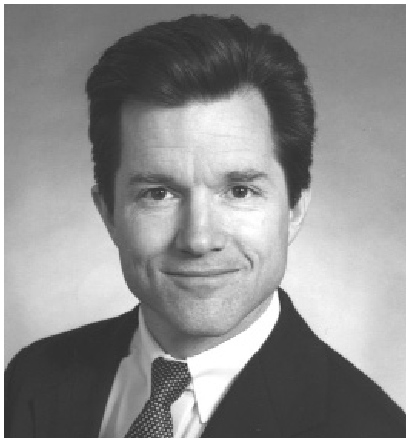
Award Banquet article written by

Jaynie Vize,
Quality Analyst
IEE Sensing

ASQ Automotive Division

Quantum Quality Part 2

by John Lindland



John Lindland

Continued

In the first article, I showed how to produce a Macro Matrix FMEA when analyzing a complete process. This is performed at the Operation level. Part 1 showed how to set up the first of the four phases of quantum quality. It showed the macro flow diagram, how to establish the inputs, operational level functions, noise factors, intended outputs, and the unintended outputs (effects). Once this was accomplished, an overview relational matrix, Matrix FMEA based on Criticality (the product of severity and occurrence), and a second Matrix FMEA based on risk priority number (the product of severity, occurrence, and detection).

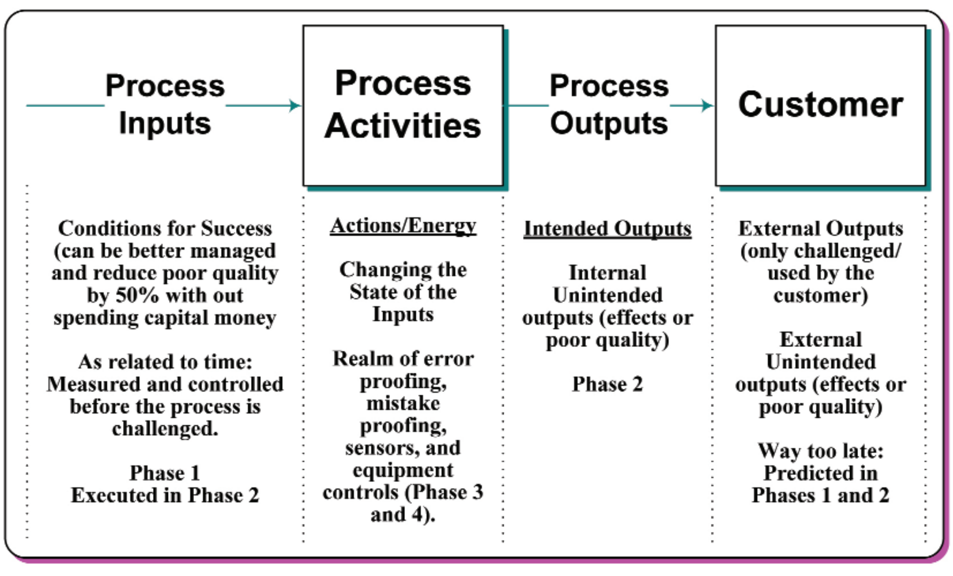
What Phase 1 accomplished was to prioritize improvements with inputs, process operations, and noise factor reduction/mitigation. It also identified the conditions for success for every operation which can be better managed through preventive actions. Those preventive actions (managing the company better) can reduce the levels of poor quality by over 50% without spending any capital money. This is not theory. This is leadership first and management second. Leadership is identifying what needs to be done and making sure that everyone knows what is expected, has the ability and resources to accomplish goals, and has the freedom/authority to move forward with achieving those goals. Management is managing the resources of the company to achieve those goals. It is also managing employees into accountability. It should be understood that leaders must also be managers.

