

LEBENTECH™ INNOVATIVE SOLUTIONS, INC.

Proactive Innovative Solutions for Success and Competitive Advantages

PREMIER CONSULTING

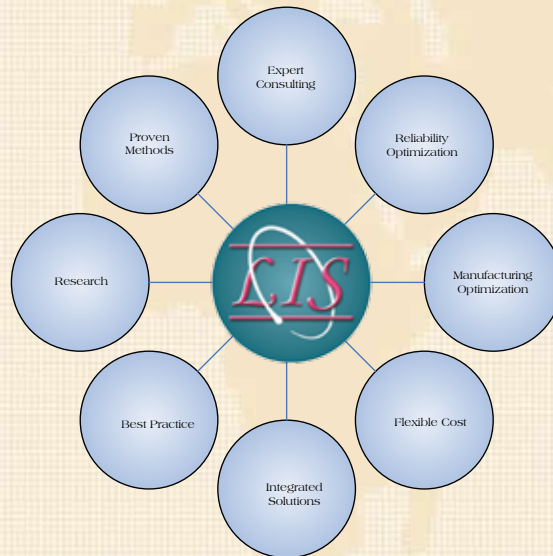
RMQ TRAINING • RELIABILITY ENGINEERING
MANUFACTURING ENGINEERING • ENGINEERING DESIGN MODELING
QUALITY ENGINEERING • MAINTAINABILITY ENGINEERING



PROVIDING $\int_{-\infty}^{\infty}$ INTEGRAL SOLUTIONS

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PROVEN METHODS



Complete & Comprehensive Innovative Solutions for each Phase of the Product's Life-Cycle

Life Cycle Phases	Conceptual	Demonstration & Validation	Engineering Development	Production	Field & Service
Goals	<ul style="list-style-type: none"> System Reliability System Availability MTTR MTBF Maintainability Reliability Program Plan Benchmarking 	<ul style="list-style-type: none"> Reliability Analysis Design Analysis Maintainability Analysis Manufacturing Models Design for Reliability Design for Maintainability Warranty Prediction 	<ul style="list-style-type: none"> Reliability Quantification Design Verification Reliability Demonstration 	<ul style="list-style-type: none"> Process Failures Process Capability Process Control RCA Failure Effect 	<ul style="list-style-type: none"> MTBF Estimation Failure Time Distribution Testing
Applicable Strategies	<ul style="list-style-type: none"> Allocation LCC MTTR MTBF Gap Analysis Program Development 	<ul style="list-style-type: none"> Thermal Analysis RBD FMECA MTTR Maintainability Verification FTA [Probability risk approach] Stress – Strength Analysis Statistical Models for maintainability Warranty models 	<ul style="list-style-type: none"> Reliability Life Prediction FRACAS Statistical DOE Reliability Growth Reliability Test Development Maintainability Demonstration Stress – Strength Analysis Statistical Models for Maintainability HALT 	<ul style="list-style-type: none"> Develop Reliability Audit Plan Reliability Acceptance Test Development of ORT Development of HASS Test Warranty Performance Analysis End of life Assessment PFMEA Process Development Process Verification Process Validation Test Methods Validation 	<ul style="list-style-type: none"> Warranty Cost Assessment Reliability Growth Monitoring



LEBENTECHTM **INNOVATIVE SOLUTIONS INC.**

❖ **COMPANY OVERVIEW**

LEBENTECH is a consulting company providing a vast array of innovative reliability, maintainability, and manufacturing engineering solutions. We proactively provide innovative solutions for success and competitive advantages. Our project team is a conglomeration of over a decade of experience in a wide variety of areas such as product design, manufacturing system development, design evaluation, reliability and maintainability analysis etc. We strive to develop a partnership approach with each customer. It begins with a thorough assessment of your needs not just in terms of product design but also end use environment in which the product will work.

❖ **OUR VALUE**

We expect the highest level of performance and integrity from ourselves. We strive to create opportunities that will develop and reach our potential, as well as achieve professional and personal goals. Personal commitment, teamwork, resourcefulness and innovation are the salient criteria in achieving excellence in all we do. Our experience helps deliver optimal results while giving our clients the satisfaction they desire.

❖ **CONSULTING PROCESS**

Every step of our consulting process focuses on customer needs, expectations, requirements, and how best to realize them. Our consultants utilize a systematic methodological approach that requires application of associated technologies to proactively provide innovative engineering solutions for specific problems. We develop manufacturing, reliability and maintainability evaluation approaches by researching, analyzing, selecting and applying engineering concepts, techniques and criteria. Our consulting services enable our clients to implement lasting change in their business operations from a reactive mode of reliability management to a proactive preventative mode of reliability management.

❖ PORTFOLIO

Whether a sole proprietorship or small business; **LEBENTECH** provides your company with affordable yet professional consulting services. We strive on excellent service with the overall goal of achieving for our clients, a world class competitive advantage. We are committed to your current and future success and remain unsatisfied until we develop an innovative engineering solution that ensures our client's needs are fulfilled.

The foundations of our engineering solutions are: strategic research effort, model development, and extensive engineering analysis, creative application of experience and engineer's resourcefulness. Ultimately we provide companies with opportunities to develop and manufacture more robust products to strengthen productivity and increase revenue. We deliver unmatched consulting service by employing consultants with talent, experience, creativity and who are dedicated to providing innovative solutions for success.

Contact us for more information on our services 954 – 796 - 7107.

❖ A PRACTICAL FOCUS ON INNOVATION

Researching is a major component of **LEBENTECH** tradition of excellence. We do not hesitate to conduct requisite research that ensures our engineering solutions are appropriate and successful. Our talented and experience consultants work as partners with your staff to help evaluate products, test and validate designs and optimize manufacturing process to ensure specific output requirements are met.

We recognize that consistency of client's product is very important and therefore help clients apply a system of robustness for the evaluation and improvement of the product development process. Typical approaches employed include the application of statistical design and analysis of experiments. **Response surface methods, probabilistic design, and linear programming are other approaches selected for specific applications.**

We help clients apply the appropriate robust design approaches that will produce extremely reliable design both during manufacture and in use. We demonstrate to clients how they can utilize robust design approaches to develop designs with either the lowest cost or the highest reliability or an optimized combination of cost and reliability. This is accomplished through a practical focus on innovation.

❖ DEMONSTRATED CAPABILITIES OF LEBENTECH INNOVATIVE SOLUTIONS INC.

With a passion for creativity and innovation, **LEBENTECH** is synonymous with excellence since its inception. Our work focuses on a systematic methodological approach that requires application of associated technologies to provide innovative engineering solution for specific problems. Our capabilities enable us to quickly develop innovative engineering solutions essential and critical to businesses that pursue transformation to become capability driven, based operations.

At LEBENTECH the experience, knowledge, technical capabilities, and customer relationship already exist. We know reliability and maintainability engineering application. We are masters at manufacturing engineering and quality engineering and in most design and development challenge. We have demonstrated capability at providing critical innovative solutions in various areas of disciplines and services identified. We apply practical approach that helps your organization focus on the most important element of RAM program requirement. Our engineering services provide our clients the benefit of a dedicated engineering function at affordable cost.

LEBENTECH utilizes innovative strategies to assist clients in developing reliable and robust products. Our engineers proactively perform detailed investigative and statistical engineering activities. This strategy determines what could go wrong with process, part, or product. Our expert then organize and present that information and knowledge so that the method justifies the appropriate actions required in transforming performance and or improving life cycle cost. We proactively improve the manufacturability, reliability, quality and maintainability of products to ensure customer satisfaction and to meet our client's business objectives.

We guarantee that the performance specification and detail design are consistent with mission requirement and with balanced consideration of such factors as producibility, operability, maintainability, and safety. In order to meet our goals we provide our customers: quality service, solutions that provide the basis for continuous product and process improvement, open communication, and best pricing and value. We strive to be your premier provider for innovative consulting services. We are committed to continually improve our service and lead in the consulting field.

