White Paper

Introduction to Japanese Style Mizenboushi Methods

for Preventing Problems Before They Occur

By James McLeish and William Haughey

Mizenboushi Methods

It is well known that Toyota's undisputed leadership in automotive product and component Quality, Reliability and Durability (QRD) that is achieved in a lean, low cost manner is one of the key factors that fueled their dramatic growth in global and U.S. market share. This growth has made headline news as it has come at the expense of the U.S. auto industry, resulting in an economic meltdown that has driven many OEMs and suppliers into bankruptcy, led to government bailouts, and created record regional unemployment throughout the Midwest. As in many market segments, customers expect and demand performance, value and high QRD. If you are not meeting these customer expectations, you are at risk for losing your market.

The methods and tools of the Toyota Production System (TPS) that produced unrivaled manufacturing quality were revealed to the world in the book The Toyota Way by Professor Jeffrey Liker of the University of Michigan. Similarly, Toyota's engineering methods were studied and documented in books such as Product Development for the Lean Enterprise – Why Toyota's System is Four Times More Productive and How You Can Implement It by Michael Kennedy and The Toyota Product Development System by James Morgan and Jeffery Liker.

Toyota knew that as their competitors started to learn their quality control techniques and methods for quickly responding to and resolving quality problems, they would need to continuously improve in order to maintain their competitive lead. They concluded that the next logical step was to develop methods to prevent quality problems before they occur and that this was best accomplished during new product design and development.

Toyota had develop outstanding engineering capabilities primarily though on-the-job training that required all their engineers, in every department and technical area, to personally investigate and solve product quality, performance and reliability problems and then document what they learned from the failure situations they encountered. These techniques are known in Japan as *"Genchi Genbutsu"* the *"go and see actual part in actual place"* principle and the *"Herenso"* or *"giving a thorough update report"* process.

Years of using these techniques enabled Toyota to gain vast amounts of information on what did and did not work in their products. Toyota then developed methods for sharing and teaching this knowledge throughout their global engineering organization. They began using this knowledge to assess the susceptibility of a new design to previously encountered quality problems and field failure modes. Over time, this evolved into the Mizenboushi (Preventative) Method.

Knowledge of the Mizenboushi approach was first bought to the U.S. by retried Toyota engineering and quality executive Tatsuhiko Yoshimura (known as Yoshimura-san to his students) when he was hired by General Motors to review and recommend improvements to their QRD processes. Yoshimura-san taught the Mizenboushi Method within General Motors that introduced a problem prevention process called GD³.

There are three parts or phases to the GD³ process - Good Design, Good Discussion and Good Dissection.

The first phase, **"Good Design,"** emphasizes creating a robust design by:
- Recognizing and reusing proven successful aspects and techniques of past products.
- Identifying, minimizing and managing the potentially disruptive influences of changes and new technologies that may include changes in usage conditions or environments.
- Minimizing the number of changes in a single product.
- Comprehending the impact of interface where different materials or parts are connected together.
- Designing in features that can make the presence of budding problems visible or what would be called prognostics here in the U.S.

The second phase, **"Good Discussion,"** is a design review risk management process that focuses on the proposed new features or changes to a proven design or its environment. The Good Discussion process utilizes a tool called a **Design Review Based on Failure Mode (DRBFM)**.

A DRBFM is similar to a Failure Mode and Effect Analysis (FMEA) and both methods use a multi column analysis worksheet. However, a traditional FMEA can be very time consuming and costly to perform, especially in today's faster/shorter product programs, due to the FMEA's methodology of meticulously evaluating and documenting every possible failure mode of every item and feature in a new design. This aspect of a FMEA was originally intended to demonstrate and document that a comprehensive engineering due diligence assessment was performed. This may often be a contractual requirement for an engineered product, part of a military program, or an internal process to generate evidence that a thorough engineering analysis was performed in the event product litigation is needed in the future.

By contrast, the DRBFM, like everything else at Toyota, was designed as a "lean" process intended to create the most value at the lowest cost with little wasted effort. To accomplish this, DRBFM focuses only on the areas of change, interfaces, and risk management in a new design. The DRBFM documents the concerns, effects, detailed causes and control features based on the knowledge of experienced product engineers. The purpose of the DRBFM is to make the risks related to the changes visible by discussing them at length within an experienced team. By focusing deeper on fewer issues, the DRBFM process produces more value faster. The Society of Automotive Engineering (SAE) currently has a task force developing a new recommended practice, SAE J2886, to document the method and intent of the DRBFM.

The third phase **"Good Dissection,"** is a test result analysis process that goes far beyond a pass/fail assessment. This process requires that performance test results are evaluated for signs of inconsistent performance or transients that may indicate a functional discrepancy. Next, parts from usage and environmental life tests are disassembled, and, where appropriate, dissected and closely examined for signs of wear or degradation that could identify a weakness in the design that should be considered for improvement prior to moving into the production phase.

The Good Dissection process utilizes an analysis tool called a **Design Review Based on Test Results (DRBTR)** that is used to document observations, consider the possible effect on the customer, determine if and what type of corrective action is required, and provide feedback to engineers and suppliers to facilitate improvement in future designs.

Yoshimura-san, who was also a professor at Japan's Kyushu University and an independent consultant, documented the Mizenboushi philosophy and GD^3 methodologies in a book title <u>Toyota Styled Mizenboushi Method – GD^3 Preventive Measures – How to Prevent a Problem Before it Occurs</u>. The book was published in Japanese in 2002 by JUSE press. An English language version of Yoshimura-san's book has not yet been published, although a limited number of soft-bound English translations were distributed within General Motors. The book documents the history and rational behind the Mizenboushi philosophy, outlines what to do in each of the three GD^3 phases, recommends tools and formats, and provides case studies.

It is interesting to note that the Physics of Failure (PoF)/Reliability Physics (RP) movement developed in the United States and practiced by the staff of DfR Solutions has a number of similarities to Toyota's Mizenboushi (Preventative) Methods.

- Both engineering QRD philosophies are based on sharing and communicating the knowledge obtained in failure analysis and problem solving to foster product improvement.
- Both techniques have been proven to produce products with world class QRD results in the field.
- The Good Discussion process and Design Review Based on Failure Mode (DRBFM) methods are similar to DfR's Physics of Failure-based Initial Reliability Assessment (IRA).
- The Good Dissection process and Design Review Based on Test Results (DRBTR) tool is similar to a number of methods and activities at DfR, including test to failure for component qualification, DfR's pre- and post-HALT activity and root-cause analysis of any accelerated life test failures.

Additional articles in this series will provide more information, details and case study examples on the Mizenboushi (preventative) philosophy and the GD^3 methodologies of Good Design, Good Discussion – DRBFM, and Good Dissection – DRBTR.

If you would like to know more about these techniques, please contact Jim McLeish, in the Michigan Office of DfR Solutions, at jmcleish@dfrsolutions.com.