Phase 2, the topic of this article, will speak of a strategy for moving forward with Phases 3 and 4 of Quantum Quality. Phase 2 of Quantum Quality is not an assignment from the resources that performed Phase 1. Phase 1 is performed by a team of managers/executives and a few key resources, experts of the complete process under study. Phase 2 is performed by some of the same resources as Phase 1. However, the majority of the resources are performed by the same resources which are used to perform normal Production Part Approval Process (PPAP) activities. If a reader is not familiar with PPAP, it is one of the core automotive quality tools, which is auditable under ISO/TS 16949. The team used in Phase 1 identifies separate teams to study specific operations at the micro level of detail. Those teams are launched at the same time that Phase 2 teams are launched. In most cases, Phase 3 and 4 teams will complete their work before the Phase 2 teams have completed their assessments. Phase 3 rarely takes more than 4-6 hours. Phase 4, if performed at a high level of detail rarely takes more than 2 hours, but might take longer on the rare application of state of the art technology (research required).

Phase 2 has two primary steps. Identifying key metrics and verifying/validating gages and then measuring inputs first and then intended outputs second. The key metric exercise is performed by the same resources as Phase 1 and can be performed immediately after the first Macro FMEA is completed. As part of offering a quick look into Quantum Quality, the rest of this second installment will be a quick overview of these steps.

Phase 1 produced three different Macro FMEAs. One was a simple relational matrix which identified how the intended outputs were created, which of the product features (intended outputs) where more likely to experience variation, which of the unintended outputs (effects) were most likely to occur, which inputs had the largest impact on both the intended and unintended outputs, which operation had the largest impact on the intended and unintended outputs and which noise factors were also most significant. The other two Macro FMEAs were the criticality (SO) matrix and the RPN matrix.

There are three levels of measurements as related to time, four if you add measuring the process. In addition to these three levels is measuring the action and energies which produce dimensions and material characteristics of the manufactured/assembled product. I will leave the process level measurements to error proofing, mistake-proofing, sensors, and equipment controls. These will be addressed in Phase 4 of Quantum Quality. The three levels of measuring quality relate to measuring the quality of the inputs, the intended outputs of each operation, and the resulting levels of poor quality. The PPAP activities will address measuring and validating the inputs and output metrics and capabilities. Phases 3 and 4 will address the process activities and solutions. The relationship of measuring and time is shown in the following drawing.



Quantum Quality Part 2 *continued*

An important point to understand, and one which is almost always overlooked, is which of the intended output metrics are most closely related with the unintended outputs (effects).

Correct Setup	219
Competent Employee	160
Correct Tool	114
Correct Drill	90
Correct Orientation	60
Correct Pipe	57
Correct Angle	54
Sharp Tool	45
Low Contamination	45
Tight Fit	27
Correct Temp	21
Correct Time	21
Correct Gauge	21
Correct Wire	19
Correct Tray	15

The priority for measuring/controlling inputs was already addressed in Phase 1. The following table shows the priority impact that the inputs have in creating both the intended and unintended outputs.

It clearly shows the priority of measuring and managing the primary conditions for success of the process activities. The numbers in the second column are from the original correlation analysis from the first article on Phase 1.

The company will benefit most if the setup is error-proofed, or in the least it should be closely managed. The competency of employees should be created first and managed second. It might be measured after the fact but that is not where money is made in a company. The remaining items on the list can be both managed (material handling, tooling management) and measured. If performance is not up to the quality required by the process, actions can be taken with the internal/external supplier to improve quality.

Identifying the most important intended output to measure is achieved by using a cause and effects relational matrix where the causes (intended outputs) are correlated to the unintended outputs (effects). The following table was produced from the intended and unintended outputs of the Macro FMEA from Phase 1 of Quantum Quality.

Producing the correct bend is the most important metric. The bend can be measured and controlled or the tooling of the process can be changed such that if the correct bend is not produced it cannot be accepted in a following process. The mechanical interference in this case relates to the tube and a hole in a bracket. It is designed to be a mild interference fit. If the bracket hole is on the high side of the specification and the tube is on the small side of the specification there is no interference. The management team can move directly to a technical solution at this point (change the specifications). The correct position can be ensured through the use of tooling and if necessary a sensor. The correct OD/ID can be monitored going into the process or measured 100% with a sensor in the process when the part is placed in an operation (cannot accept mistake-proofing). The reader is free to review the intended outputs (above) and consider what they think are the best ways to measure. It is my opinion that I do not want to measure what can be taken care of automatically by a process or design change.

However, as part of PPAP, each dimension of the design would need to be verified and when a dimension relates directly to performance, as a minimum a potential capability study will need to be performed (Ppk). The gauges used in such a study will need to have a recent Measurement System Assessment study completed and they must be current on their calibration.