INTEGRATING DESIGN FOR PERFORMANCE AND RELIABILITY

❖ LEBENTECH UNIQUENESS

- ◆ Flexible cost and accommodation for long and short term assignment
- ◆ Excellence in engineering solutions
- ◆ Capability and flexibility to offer solutions in a multi discipline approach
- ◆ Demonstrated capabilities

Our mission involves enabling and empowering our clients to develop robust products with exceptional quality performance. Our strategy serves a variety of domestic industries inclusive of consumer products, aerospace, medical device, pharmaceutical, high-tech, automotive, and manufacturing. Our unique methodology is drawn from an array of disciplines, such as reliability engineering, real world experience, researching, manufacturing engineering, quality engineering, design and maintainability engineering. We work with clients who are prepared to be competitive in producing the best quality products. We put our client's interest first and accept only those projects where both our clients and our staff can have maximum impact.

❖ AFFILIATED CONSULTANTS

We are a team of uniquely qualified professional consultants who are recognized for delivering expert consulting that culminates in practical solutions. The methods we apply and solutions delivered guarantees that when service is provided to your company you will always call us again for your next project. Our team has combine knowledge and experience that enables us to facilitates projects of any size and complexity. We are a team of great minds **revolutionizing and optimizing manufacturing and reliability solutions.**

We deliver significant improvements in design, quality, manufacturing and reliability through the application of engineering, statistics, mathematical modeling, research, and scientific methods. **We work diligently with your team** to explore the most reliable and effective solutions cost effectively. The comprehensive and broad-based expertise of our consultants enables our team to provide qualitative and quantitative assessments that are intelligent, dedicated and analytical in an efficient and timely manner.

All principals have significant roles and made tremendous impact in the manufacturing, teaching, quality and reliability field of service. **Our lead consultant Lennox Bennett** served as an RAM engineer with Lockheed Martin, a reliability test engineer with ZEROX, a manufacturing engineer with Motorola, a verification engineer with Maytag and an advance quality engineer with GE Appliance. He also had responsibility for design assurance at Sunbeam Products Inc.

❖ AREAS OF CONSULTING SERVICES

- ◆ RELIABILITY ENGINEERING
- ◆ MANUFACTURING ENGINEERING
- ◆ MAINTAINABILITY ENGINEERING
- ◆ ADVANCE QUALITY ENGINEERING
- ◆ RMQ TRAINING
- ◆ ENGINEERING DESIGN MODELING

❖ RELIABILITY ENGINEERING APPLICATIONS

- ◆ WARRANTY ANALYSIS
- ◆ RELIABILITY PROGRAM DEVELOPMENT
- ◆ LIFE DATA ANALYSIS
- ◆ RELIABILITY GROWTH MODELING
- ◆ ACCELERATED LIFE TESTING
- ◆ FAULT TREE SAFETY ANALYSIS
- ◆ RELIABILITY PREDICTION AND ANALYSIS
- ◆ RELIABILITY TEST PLAN DEVELOPMENT
- ◆ RELIABILITY CENTERED MAINTENANCE
- ◆ FRACAS IMPLEMENTATION & MANAGEMENT

❖ MAINTAINABILITY ENGINEERING APPLICATIONS

- ◆ MAINTAINABILITY PROGRAM DEVELOPMENT
- ◆ MAINTAINABILITY PREDICTION AND ANALYSIS
- ◆ MAINTAINABILITY DEMONSTRATION TESTING
- ◆ REVIEW DESIGN FOR MAINTAINABILITY
- ◆ PRODUCT FMECA AND DEVELOPMENT

❖ RELIABILITY TRAINING DEVELOPMENT

- ◆ STATISTICAL DESIGN OF EXPERIMENT
- ◆ MEASUREMENT SYSTEM ANALYSIS
- ◆ STATISTICAL PROCESS CONTROL
- ◆ STATISTICAL HYPOTHESIS TESTING
- ◆ RELIABILITY ANALYSIS
- ◆ INTRODUCTION TO STATISTICS

❖ MANUFACTURING ENGINEERING APPLICATIONS

- ◆ MANUFACTURING COST ESTIMATES
- ◆ PROCESS DEVELOPMENT AND IMPROVEMENT
- ◆ MANUFACTURING FACILITY PLANNING
- ◆ MODELING AND ANALYSIS OF MANUFACTURING SYSTEM
- ◆ PRODUCTIVITY MEASUREMENT AND IMPROVEMENT
- ◆ PRODUCT VERIFICATION AND VALIDATION
- ◆ OPTIMIZATION OF RESOURCE ALLOCATION
- ◆ ENGINEERING ECONOMIC ANALYSIS

❖ QUALITY ENGINEERING APPLICATIONS

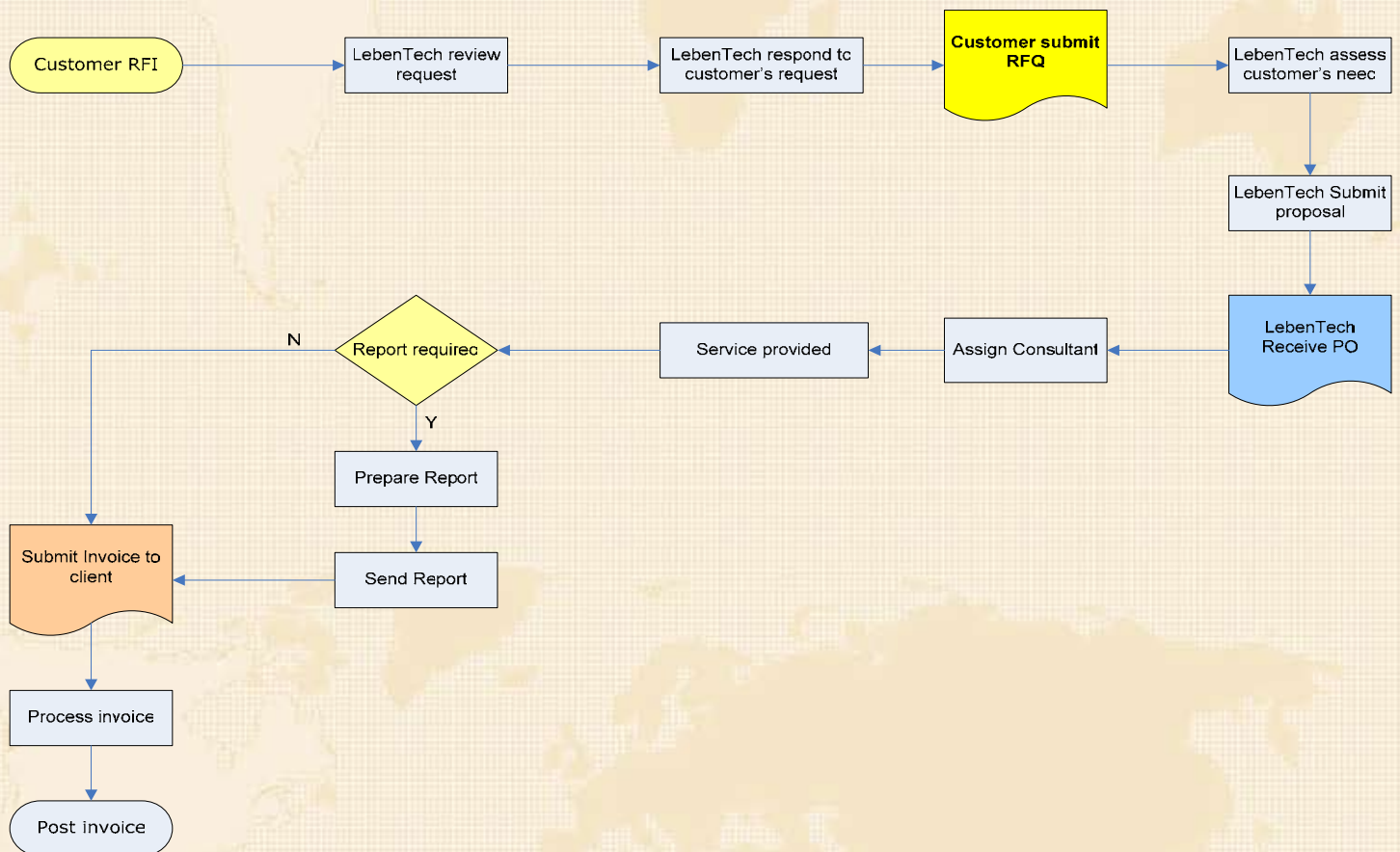
- ◆ SUPPLIER EVALUATION
- ◆ QUALITY PLAN DEVELOPMENT
- ◆ SIX SIGMA APPLICATION
- ◆ SUPPLIER QUALITY ASSURANCE
- ◆ DESIGN AUDIT TO INTERNAL STANDARD
- ◆ GAGE R&R STUDIES
- ◆ STATISTICAL PROCESS CONTROL

PREMIER CONSULTING SERVICE WITH FLEXIBLE AND AFFORDABLE COST

DOING BUSINESS

Using our premier contract service or access to LebenTech engineering and consulting capabilities is straight forward. We make the details of doing business simple by eliminating the need for lengthy contact negotiations with flexible and adjustable rates and pre-negotiated terms and conditions. This enables agile response in getting the consultant on the assignment to solve our clients engineering problems, hence saving money and time.

