Hi There, Martin Shaw of Reliability Solutions here

It has been a busy 2024 , I have been consulting with a wide range of companies on driving Reliability Improvement using tools which I have built into my *Holistic Model. Y*ou may remember my blog at start of the year on Holistic Reliability, let me remind you where the term originates and how we have progressed .

Holistic *'is a belief that the parts of something are intimately interconnected and explicable only by reference to the whole'*

This is particularly true with Reliability as simply carrying out an Accelerated Life Test or HALT test, etc will never achieve the ultimate objective you seek, we must go much deeper into understanding the whole suite of tests and proactive assessments required to PREVENT defects ever occurring.

Why do we need this model?

It is very difficult to now make realistic Reliability predictions from limited sample testing as field failure rate targets are so low with today's technology, hence representative statistical testing is rarely possible. Using simulation models NEVER gives an accurate prediction that will correlate strongly with actual field failure data and accelerated stress testing is commonly not capable of stimulating sufficient 'real' defects, hence we need an alternate approach to make a BIG CHANGE in Reliability.

When and who can use the model

It is advisable the Holistic model is applied from earliest possible step in the design cycle in order that each factor can be measured as it is completed and hence a 'running' or 'fluid' score is available throughout the design phase and into pilot or initial mass production, at which stage the final scores are input. P

Project Managers make excellent use of this tool to monitor how each group is performing (Design Product Eng, Test Eng, Quality, NPI, Process Eng, etc.) and the effect of their work is obvious from each factor scoring. It is very clear if the product score is sufficiently high at early stage of using the model, hence the teams performing poorest can get the required focus to ensure improvements made EARLY that will enhance product in later stage of development cycle.

Finally a score at the end point before moving into full blown mass production is available to truly judge how well this product will perform in manufacture and in the field

Holistic Model Background

It has always been the case there are a range of contributing factors that have a direct effect on product reliability , the trick is in finding a way to bring together these *'intimately interconnected'* factors or parts which come together to affect the *'whole'* product

Reliability Solutions are now in a very strong position to start releasing the holistic model and how to develop it in such a way it will have direct representation and relation to the product reliability and also quality levels.

This is an exciting time as we start to apply the solution model which companies have been waiting on for many years, though they never actually realised it, **up until now that is !!**

Implementing the Holistic Model

How would your company develop their unique holistic model to drive World Class Reliability?

1. Must look critically at your product and define the key elements that guarantee customer satisfaction
    a. This may be long life function, appearance, durability, feel, ease of operation, etc.

2. Set out the methods to achieve your objectives which can assist the developer or manufacturer to achieve their goals

    a. This could be how to ensure consistency in manufacture with near perfect tolerance matching
    b. Ensuring manufacturing capability is high enough to guarantee high volume production with maximum yield and minimal rework
    c. Improve Process Control to Minimise opportunity for Early Life defect
    d. Meeting Field Reliability targets 50% Lower than previous products to drive cost of fail reduction and increase customer satisfaction
    e. Etc.

3. Defining the tools available to support achievement of the objectives within short life cycles

    a. Using a modified and Effective DFMEA which gets engineers really interested
    b. DFM of DFx application to drive stronger design for manufacture, test and service
    c. A faster and more effective form of Accelerated Reliability Testing at Key Component, Sub-assembly and Full Assembly levels, covering all the defect contributors
    d. A strong Design Quality test approach to mix function with stress and Maximise defect detectability levels
    e. A detailed manufacturing readiness review method to ensure a pragmatic and objective approach to internal critical assessment
    f. Manufacturing intensive process review with GAP Analysis, not an old-fashioned style of ISO Quality audit which adds little value, applicable internal and with Supply Chain
    g. Strong Process Control Plans from detailed process Map
    h. Etc