All input dimensions will need to be validated on 3-6 parts and 30 parts for Ppk studies when the input measurement relates strongly to performance. The reader can easily relate to performance by looking at the impact that the inputs/intended outputs have in creating the unintended outputs. In my upcoming book, Quantum Quality, I cover all the related steps in some detail and with explanations.

Keep your eyes open for Quantum Quality Part 3. Part 3 will cover Phase 3 Micro Matrix PFMEA. Phase 3 will eliminate normal ongoing root cause analysis and problem solving teams for any operation which has been studied. It will prioritize root causes which require solutions. It will also provide a Micro Matrix PFMEA which will be a true living document which contains 100% of all known cause and effects. This matrix will be easy to review and to update, should new causes be found or new unintended outputs result from the process.

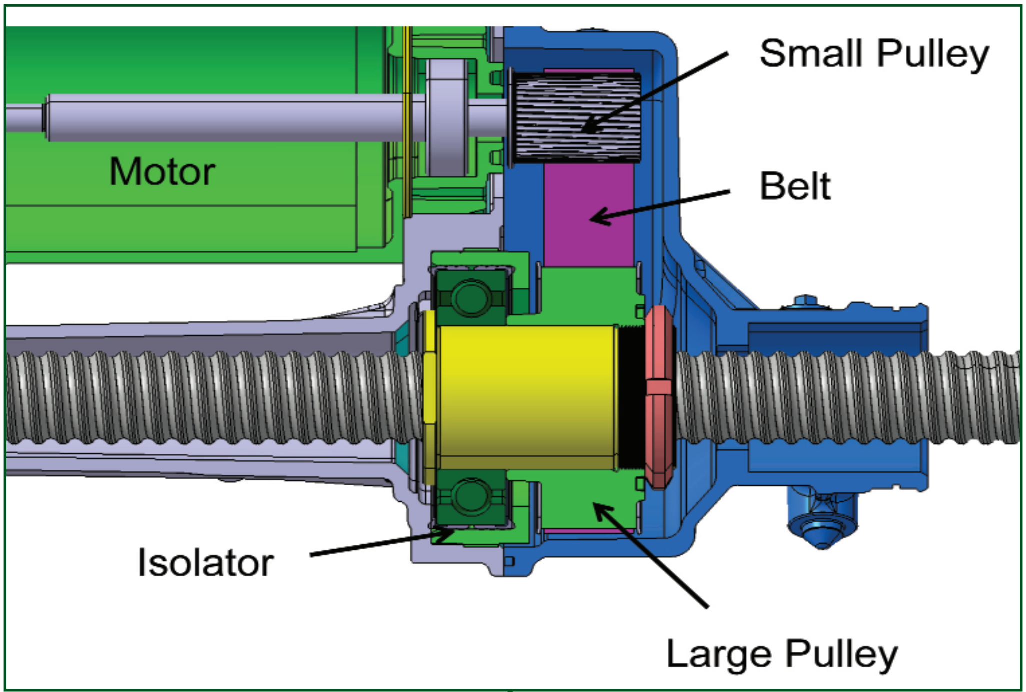
9: Strong
3: Medium
1: Weak
Blank: None

	Effects	Unintended Outputs																				
		Engine Damage	Uneven Length	Flow Off Target	Damaged Pipe	Interferrence Fit	Cannot Assemble	Angle Variation	Poor Quality Spray	Not Perpendicular	Bracket Falls Off	Weak Joint	Sharp Edges	Stepped ID	Large OD	Small OD	Uneven Chamfer	Partial Blockage	Low Fluid Volume	Nozzle too Short	Missing O-ring	Totals
Intended Outputs	Correct Bend	9	9	9	9	9	9	9		9							9					81
	Mechanical Interferrence		9		3	3		9		9	9	9			9	9						69
	Correct Position	9	9	9	9		9	9		9												63
	Correct OD				9	9					9	9			9	9						54
	Correct ID	9							9					9				9	9			45
	Zero Burr	9		9					9				9				3					39
	Correct Angle	9		9		9	9															36
	Correct Chamfer	9							9				9									27
	Correct Length		9											9								18
	Good Penetration										9											9
Totals		54	36	36	30	30	27	27	27	27	27	18	18	18	18	18	12	9	9	0	0	

Solving Technical Problems: Questions drive the tactics

by Rob Langdon

Robert Langdon is Currently Manager Problem Resolution and Robustness at TRW Automotive Steering Systems Engineering. His previous positions include Senior Consultant - Shainin Problem Solving and Prevention, Six Sigma Manager -GKN Sintermetals, and various product and process engineering positions within Delphi. He has a BSME from GMI Engineering & Management Institute '89, and MSE from GMI Engineering & Management Institute '94. He is currently Publication Chair for ASQ -auto.