PROCESS FLOW



Innovation Delivers Effective Affordable Solutions

❖ **LEBENTECH IS A VIABLE OPTION FOR CONSIDERATION EVERY TIME**

We help our clients improve their process and products by applying world class professional knowledge, bringing academic standard of research into the work place while identifying potential efficiency and cost savings. We leverage top tier, experienced talent with a combination of proven process and innovative methodology to provide desirable outcomes for our customers. Our commitment to excellence shows in our understanding of customer's product requirement and our ability to provide a full range of innovative solutions. **We exceed client's expectations.**

LEBENTECH enables companies to optimize reliability and availability while reducing maintenance cost from concept to in service. We are leaders in innovative solutions. Our clients choose us for the quality of service and our intense focus on providing practical solutions. Whether hi-tech or sole sector we are committed to serving you better than anyone else.

If your business includes Hi-Tech systems and requires improvement in product reliability, or in the manufacturing process, or if significant reduction in the design cycle and cost is imminent then don't hesitate to contact **LEBENTECH**. When the equation is where to find experience and result oriented, manufacturing, quality, maintainability or reliability engineers the answer is simple **LEBENTECH**. Our talented engineers provide inimitable engineering evaluation, reliability enhancement, qualifications test development, manufacturing solutions and more.

LEBENTECH INNOVATIVE SOLUTIONS INC.

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Welcome to **LEBENTECH!** We invite you to EXPERIENCE THE DIFFERENCE. Our approach is simple, the results are outstanding.

Make the Connection

LEBENTECH™ — **PROACTIVE INNOVATIVE SOLUTIONS FOR SUCCESS AND COMPETITIVE ADVANTAGES**

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❖ LIFE DATA ANALYSIS

Life data analysis is used to make prediction about the life of a product in a population, fit data to appropriate distribution, estimate parameters such as reliability or probability of failure at a specific time, mean life of a product and failure rate.

We are experienced in performing life data and reliability analysis including: Weibull and Kaplan-Meier, normal, log normal, chi square distribution and regression analysis.

Our engineers apply distribution such as Weibull, Exponential, and Lognormal to study mechanical, electrical, electronics failure data for the purpose of warranty analysis, comparing products from two different suppliers and to support product development.

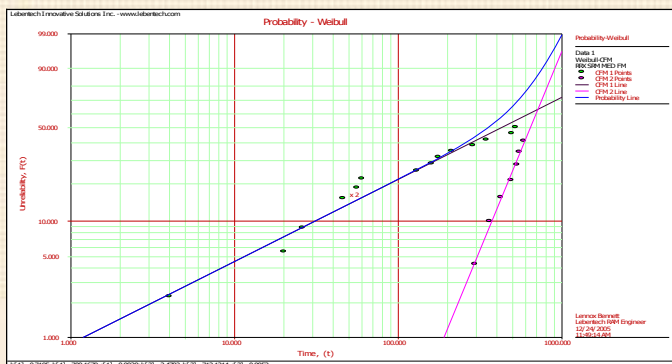


Figure 1: – Weibull Application for Competing Failure Modes

We work with our clients to analyze and characterize product reliability through the application of life data analysis. Our engineers also have field failure and reliability data analysis experience that enables them to apply field data

to requirements for reliability improvement on new products.

DELIVERABLE: Failure distribution, mean life, reliability estimates and graphical illustration [See figure 1].

❖ RELIABILITY TESTING

Testing is necessary to ensure performance adequacy, avoid unnecessary expenses, and aid in design reliability of the product. The process can be defined as a method of determining performance by exercising or operating a system or item using instrumentation or special test equipment that is an integral part of the item being tested.

Our consultants apply various test approaches to validate design and provide assurance that reliability requirements and goals are achievable. We work with our clients to help administer, evaluate and analyze test results for applications such as:

- ◆ High Accelerated Life Testing
- ◆ Accelerated Life Testing [ALT]
- ◆ Functional Performance Testing
- ◆ Reliability Growth Testing
- ◆ HASS
- ◆ Environmental Testing

For high reliability products it is common to apply accelerated life testing strategy for evaluating reliability. Our consultants help our clients select appropriate stress levels that will yield the

correct linear relationship and meaningful results. We also model the data required to develop the life relationship as shown in figure 2.

Typical models applied for ALT includes: **Arrhenius Acceleration model, Inverse Power Law, Miner's rule, Coffin-Manson, Eyring, degradation models, Pecks, and Thermo-mechanical Stress.**

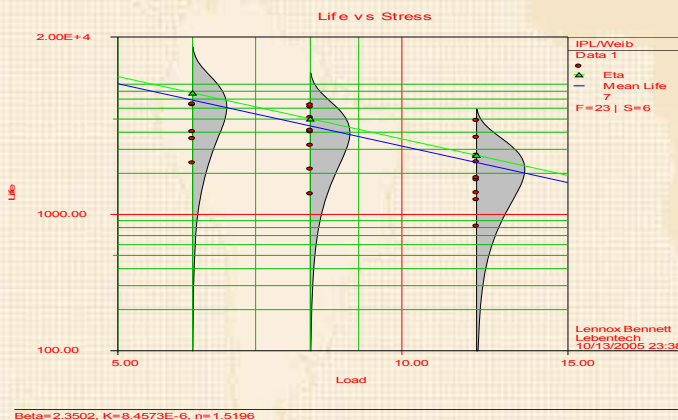


Figure 2: – Life vs. Stress Application of Power Law Model

For our clients interested in HALT we recommend the appropriate stress that will stimulate and precipitate specific failure mode. We also help with the development of the appropriate test profile for the applicable stress.

We are experienced with planning and execution of accelerated life testing including HALT and ALT and similar test methods employing temperature, humidity, vibration, and power variation and cycling stresses on electronics, electrical, or electro-mechanical products to discover and correct weaknesses.

We are also knowledgeable in ESS, HASS and HASA, and related production screening methods

for eliminating latent manufacturing and part defects from production units.

A typical profile for temperature and vibration is provided for illustration in figure 3.

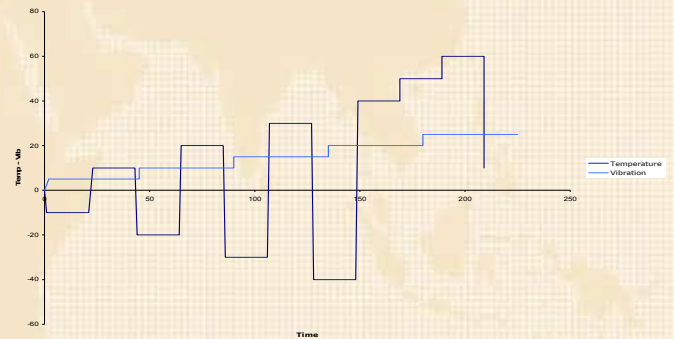


Figure 3: – Graphical representation of Temp-Vibration Stress Profile

Contact us

- ❖ To raise reliability effort to world class product testing standard

DELIVERABLE:

Detail test reports - engineering analysis, executive summary that explains method of data analysis, the significance of the results, and recommendations for product improvements.

❖ REPORT AND PRESENTATION

Report contents are dependent upon task undertaken, but are typically expressed in an executive summary format that explains:

- ♦ Overview
- ♦ The reliability analysis process
- ♦ Data analysis
- ♦ Key performance indicators
- ♦ Recommendations of opportunities for product or process improvements

❖ RELIABILITY GROWTH TESTING

Reliability growth testing is a series of test conducted to disclose deficiencies and to verify that corrective actions will prevent recurrence in the operational inventory. Reliability growth modeling is typically applied to predict future failures and track reliability improvements of products. We help our client's in the application of the technique at different stages of the product life cycle.

For our customers who desire information on the product reliability and improvement, or if the product will meet reliability requirements, we help them develop and analyze reliability growth models.