4. Map out the product and set up a method to apply the selected and necessary tools in an organised manner with a scoring approach which relates directly to the contribution each tool can make in achieving your objectives of World Class Quality and Reliability;

    a. Design for Assembly review following a detailed approach developed from lessons learned and product analysis will have significant effect on a low cost high volume product which requires error free easy assembly
    b. Design Quality testing and Design Maturity measurement will greatly enhance the reliability of a complex product with wide range of operational capability
    c. Production readiness review will be important when manufacturing products with complex processes and making ready a process that can be controlled to 6 sigma style levels
    d. Detailed Accelerated Stress test plans at Key component, Sub and Full assembly levels as all require different forms of stress test to maximise Defect Detection Capability
    e. Supply Chain selection and Management models / methods to maximise Supplier Quality and performance.
    f. Etc

5. Decide on how to measure each factor.

    a. Design Quality would have a % Design Maturity measurement
    b. Design for Assembly (DFM, DFx) will be a % rating score
    c. Early Life Reliability Testing will be rated on no. of defects
    d. Accelerated Life Testing measure could be based on MTTF prediction
    e. Set targets for initial Mass Production yield levels and score this factor related to yield targets
    f. Production Readiness % level score
    g. Manufacturing Yield levels Vs Target are measured and scored accordingly
    h. Etc.

6. How do we bring it all together in a matrix that provides an Output Metric we can use ?

    a. This is best achieved with a co-ordinated NPI matrix including all the key elements which contribute to product failure and the reliability level required
    b. Each element is assigned a target and scoring mechanism to convert data into NPI scores
    c. Run simulation of previous products with the new NPI Metric table and compare output score with known customer failure / reliability levels to perform data fitting and calculate the ***'correlation factor'***
    d. Once the correlation factor has been estimated we can start to use it and make our comprehensive predictions from our suite of information / data contained in the NPI matrix to output an ***HOLISTIC PREDICTION OF RELIABILITY***

An example of a typical model is shown below ;

	NPI Metric Item	Measurement	Scoring Guide	Score
1	Design for Manufacture / DFX	% DFX score	<70%(0), 70 - 80%(0.5), 80-85%(0.75), > 85% (1)	0.75
2	DFMEA - Reliability defect focussed	Weighted RPN Average	<60(1), 60 -70(0.5), 70-85(0.25), > 85 (1)	0.5
3	Design Quality Maturity from Design Quality Assurance (DQA) Testing	% Design Maturity	<70%(0), 70-80%(0.5), 80-85%(0.75), > 85% (1)	0.5
4	Product Manufacture Process Readiness score	% score (ticksheet)	<80%(0), 80-85%(0.5), 85-90%(0.75), > 90% (1)	1
5	Critical Sub-Assembly Early Life Rel Test	Score based on no. % def found	0 fails (1), <5% fail (0.75), 5-10% (50%) > 10% (0)	0.75
6	Full Product Accelerated :Life Testing (ALT)	Score based on no. % def found	1 fails (1), <5% fail (0.75), 5-10% (50%) > 10% (0)	1
7	Full Product Operational Limit Test (Temp, RH, Voltage, pwr cyc)	Score based on no. def found	Meets spec conditions (50%), +20% margin outwith (75%), +30% Margin (100%)	0.75
8	Manufacturing Process Yield Measurement	% Rolled Yield	<70%(0), 70-80% (0.25), 80-90%(0.5),90-95%(0.75), > 95% (1)	0.75
9	Critical Component / Sub-Assembly Supplier Assessment Scores	% scoring	<70%(0),70-75%(0.5), 75-85%(0.75), > 85% (1)	0.5
10	Critical Component / Sub-Assembly Supplier Process Rolled Yield data	% Rolled Yield	<70%(0), 70-80% (0.25), 80-90%(0.5),90-95%(0.75), > 95% (1)	0.5
11	Full Product Assembly PFMEA	Weighted RPN Average	<60(1), 60 -70(0.5), 70-85(0.25), > 85 (1)	0.25
			AVG	**66%**
			Prediction	**3.5%**

Depending on the Corelation factor calculated from simulation using previous products, the NPI score can be used to make the ***Holistic Prediction***, in this case a simple power based function l based equation is found to work best when fitting the data and a prediction is made, in above case of 3.5%

Where Next??

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