Problem background

Learning to solve problems faster and more efficiently usually comes from lessons learned during those problem solving efforts. The following is a case where the approach to problem was reconsidered during the investigation.

During a core technology development project, an objectionable "Noise" problem was identified in a steering gear. After a problem solving investigation, a design change was implemented to fix the noise. A rubber isolator was added to a bearing to dampen the noise transmission path between the housing and bearing, and prevent it from reaching interior of vehicle.

A "New problem" emerged during testing of new design level gears with the noise fix. A belt to pulley un-meshing was observed during testing of the new design. The belt was re-engaging one tooth off upon re-mesh. Some were worse than others.

The questions that we often ask in a case like this is "What's wrong?", What's different?", or "What Changed?" Several changes were made to incorporate the isolator.

- Isolator itself
- Housings were from production source
- Pocket in housing to hold bearing is larger
- Belt rides outboard farther on small pulley
- Ballnut assembly with large pulley is longer
- Large pulley design is different to fit ballnut
- EPP software level has changed.

We wanted to understand what change was responsible for the new failure mode? Was it One, some, or all of them? We started by asking the question "What's Different?" We began with tactic of swapping component which a lot of times can quickly identify which are driving the difference. In this case each data point took a half to full day. The measurement was subjective and resuits were often confusing. We were able to get some discrimination using tension to cause un-meshing on a bench test. What we found was that the bench test did not correlate to vehicie test. This tool did tell us that part of the difference was in electronic power pack (EPP) and part was in new pulley configuration. The problem was that we had reached a point where further swaps not feasible.