Our experience consultants designed reliability growth test and select from an array of models such as *Duane, Gompertz, Power Law, Lloyd Lipow, Crow AMSAA, and Crow Extend for application*. We analyzed the data to provide information and practical innovative solutions.

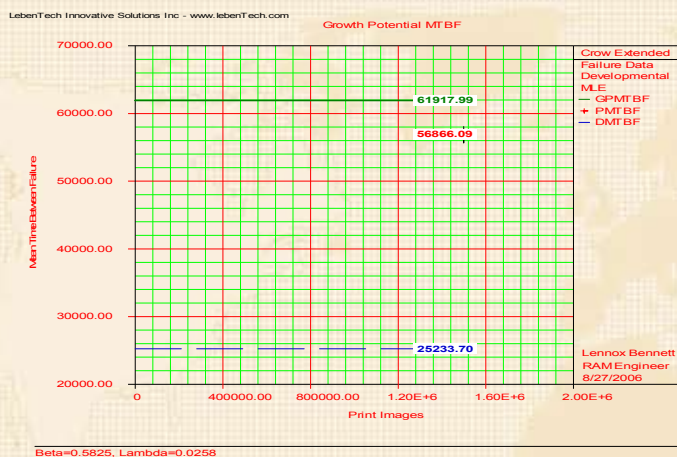


Figure 4: – Growth Potential MTBF Plot for Electro-mechanical System

The graphical illustration in figure 4 represents our application of the Crow Extended Model for reliability growth projection. This case study is the output of reliability growth testing conducted on a complex electro-mechanical system.

For products that are in service our consultants also utilizes reliability growth application for analyzing failures of repairable systems. An example of the power law model application used for this purpose is illustrated figure 5.

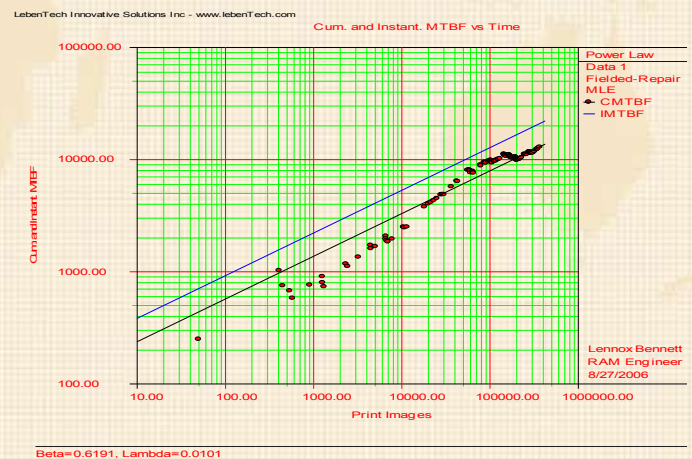


Figure 5: – Power law Application for Repairable System

We work with our customers to identify the appropriate growth testing strategy as well as help them develop a unique reliability growth program for their products.

DELIVERABLE:

Detail test reports inclusive of engineering analysis as well as reliability projections.

❖ TEST PLAN DESIGN DEVELOPMENT

We help client's develop and select the appropriate test plans based on the specific design requirements to be later verified or validated. We also help clients plan, conduct and analyze customized reliability test. We recommended test plan based on one or more of the following:

- ◆ Prior knowledge of product
- ◆ Sample Size
- ◆ Success – Failure Testing
- ◆ Failure mode to be evaluated
- ◆ Time and cost allocation
- ◆ Phase of product development
- ◆ If intent is to simulate or stimulate failure

We recommend the appropriate test strategy to be developed for performing measurements on specific item or program. Strategy recommended will serve as a means to verify the achievement of the product goals and determine short comings that required corrective actions and opportunities for improvements.

DELIVERABLE:

Detailed uniquely structured reliability test plan.

❖ RELIABILITY PROGRAM DEVELOPMENT

More and more customers in today's market-place demand product reliability. To meet this demand product design now requires a more

focus reliability process that will validate the design for reliability and robustness. We help management prioritize resources to meet schedule, performance, cost and reliability objectives.

The objective of a reliability program is to establish exceptional level of reliability and technical capability and managerial excellence that will be embraced and accepted by company's customers. This program is documented in a technical reference that provides a standardized source of information for promoting general reliability techniques, application and operational requirements on all new products / program.

LEBENTECH develops unique reliability program to achieve the purpose of validating the design for reliability and robustness. Whether a supplier or customer we customize the program to suit your products reliability requirements.

Provide the requirement we will do the work. Our consultants utilize MIL-HDBK-785 as a basis reference for program development.

DELIVERABLE:

Structured detail standard program document outlining reliability plans and task for different phase of the development cycle. Our clients use this document in planning requirements for reliability procurements, in-house hardware development efforts and for existing products or programs.

❖ RELIABILITY PREDICTION

Reliability prediction is a process of quantitatively assessing an equipment design relative to its specified reliability. Reliability prediction serve as a means to provide forecast of the reliability of a system or system element, postulated on analysis, past experience, and tests. Reliability prediction and modeling serves to help design integrity, identify and quantify sources of undesired failure frequency and document the reliability risk.

We help our clients understand how reliability modeling and prediction is a beneficial and productive task. We also help our clients to understand how they can use reliability modeling and prediction results to provide design guidance and for maintenance planning analysis, safety and hazard analysis.

Several approaches are available for performing reliability prediction. Figure 6 is a representation of the mechanical stress - strength interference method applied by our consultant to obtain a point estimate of the reliability for mechanical components.

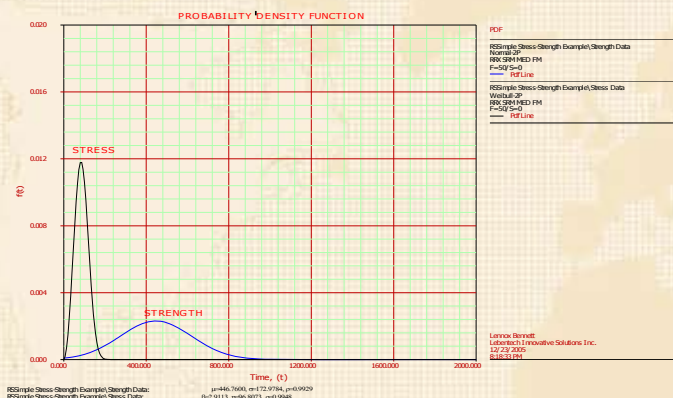


Figure 6: – Graphical Representation of Stress vs. Strength

LEBENTECH engineers assess reliability from observed field data under actual field test or simulation conditions. Our consultants also utilize prediction techniques to determine the feasibility of meeting the design goals. Prediction techniques applied are inclusive of:

- ♦ Failure Data Analysis
- ♦ Parts Count Prediction
- ♦ Empirical Models
- ♦ Mechanical Stress / Strength
- ♦ Cumulative Hazard Function
- ♦ Parts Stress Analysis

We perform analysis of reliability requirements and goals, construct models, analyze product design for reliability and performance. Applicable standards for prediction includes: MIL-HDBK-217 for electronics parts, NRPD and NSWC-92 for mechanical components.

Typically we apply reliability prediction during development to help our clients determine the feasibility of their products meeting reliability requirements or goal, estimate the failure rates that support design trade off evaluation, estimate the failure rate for a failure mode and effect analysis [FMEA], estimate failure rates for calculating failure rate dependent characteristics such as maintainability, supporting a customer requested evaluation, and estimating the expected rate of failures for the associated life cycle cost.

DELIVERABLE:

Report of upfront predicted reliability or probability of success of the part or system.

❖ WARRANTY ANALYSIS

Warranty analysis refers to process of analyzing warranty and return data for the purpose of determining the reliability characteristics of the product. **Warranty cost is a million dollar headache for numerous companies.** Warranty repairs can significantly reduce the profit for a given product. Therefore being able to adequately predict the warranty exposure is crucial to our clients and their product success.

The **LEBENTECH** team of devoted engineers collects required data, perform Weibull statistical analysis and provide our clients with forecast warranty calculation metrics. We work with our clients to **proactively** measure, monitor and exceed warranty performance objectives. We also help convert the existing data to information that would allow timely and proactive report. **We provide comprehensive warranty data analysis at your desk.**

Our consultants bring to the table in-depth analysis and other capabilities that your company needs. We perform life data analysis with your warranty data. We also provide prediction of future failures through the use of conditional probability analysis. In addition we develop empirical reliability estimates of the warranty data.