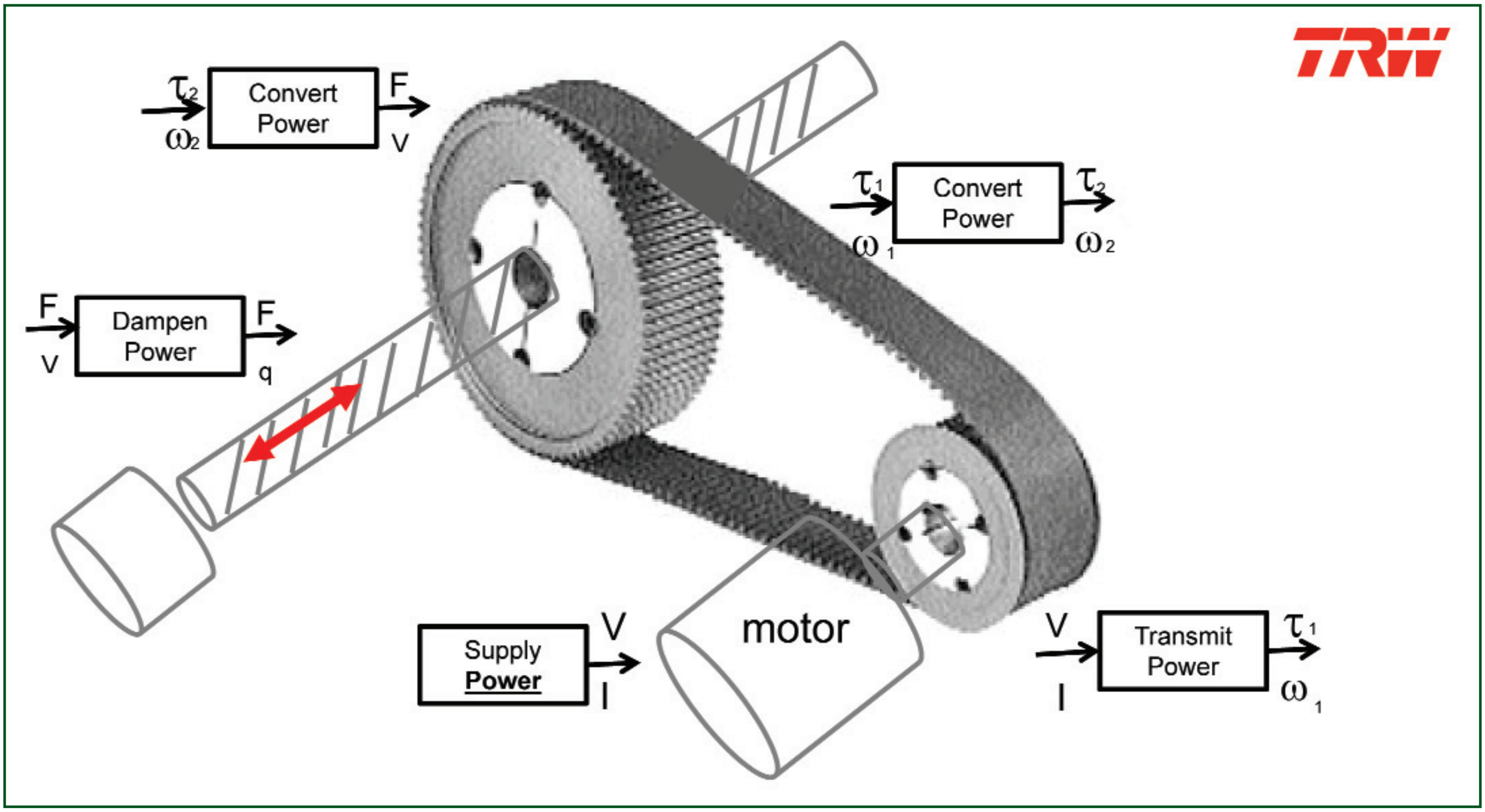
Strategy and Tactics

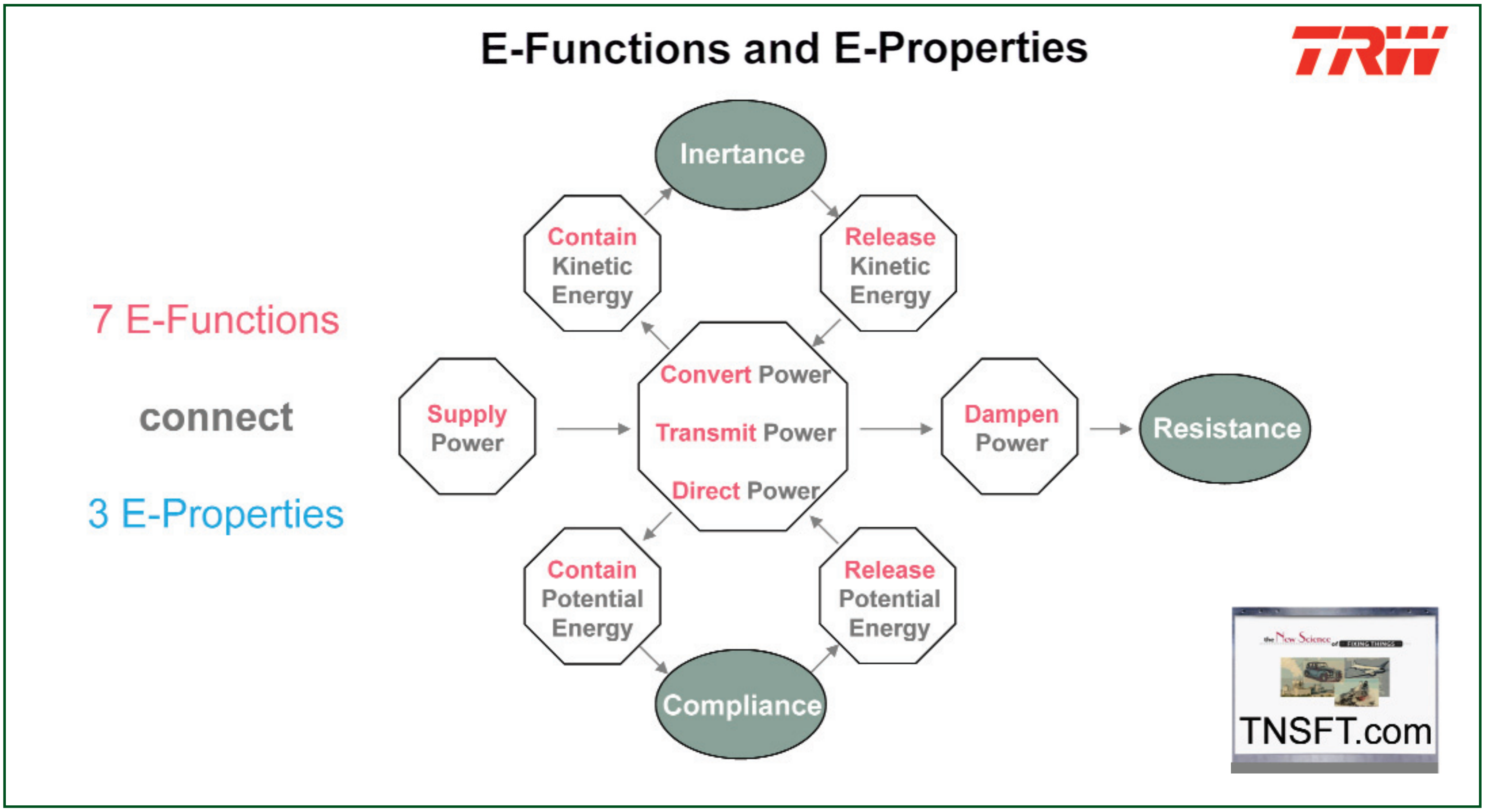
We started to revisit the strategy and the tactics. if we develop a causal explanation instead of finding what is driving the difference, we might be able to make smarter decisions on how to fix the problem. Understanding what's different in this case does not give us insight into what's happening.