LEBENTECH provide warranty data analysis that will help our clients significantly reduce the cost of warranty claim and ultimately help the company to build product value and client customer loyalty. We not only help integrate or

model data, but also evaluate and make recommendations of solutions for improvements.

If your needs includes specific details regarding warranty cost, warranty length and warranty reserve fund. **We determine the optimal warranty length such that the total cost over the product life cycle is minimized.**

We apply warranty models to determine the optimal warranty reserve fund for non-repairable and repairable products, warranty cost for product under certain warranty policy and optimal replacement for item under warranty. **We also provide analysis of warranty claim data to enable our clients to assess product performance that may possible lead to product improvement.**

DELIVERABLE:

Reports of estimates and analysis of warranty performance, forecast of future failures and emerging issues and failure modes, recommendations of optimal warranty length and estimate of warranty cost per unit.

❖ FAULT TREE ANALYSIS [FTA]

Fault tree analysis is a symbolic analytical logic technique applied when analyzing system reliability, safety and related characteristics. This is a deductive system reliability tool, which provides both qualitative and quantitative measures of probability density function [pdf] the probability of failure. It estimates the probability

that a top level event will occur, systematically identifies all possible causes leading top event, and documents the analytic process to provide a baseline for future studies of alternative designs.

We apply this technique systematically to predict the probability of occurrence of a top fault event. We work with our clients to apply FTA to identify and evaluate critical components, fault path and possible human errors.

Typically our engineers base their analyses on the results of FMEA. Our consultants not only perform FTA on your product, but also train your staff in the application.

Upon completion of a FTA project we demonstrate how our clients can use the application for identifying critical areas and for cost effective improvements as well as for the provision of input to test, maintenance, and operational policies and procedures.

We also help our clients to understand the functional relationship of system failures. In addition we explain how the results can be used to ensure jurisdictional requirements are met as well as to help understands the level of protection that the design concept provides against failures, and confirm the ability of the system to meet its imposed safety requirements.

DELIVERABLE:

Logic diagram complemented by probabilistic estimate of the risk associated with the fault.

❖ **MAINTAINABILITY ENGINEERING**

Maintainability can be defined as the ability to retain or restore a system function within a specified period of time, when provided an identified level of tools, training, and procedures.

Given the fact that more efforts are directed at higher product availability, increased safety, better product quality, environmental safety, longer product life and greater cost effectiveness, it is essential that maintainability be engineered during design definition and development phase of the life cycle to reduce cost of maintenance.

LEBENTECH consultants measure the ability of an item or system to be retained or restored to a specified condition through maintainability. We provide analysis of customer needs and requirements and help determine maintainability and availability requirements for system or components. **If required we also provide supportability analysis and provisioning guidance for product maintainability.**

For maintainability analysis we develop various metrics for use as baseline measures [benchmarking, test or field data, industry manual]. We perform maintainability prediction, assessment and evaluation based on MIL-HDBK-470, MIL-HDBK - 471A and MIL-HDBK-472 guidelines. We validate maintainability through testing [Functional, Performance, Verification, Demonstration and Evaluation] and the following analysis:

- ◆ Equipment Downtime Analysis
- ◆ FMEA
- ◆ Maintainability Design Evaluation
- ◆ Human Factor Analysis

Through maintainability analysis we help our clients evaluate the design performance with respect to both qualitative and quantitative requirements, develop the most appropriate ways and means to reduce the need for maintenance, generate maintainability related data for application in maintenance planning and in conducting support analysis, and quantifying maintainability requirements at the design level.

To help our clients validate their design for maintainability we work with their staff to develop and execute maintainability demonstration test plans.

In addition we help establish maintainability models for our clients to use as the basis for the allocation and prediction process.

DELIVERABLE:

Maintainability estimates, mean and maximum time to repair, input to spare requirements, maintainability models and block diagram, input to level of repair analysis, input to maintenance and personnel requirements and mean time between schedule and preventive maintenance.

❖ **MAINTAINABILITY PREDICTION ANALYSIS**

Maintainability prediction is a technique applied to determine an estimate of the number of hours a system or component will be unavailable while undergoing repair. We apply the technique to enable us to identify areas of poor maintainability that will potentially lead to reduced availability.

LEBENTECH maintainability prediction, assessment and evaluation is based on the acceptable standard for maintainability prediction MIL-HDBK-472 guidelines, procedures 2, 5A and 5B. During the analysis we will analyze your product for ease of maintenance.

We demonstrate how you can apply maintainability prediction to facilitate the analysis of the repair metrics of your product. We offer a systematic and structured approach to defining properties of repair. Through maintainability prediction we help our clients to define respective repair tasks.

DELIVERABLE:

An array of maintenance and maintainability parameters such as:

- ◆ Mean Time to Repair [MTTR]
- ◆ Mean Corrective Maintenance Time
- ◆ Mean Preventive Maintenance Time
- ◆ Maximum Corrective Maintenance Time

We recommend the appropriate maintenance procedure that maximizes system effectiveness. A sample representation of components of maintenance task used for calculating the mean time to repair parameter is illustrated in Table 1.

MAINTAINABILITY PREDICTION ANALYSIS FOR HYDRAULIC MANIFOLD


 LEBENTECH			MAINTENANCE SUBTASK TIMES, HR							Failure rate * q * MTTR
Failure Mode	Failure rate [λ]	Number q_i	Access	Diagnosis	Replacement	Repair	Alignment	Verification	MTTR _i	
1	3.95E-05	1	0.50	1.40	0.35	2.15	0.00	1.30	5.70	2.252E-04
2	2.45E-07	1	0.25	0.60	0.20	1.43	0.10	1.00	3.58	8.771E-07
3	3.87E-07	1	0.20	1.00	0.20	0.30	0.05	0.05	1.80	6.966E-07
4	5.77E-07	1	0.40	0.30	0.30	1.05	0.10	0.10	2.25	1.298E-06
Sub-total	4.0709E-05									2.2811E-04
				1.6284E-04 = $q_i \times \text{failure rate} = 4 [4.0709E-05]$				MTTR = 2.281E-04 / 1.628E-04		1.4011

Table 1: – Determination of MTTR

For this illustration the hydraulic manifold is used to control the elevation of an actuator cylinder. The manifold will be unable to perform its intended function if the following failure modes are observed during testing or while in use:

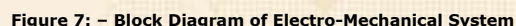
1. Valve stuck active [Servo Valve]
2. Valve fail to close on demand [Solenoid Valve]
3. Complete loss of signal [Pressure Transducer]
4. Internal leakage [Check Valve]

Individual subtask times were obtained through time studies previously performed for similar manifold. Our consultant applies the relevant data from FMECA and time study to aid in the performance of the maintainability analysis shown in Table 1.

INNOVATIVE APPROACHES TO RELIABILITY AND MANUFACTURING SOLUTIONS

Failure modes and effect analysis [FMEA] is procedure that identifies and documents all possible failure modes, effects, causes and associated corrective actions.

We also work with our clients to analyze manufacturing, assembly and transitional processes while developing PFMEA documents. For DFMEA our process begins with a functional block diagram.



LEBENTECH		PROCESS CONTROL PLAN						EVALUATION & measurement technique		SIZE	(REQ. MEAS. V. PRO. BATH)	Control Method
Operation Description	Tools	NUMB. OF	Characteristics of Products	Characteristics of Process	CLASS	Spec/Process/Production/Tolerance						
Assemble thermostat and TCO to heater	1. Spot Welding Machine 2. Temperature measuring device	1, 2, 3	1. Product functionality	1. Temperature 2. Location of joining 3. -In-process heating (Impress) 3. -Operator	MAJOR	1. Welding temperature = 80 °C 2. - Circuit must catch capacitor heat	1. Measurement of temperature emitting from machine 2. Measurement of heater insulation resistance 3. Measurement of current flow	20 30 50	Per Hr Per Batch	1. Temperature evaluation 2. Sample sent to lab for AQL 3. Insulation resistance test 4. Continuity Test		
Material data Sheet (MDS) from supplier		4	1. Product range 2. Effective date 3. Component	1. Order part number 2. Designation (CA3401) 3. Manufacture ?			1. Visual verification (VSSS)	200	Per Batch	1. Incoming material inspection (Per AQL) 2. Work instruction 3. Line supervisor approves 4. Random check by operator		
Temperature / Heat sensing device		5	1. Machine Integrity	1. Machine 2. Operator 3. Effectiveness in handling 4. Pre-heating 5. Soldering	CRITICAL	MACHINE SETTING 1. Temp = 80 °C 2. Temperature = 80 °C	1. Temperature Capability 2. Temperature measurement	5	Per Hr	1. Monitoring of temperature measurement 2. Time 3. Training 4. Periodic inspection of machine condition		

BY: LENNOX BENNETT

Figure 8: – Control Plan for Coffee Maker Manufacturing Process

Design verification plan or process control plan, an FMEA summary, FMEA worksheet document identifying critical potential failure mode for priority control, investigation and tentative resolution.