Quite simply the first step was to observe the problem. We cut a hole in the housing of both design level gears. This had never been done.
At stop position, the belt would climb up and be aligned tooth an tooth with the pulley. Upon reversal it would fall on the other side of the tooth. Therefore it was now off by one tooth. The video showed something unexpected. The gear that did not come out of mesh one tooth off was showing the same behavior, only when it fell back into a tooth, it was the same tooth as it had come from. Our previous design was running up to the edge of the cliff, and our design change caused it to fall over. In terms of what's happening, both looked nearly identical. Because a mesh problem was not observed in testing, nobody ever took a close look at *what's happening*. We could start to develop a causal explanation about what we are seeing.

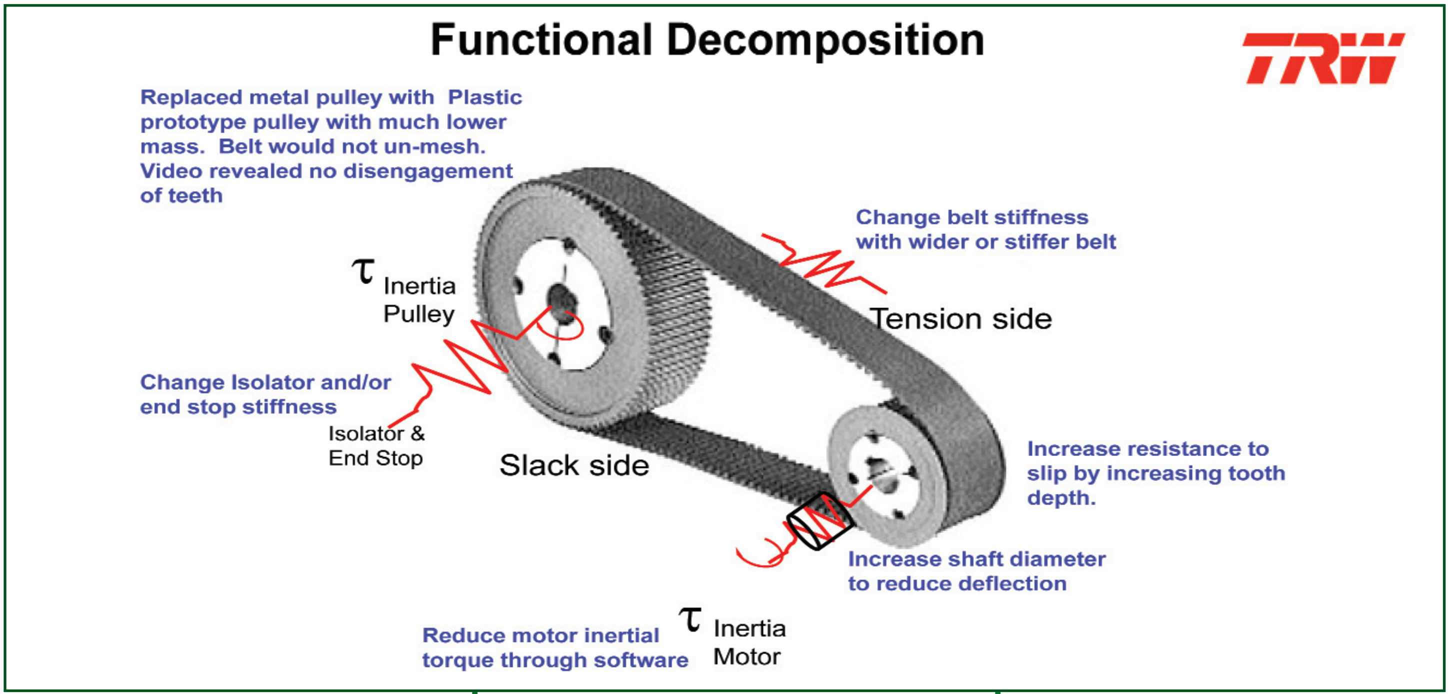
Consider the E Properties. What are the Inertances (K.E.), Compliances (P.E.), and Resistances that might be important. For belt to slip an gear, the belt either has to get longer, or gear centerlines have to get closer, and must overcome gear to belt friction.