ENGINEERING EXCELLENCE THROUGH RESEARCH

❖ APPLICATION OF PRODUCT DESIGN FAILURE MODE AND EFFECT ANALYSIS

Table 2 is a partial representation of an application of an FMEA focused on **design** of dishwashing machine.

Typically the process of developing this worksheet involve the following task: organizing cross functional team, segmenting product, developing functional diagram, brainstorm exercise to identify potential failure modes and their consequences as well as current design controls.

We follow up with a review meeting to estimate risk, provide details of control methods, recommend actions and outline mitigated risk.

DFMEA – DISHWASHING MACHINE


 LEBENTECH		Potential Effects Of Failure					Current Design Control									
Product Function	Potential Failure Mode	Local	End	S E V	Potential cause of failure	O C C	Prevention	Detection	D E T	R P N	Action	S E V	O C C	D E T	R P N	
Adequately clean dishes [Clean spec < 90]	Correct amount of water does not reach load during wash cycle	Nozzle clogs	Consumer calls	5	Incorrect nozzle design	6	1 – Prototype 2 – Wash pressure vs. gap analysis	1 – Dish washing test 2 – Home Test	4	1 2 0	Development of test pattern for loading flexibility	5	1	1	5	
		Wash arm does not spin	Poor wash performance	6	Inadequately design wash clearance	7	1 – Design Review 2 – Prototype	1 – Home Test 2 – Soil Testing	4	1 6 8	DOE	6	3	2	36	
		Surging	Poor wash performance	7	Inadequate design detergent dispenser	2	Tolerance analysis of dispenser	1 – Home Test	4	5 6	Test for detergent cup wash out	7	1	2	14	
	Wrong wash cycle chosen by control system	Poor wash performance	Service call	4	Improperly placed turbidity sensor	3	Design Review	1 – Cycle development testing	5	6 0	Cycle development testing using DOE	4	1	2	8	
Provide adequate temperature for heating water and drying dishes	Temperature insufficient to adequately heat dishes	Heat not adequate for effective drying	Poor dry performance resulting from insufficient heat	4	Inadequate heater capacity	4	1 – Prototype 2 – Design Review	1 - Heater characterization test	8	1 2 8	Weibull performance analysis of different heater	4	1	1	4	
	Water temperature does not reach correct level	Poor wash performance	Consumer calls	4	Inadequate heater capacity	4	Design Review	1 – Bench test 2 – Soil Test	8	1 2 8	Test to correlate loading flexibility	4	2	2	16	

Table 2: – Typical Output of FMEA Application

Services with Commitment

❖ FMECA RELIABILITY APPLICATIONS

Failure Modes Effects and Criticality Analysis [FMECA] is a design tool applied when analyzing engineering systems. It is typically described as an approach used when performing analysis of each potential failure mode in the system and applied to examine the results of criticality of effects of such failure modes on the system. We perform FMECA per MIL-STD-1629A guideline as indicated in table 3.

We interact with our client's staff involved with the product to apply and perform FMECA technique during design reviews to detect design flaws, especially with respect to device safety, reliability and performance. We illustrate to our clients how they can apply the technique to identify maintenance important items. In addition we help them to apply FMECA as an integral part of engineering design as well as establish the application in various aspects of reliability engineering activity that also supports fault tolerant designs, safety, logistic support, and related functions. We also train our client's staff in performing FMECA for their products. **Typically we use the technique in the industry to conduct analysis of systems of any complexity.**

DELIVERABLE:

Design verification plan, FMECA summary, FMECA worksheet document identifying critical potential failure mode for priority control, investigation and tentative resolution.



LEBENTECH

FMECA - HYDRAULIC CONTROL MANIFOLD

Name	Calculated Failure Rate	Description	Failure Mode	Cause	Local Effect	End Effect	Severity ID	Apportionment	Beta	Failure Rate	Op Time	Mode Criticality	Remarks
Housing	1.1e-6	Accommodate fluid and locate and position components that constitute the system	Fracture	Excessive case pressure	Leakage	Loss of manifold function	II	70	1	7.7e-7	1	0.023	
Bleed Valve	5.7e-6	Allows for quick easy manual bleed off of system pressure	External leakage	1 - Incorrect Installation 2 - Seal failure	Erratic operation of pressure transducer	Degradation in pressure indication capability	IV	100	1	5.7e-6	1	0.171	
Servo Valve	1.002e-5	Implement servo control	Fail to operate	1 - Electrical part failure 2 - Contamination 3 - Nozzle clog due to problem with filtration system	Loss of function	Unable to manipulate cylinder	I	70	1	7.012e-6	1	0.21	
Temperature Sensor	1.694e-6	Monitor and control system operating temperature	Open circuit	1 - Internal component damage 2 - Connection separated	Loss of signal	Temperature measurement capability impaired	I	50	1	8.472e-7	1	0.025	
Pressure Transducer	2.758e-6	Converts input energy into output energy	Degradation of operation	Drop in output voltage	Reduction in output efficiency and accuracy	Signal error or inaccurate measurement	II	10	0.4	2.758e-7	1	0.013	
Hydraulic Check Valve	3.068e-6	Stops flow from returning	Leakage	1 - Fluid contamination 2 - Ball is not centered properly on seating place 3 - Damage of spring	Accumulator will not compensate enough leakage in system during passive mode operation	Degraded performance	II	100	1	3.068e-6	1	0.092	
Hydraulic Solenoid Valve	2.625e-6	Opens path when activated	Failure to shift when energised	1 - Bad contact 2 - Burning of coil	Loss of function	Functional capability of servo impaired	I	25	1	6.562e-7	1	0.079	
Hydraulic Relief Valve	1.742e-6	Relieves over-pressure buildup	Sticking valve piston in main valve body	1 - Contaminants Loss of lubrication 2 - Air entrapment 3 - Excessively high temperatures 4 - Structural interference	1 - Low / erratic pressure drop 2 - Slow operating response 3 - Valve immobile	1 - Erratic operation of cylinder 2 - Loss of pressure control	II:::III	5	0.6	8.71e-8	1	0.002	
Accumulator Hydraulic	3.618e-6	Stores energy	Loss of pressure	1 - Ruptured gas bag 2 - External leakage	1 - Poor system response 2 - External component damage	Severe degradation of system performance	II	15	0.8	5.427e-7	1	0.013	

Table 3: – Typical Output of FMECA Application

LEBENTECH™ – PROACTIVE INNOVATIVE SOLUTIONS FOR SUCCESS AND COMPETITIVE ADVANTAGES

❖ RELIABILITY CENTERED MAINTENANCE (RCM)

For a number of companies, maintenance represents a very significant function within the production system. The increase in automation and the complexity of the control systems involved made the reliability of equipment more important. Maintenance is performed to eliminate system failure traps and hazards in order to ensure that equipment continues to work within design tolerance and specifications [Cooney 2001]. **Reliability centered maintenance** is a method used to determine the optimum maintenance requirements of a physical asset in its operating context.

For companies with requirements to develop systems which prevent failures and reduce the effects of system breakdown, we construct a maintenance model around process control and monitoring systems supported by both enabling technologies as well as methodologies. **We undertake special maintenance case studies that require the application of special methodology to assist in the solving of maintenance problems for your production system.**

To satisfy reliability needs we recommend Computerized Maintenance Management System [CMMS] that provide for the collection of data. In our view of maintenance analysis, operational reliability is created from four perspectives: reliability of equipment, human reliability, reliability of process and maintainability of process. **We help your staff capture data to facilitate reliability study and analysis.** We also identify maintenance and operational deficiencies of current system.

We demonstrate how the RCM method can be used to develop entirely new maintenance regimes or to improve existing regimes where productivity improvements are desired. Our approach includes overall equipment effectiveness [OEE]. The overall performance of a single piece of equipment or even an entire factory is governed by the cumulative impact of the three OEE [Availability, performance rate and Quality rate].

DELIVERABLE: Appropriate maintenance model and proactive maintenance strategies are recommended.

DELIVERING INNOVATIVE SOLUTIONS GLOBALLY

❖ DESIGN OF EXPERIMENTS [DOE]

Experiment can be defined as a test or series of test in which purposeful changes are made to the input variables of a process or system so that we may observe and identify the reasons for changes in the output response.

In engineering experimentation plays an important role in new product design, manufacturing process development, and process improvement.

Our consultants apply DOE as an evaluation technique in making a more robust design, as a means to optimize product and manufacturing process parameters.

Selectively we work with the following experimental methods:

- ◆ Response Surface Methods [RSM]
- ◆ Evolutionary Operation [EVOP]
- ◆ Taguchi's Method
- ◆ Factorial Designs

Table 4 represents the outcome of a series of experiment performed by one of our consultants. The process studied is a surface mount technology [SMT] stencil printing solder operation.

The study focuses on identification of the critical input parameters that affects the height, volume and area coverage of solder deposited on a pad.

RSM FOR OPTIMIZATION

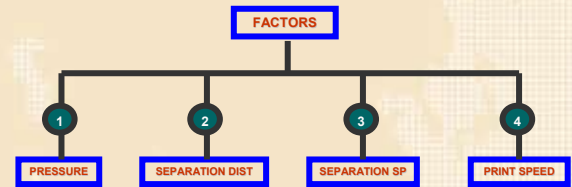


Figure 9: – Experiment Design Factors and Levels

We not only perform experiment for our clients, but also help them with the planning of experiment, and selection of experimental design appropriate for their needs.

Through DOE we investigate and isolate factors that cause variation from the mean. We also perform DOE analysis to support test planning and data analysis.

DESIRABILITY OF PREDICTED SETTINGS

PREDICTED OPTIMUM SETTINGS				PREDICTED RESULTS			DESIRABILITY
PRINT SPEED	PRESSURE	SEEPER SPEED	SEPER DISTANCE	8 MIL X 50 MIL	12 MIL X 50 MIL	16 MIL X 50 MIL	
20	6.4	2	1	5.021	5.093	5.32	86%
20	8	2	1	5.029	5.057	5.24	90%
21	6.4	1.8	1.1	5.014	5.08	5.31	86%
CURRENT SETTINGS							
20	7	2	3	5.186	5.228	5.435	72%

Table 4: – Results from an RSM Experiment

DELIVERABLE:

Include statistical analysis of data from experiment, prediction of process behavior through the use of empirical models, identification of critical input parameters and optimal setting for parameters.

❖ **PRODUCT IMPROVEMENTS**

Our engineers utilize an iterative process to improve product design. We select from an array of improvement technique to provide practical innovative solutions for your engineering problems and constraints. Techniques include but are not limited to the following:

- ◆ Taguchi's Loss Function
- ◆ Linear programming
- ◆ Design of Experiments
- ◆ New Technology Application

We have implemented employee training, quality controls, production planning, process capability studies, and statistical methods as part of our improvement projects. In addition we utilized special quantitative methods such as linear programming and queuing analysis to optimized workforce utilization.

❖ **PROCESS AND PRODUCT VALIDATION**

Validation is a technique for establishing documented evidence which provides a high degree of assurance that a specific process will consistently produce a product meeting its predetermined specifications and quality attributes.

Through validation we characterize your manufacturing process with the intent to identify and establish critical parameters for control and monitoring and ultimately optimize these parameters.

Typically for assignments involving validation we target efforts to companies where superior process capability is required. We validate process and equipment to determine and establish confidence that the process is effective and reproducible and assure that the process equipment as well as ancillary systems is capable of consistently operating within established limits and tolerance.

For our clients in the pharmaceutical and medical device industry we perform process validation to meet requirements of Current Good Manufacturing Practices [CGMP] for finished pharmaceutical, 21 CFR Part 210 and 211, and for Good Manufacturing Practice Regulation for Medical Devices, 21 CFR Part 820. We develop validation protocol and perform the following:

▶ Prospective Validation

1. IQ – Installation Qualification for Equipment
2. PQ – Performance Qualification for Process
3. Performance Qualification for Product

▶ Retrospective Process Validation

▶ Test Method Validation

DELIVERABLE:

Final validation report providing indication of compliance to respective FDA standard or ISO 9001 requirements and documentation of the system validated.

❖ ENGINEERING PRODUCTIVITY EVALUATION

This can be defined as the ratio of output to sum of all input factor. It is concerned with the efficient utilization of resources [inputs] in producing goods and services [output]. Knowing what productivity level your company ought to be operating is extremely important for business success. Several approaches are available for measuring productivity. Our consultants evaluate productivity from an engineering perspective.

We select the appropriate technique that is unique for our client's application, but typically we develop a total productivity model [TPM]. This model considers the impact of all input factors on the output in a tangible sense. Other approaches employed to determine productivity includes:

- ♦ Index Approach
- ♦ Utility [Measuring manufacturing productivity]
- ♦ Servo system approach [models workers productivity]

We perform evaluation of clients operation to determine its productivity. We apply unique methodology to evaluate productivity both within a given time period and between successive time periods.

We are ready to be of service if your needs includes assessment of efficiency of conversion of resources, facility resource planning, comparison of productivity level between departments and, establishing future target productivity levels.

DELIVERABLE:

Recommendations of the appropriate improvement technique for implementation, identification of specific inputs or resources whose utilization must be improved, indices of total productivity, productivity of each operational unit, analysis of trend in partial productivity, partial productivity with respect to human, material, energy and other input factors.

❖ MANUFACTURING SYSTEM MODELING & ANALYSIS

A model of a real system is a representation of that system in another medium. Our engineers utilize analytical and experimental models and model approaches that address a wide variety of manufacturing system design and operation issues.

We develop mathematical models that test whether a manufacturing system will achieve the operational goals set by our clients and will perform as designed by our client's engineers.

Models developed are verified and validated to assure that the data used in the project are appropriate, accurate, sufficient, and correctly transformed if necessary. The models developed are used to provide an analysis of the manufacturing system [FMS, Cellular].

Models developed span a spectrum of manufacturing systems such as: discrete, process, fabrication and assembly. Each model developed is developed for a specific facility type

configuration [product, process, group technology]. Models developed will be unique based on our client purpose for the model. We typically build models that serve the following purposes:

- ♦ Optimization – finding the best values for decision variables
- ♦ Performance prediction
- ♦ Control
- ♦ Insight – providing better insight of the system

Modeling approaches employed for manufacturing system include: Analytical Queuing models [Poisson Arrivals, Exponential, Finite population] and empirical Simulation process model for serial lines or flexible manufacturing system [FMS].

DELIVERABLE: Summary of system performance.

❖ **PROCESS DEVELOPMENT**

Process development is concerned with adequately designing and providing a means of controlling the process to assure consistent process performance. **We help establish process user's requirements, and measurable process specifications through a systematic process development methodology.**

Our consultants utilize a structured approach that is unique for each process development

application. Our process development strategy incorporates means that establish:

- ♦ Process Design
- ♦ Process Control
- ♦ Process Control Methods
- ♦ Test Method and Acceptance Criteria

We help our clients define process requirement, and process end points for new products as well as determine how end points will be measured. We also recommend a processing method that will achieve the processing end point.

We also establish process controls that will assure, on an un-going basis that the process continues to create or support the product characteristics it was design to fulfill. Our consultants also propose facility characteristics such as work station design, material handling and flow, floor layout, manufacturing equipment reliability and capability. In addition we also recommend the appropriate manufacturing or assembly methods.

DELIVERABLE:

Include but are not limited to the following: verification that process can be controlled within proposed limits and achieved acceptable processing outcomes, recommendations of process control limits, recommendations of methods to assess effectiveness of process controls and recommendation of appropriate process controls.

❖ MANUFACTURING COST ESTIMATES

As technology has advanced, the problem of cost estimation, cost control, and cost analysis assumed significant dominance in engineering decisions. Consequently accurate cost engineering is essential to the success of any manufacturing project.