Solving Technical Problems: *continued*

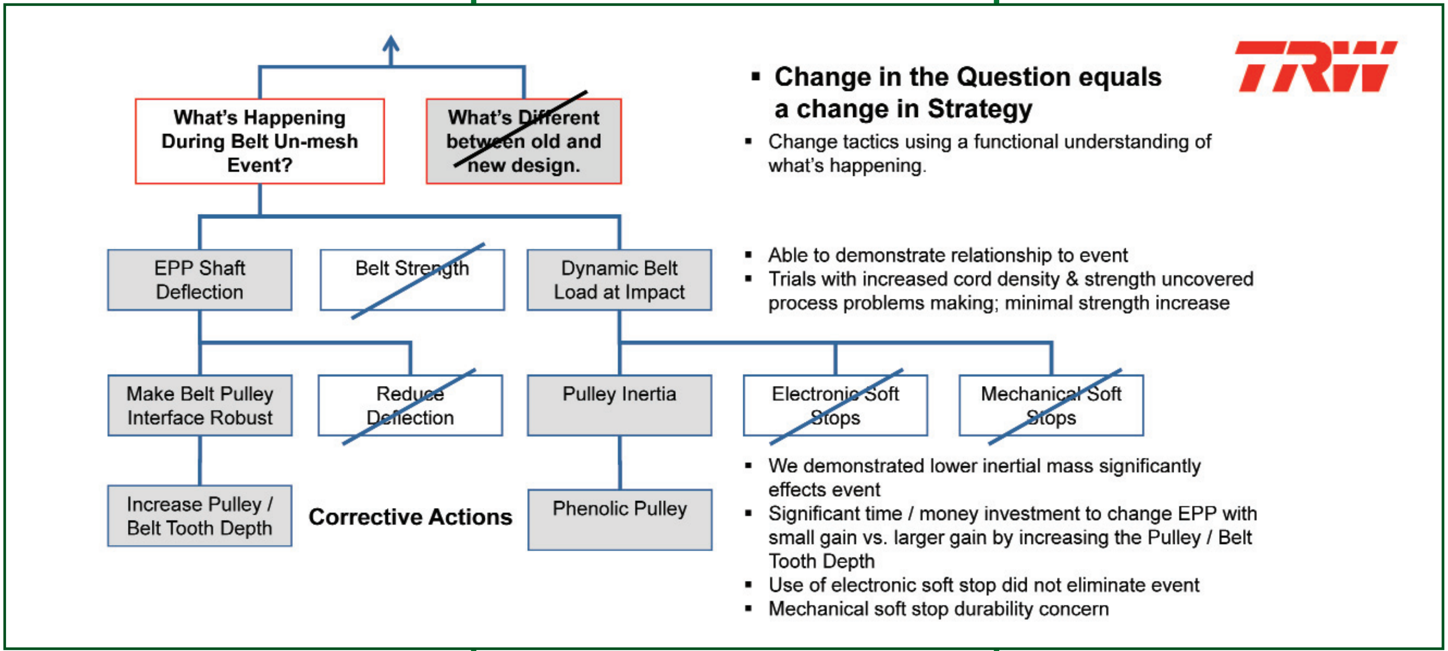




Solving Technical Problems: *continued*



We now understood some of the major contributors to why the belt became un-meshed. Based on this understanding, we could now make decisions based on cost, ease of implementation, benefit, etc. We were able to identify corrective actions that in this case we would not have arrived at unless we understood "What's happening". Confirmation testing confirmed that changing two properties eliminated the un-meshing event. Both were low cost options, and the one was actually a cost reduction.



Summary

The Strategy of solving a problem fast, requires tactics that are in phase with the strategy.

Asking the right question sets the strategy. The tactics result from the question being asked. If you can't get the answer by asking "What's wrong?" or "What's different?", its time to change the question.

Answering the question "What's Happening?" helped us to understand how energy was being used in the system and helped us understand the options for fixing the problem.

Chrysler Develops Laboratory Based Shainin® Training

Chrysler Group has developed a new "learning by doing" approach for reactive problem solving. The new course takes place both in the classroom and the laboratory. The class learns the theory in the morning and then practices the skill in the lab in the afternoon. This blended approach of hands-on practice with classroom instruction is designed to build the problem solvers' skills faster than traditional training. Two groups of students - 37 in total - have taken the class so far. The four Chrysler instructors are all certified to teach through Shainin LLC.

Chrysler instructors begin the class teaching Component Search™. The group learns the theory. Next, the instructors cover Chrysler case studies in order to teach practical application of the tool. For hands-on practice, the students receive a pair of flashlights. One of the flashlights has been "modified" to not work properly. The students then apply the morning's lesson to find the Red X® (root cause) in the modified parts. This "learning by doing" method is used for seven different lab exercises. The instructors teach the Shainin® toolbox in a classroom and transfer this experience into hands-on skills.

The laboratory is at the Chrysler Quality Engineering Center in Auburn Hills. This lab is equipped with workbenches, a car hoist, a machine shop and storage areas. The class of 20 divides into 10 teams and works with the system or components for each lab exercise to determine the Red X. Students create the Project Definition Trees™ and Solution Trees™ then test their Red X candidate in the lab. Each exercise has its own set of instructions, a unique measurement system, parts and results.

The Chrysler Group has four certified Shainin Instructors. They are Sarah Wodzisz, Frank Falzetta, Dan Lochmann and Jud Estes. These instructors are scheduled to deliver the two week class at least twice next year. Before the class, all four instructors prep for teaching and the labs. The experimental parts must be repaired and prepared before each class. Maintaining precisely broken parts is harder than it sounds. Preparing the training material was a joint development process with Shainin LLC and Chrysler Group instructors.

The new technique of "learning by doing" has paid off for the Engineering and Quality departments. Development and quality problems are solved quickly by the trained engineers. The classes are continuously evolving to improve the speed and skills of Chrysler Group problem solvers.

Judson B. Estes is a founder of the Blackbelt program at Chrysler. The Chrysler Blackbelt program incorporates Shainin, Kepner Tregoe and Statistics into a unified problem solving approach. He is a Master Blackbelt working with Chrysler, Jeep, Dodge and SRT vehicles in Auburn Hills. He also deployed and developed the Blackbelt program overseas at Daimler trucks and Mercedes Benz cars in Stuttgart, Germany and in England with Mercedes Benz High Performance Engines and McLaren Formula One racing.

Frank Falzetta is a Reactive and DFSS Master Blackbelt at Chrysler. He has worked as a problem solver / coach throughout Europe and North America. His most recent responsibilities have been to develop the DFSS and Reactive Black Belt programs at Chrysler.

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