Cost estimating in product manufacturing can be defined as the determination of the factory cost for a component, sub assembly, or final assembly based on defined manufacturing process plan. Our consultants apply structured approaches to provide complete, detail cost estimation and analysis of cost associated with specific aspect of manufacturing based on quantity produced and product quality level.

Cost estimates provided are based on the use of engineering performance standard [time study, method time measurements] and will aid our clients the following respect:

- ◆ Make or buy decisions
- ◆ Check quotations from supplier [contribute to cost reduction]
- ◆ Establish a bid price for customer quotation
- ◆ Evaluate product design alternatives
- ◆ Provide standards for production efficiency
- ◆ Control of manufacturing cost

Cost methods applied will depend upon the category production costing required [tooling, material, shop order]

DELIVERABLE: Summary of cost estimate.

❖ ENGINEERING ECONOMIC ANALYSIS

This is a specialized examination of the more general decision making process. This application deals with concepts and techniques of analysis useful in evaluating the worth of a systems, products, and services in relation to their cost.

We utilize the concept of engineering decision making for obtaining realistic comparison between alternatives while resolving economic consequences of the problem. We apply the principle of engineering economy to the following:

- ◆ Evaluation of engineering proposals
- ◆ Finding the economic life of an asset
- ◆ Evaluating equipment replacement alternatives
- ◆ Economic operation of equipment
- ◆ Establish break-even and minimum cost points
- ◆ Determine rate of return on investment

If your company is seeking solutions for problems that have economic aspects, that are sufficiently important to be a significant component of the analysis leading to a decision, **we are available to provide our service**. In providing solution we typically construct a model to predict the outcome of each of the feasible alternatives.

When you provide us with a description of a recognized problem, our consultants will work with your team to define goals or objectives, assemble relevant data, and in the identification of feasible alternatives.

DELIVERABLE:

Prediction of the outcome of each alternative, recommendations of the choice of the best alternatives to achieve the objectives, and summary of the engineering analysis are representative deliverables.

❖ **QUALITY ENGINEERING APPLICATION**

Quality plays an important part in ensuring that requirements are realized. It is universally recognized that quality is fundamental in achieving long term success. In today's market organization or business requires the service of consultants with state of the art knowledge and experience with quality principles and methods.

LebenTech engineers help clients in a variety of organizations and industries in the development and implementation of quality systems to improve their productivity and competitiveness. We help our clients rise to the challenge of the global quality revolution by developing new techniques for improving the quality of their products and processes.

The clients we serve have enjoyed benefit from higher quality, and productivity as well as reduction in time and cost to develop, produce, and deliver products and service, and improved safety. Typically we help our clients apply statistical methods driven by engineering models to achieve quality improvements.

Our consultants apply a variety of tools and methodologies such as quality function deployment [QFD], statistical process control [SPC], design for assembly [DFA], Taguchi methods, cause and effect diagram to help our client provide substantial improvements in quality, reduction in cost, and increased in productivity. We have the experience and versatility to apply quality tools in various situations as required by our clients.

❖ **RMQ TRAINING**

Training is a planned effort by the organization to facilitate the learning of information, concepts, techniques and skills related to a specific behavior or function. Typically organization train staff to meet the demand and challenge of performing specific functions such as reliability or manufacturing task.

Training provided by **LEBENTECH** is focused on the systematic acquisition of knowledge, skills, and concept that will result in improved performance in specific reliability or manufacturing applications. It also involves a systematic set of procedures and experience that are planned and implemented by our engineers.

Topics are selected to meet the needs of your company, but we offer unique programs that differ in emphasis and quality, but specific to our client's needs. Our training methodology involves diverse techniques in use within organizations, paying particular attention to how diligently they

recognize and incorporate widely recognized principles of learning.

We develop valid custom training programs that will provides our clients staff with valuable foundation of knowledge in each topic specialization. Training is typically offered on customer's site.

❖ MAKE A WINNING CHOICE

Developing reliability, manufacturing or design solutions require more than simply throwing people or technology at a problem. It requires the appropriate talent, and technology, managed by a company that appreciates process development.

As a company LEBENTECH is devoted to helping our clients develop the tools and experience necessary to improve manufacturing and reliability of their products. Our methods and applications have been successfully proven.

LEBENTECH is the premiere consulting choice for companies focused on delivering reliable low cost products to market in the shortest possible time. We recognize that reliability, maintainability and robust design are key priorities for successful business.

We provide global consulting and contract service. **LEBENTECH** helps clients evaluate and manage product reliability requirements and manufacturing capabilities. Our comprehensive strategy will adequately support your design, reliability, maintainability and manufacturing engineering needs.

At **LEBENTECH** talented and highly capable professionals provide innovative solutions for success in various high technology applications. *Through innovation we deliver effective affordable solutions. We provide complete engineering services that help companies realize lateral requirements.*

We evaluate products, parts, or process for cost, efficiency and reliability. We also develop, coordinate, and conduct technical reliability studies, compile and analyze performance and statistical control process as well as develop mathematical models to identify units, batches or process posing excessive failure risk.

If your company has needs for analyzing reliability in design, cost, production and customer satisfaction of company products then **LEBENTECH** is your obvious choice. You are invited to experience the difference in innovative consulting service.





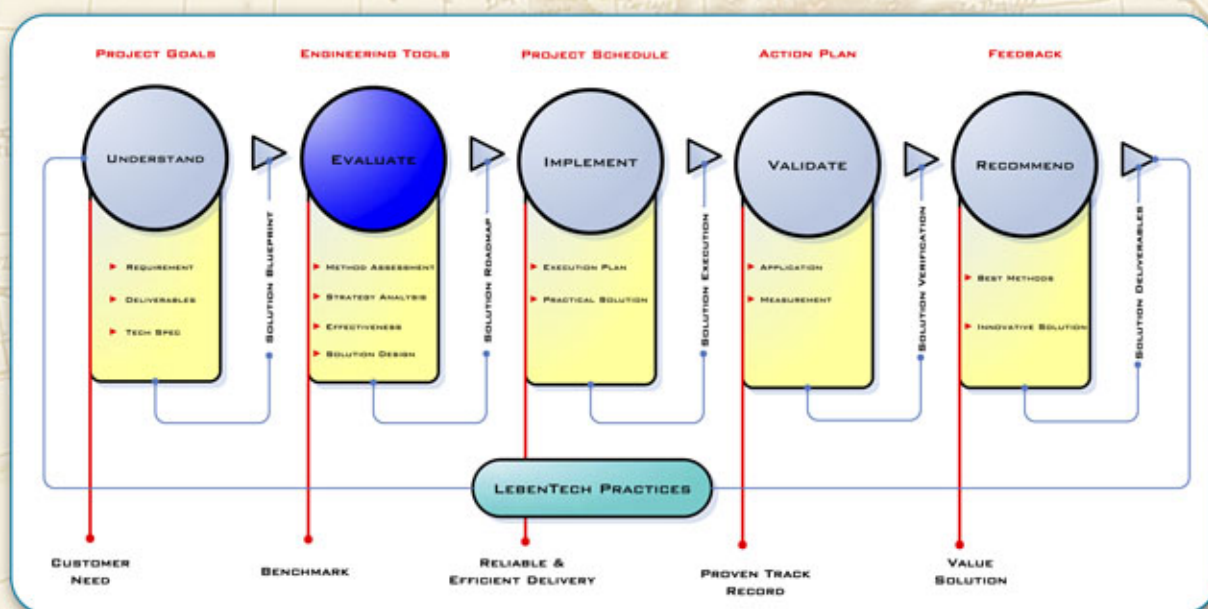
LEBENTECH



We value corporate dedication to development and manufacture of reliable and robust products. We are a consulting company that is exclusively focused on providing a complete range of innovative engineering solutions for all needs in high performance products. We are absolutely committed to our clients and their business success.

ACCESS TO OBJECTIVE EXPERTISE

At LebenTech, helping companies maintain the competitive edge is our business. Our consultants offer deep experience and expertise, including knowledge of industry best practices. We help ensure that your product and process design strategy supports you business and technology needs.



Our consulting methodology reflects our dedication to best practices and overriding goal of helping our clients achieve and maintain competitive advantages. Please do not hesitate to contact us to provide solutions for your engineering problems.

LEBENTECH™ - PROACTIVE INNOVATIVE SOLUTIONS FOR SUCCESS AND COMPETITIVE ADVANTAGES

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