Interpreting the Resulting Score

The scores for the six areas of assessment are indicated below out of a five point system (five is best). It should be stressed that the process of developing reliable products cannot be so structured that a single numerical metric can represent its overall effectiveness. Nevertheless, the rating system presented can be valuable as a gross indicator, capable of identifying areas of weakness.

Areas and Elements Requiring Remedial Action

For areas and elements that are given ratings below average, remedial action is strongly recommended. The initial steps for remedial action should documented in an improvement plan that represents the strategy and commitment to improve. Clues regarding the areas of improvement should be evident from the questions posed that could not be answered affirmatively, and for processes/ procedures that are implemented on an ad hoc basis, or not at all. Other common problems include lack of communication and integration regarding reliability activities. Improvement might include additional training; real-time access by engineers to the organization's data collection, analysis, and corrective action system; refinements in testing; and more thorough root case analyses. For each step, a detailed schedule showing the necessary activities should be developed, responsibility for each activity assigned, and budgets allocated.

AREA 1: DEFINING A RELIABILITY PROGRAM

Ensure that the reliability approach:

- Shows an understanding of the customer's needs, the importance of reliability, and the importance of integrating reliability into the design of the product and the processes used to manufacture the product.
- Describes a sound, cost-effective approach for designing and manufacturing a reliable product.
- Shows how customer-imposed requirements will be met or explain why the requirements are counterproductive and must be adjusted.

If this area is rated below an acceptable level as determined by the organization, then the following recommendations used in conjunction with Appendix A of the Assessment Guide will help in selecting specific improvements.

1. **Customer Expectations.** Develop or strengthen means for fully understanding the customers' reliability expectations and requirements, and those imposed by the marketplace requirements or government or legal requirements. Methods include market surveys, customer surveys, benchmarking, and analysis of feedback from customers (warranty return forms, complaints, etc.).
2. **Management Commitment.** Demonstrate a clear management commitment to developing and manufacturing reliable products and ensure that policies reflect this commitment. Ensure that adequate resources are committed to effectively implement the policies.
3. **Responsibilities and Authority.** Assign well-defined responsibilities and authority for implementing reliability policy and procedures. Ensure that assigned personnel receive periodic training to stay abreast of advances in reliability engineering.
4. **Training and Education.** Provide effective and continuing training in reliability tools, techniques, and approaches for your engineers, managers, and others involved with the design, development, manufacturing, and support of our products.
5. **Reliability as Part of Systems Engineering**. Make the reliability aspects of design and manufacturing an integral part of the system engineering process. Whenever possible, integrate reliability software tools with CAD/CAM.
6. **Need to Tailor for Different Products.** Tailor the reliability program for each product or product type based on cost, technology, criticality of use, and so forth. If tailoring requires exceptions to established policies (e.g., an FMEA will always be performed), require that justification be provided and documented.
7. **Need to Be Proactive.** Take proactive steps to identify potential problems as early as possible, using design reviews, trend analysis, root cause analysis, and other methods. Implement or improve a data collection system that supports the identification of failures, the conduct of root cause analysis, and the development of corrective action. Ensure that the data are accessible in real-time to those who need it.

AREA 2: DEVELOPING RELIABILITY REQUIREMENTS

If this area is rated below an acceptable level as determined by the organization, then the following recommendations used in conjunction with Appendix A of the Assessment Guide will help in selecting specific improvements.

1. **Customer Requirements.** Institute a procedure for ensuring traceability of design requirements for reliability to customer reliability performance needs and expectations. Make maximum use of data from past programs in establishing reliability requirements for new products.
2. **Perspectives of Requirements.** Ensure that you have a thorough understanding how customers measure reliability. Develop methods for addressing failures that may be out of the organization's direct control (i.e., those controlled through design; manufacturing; packaging, handling, and transportation; and other factors that are within the control of the organization).
3. **Allocating Requirements.** Ensure that methods for allocating requirements at the product or system level to successively lower levels of indenture are logical and repeatable. View allocation as an ongoing process rather than a one-time event, and refine the allocations as additional information and insight into the design are obtained.
4. **Reliability Figures of Merit.** Ensure that reliability measures, or figures or merit, are used that are meaningful to the customer and to designers.

AREA 3: DESIGNING FOR RELIABILITY

If this area is rated below an acceptable level as determined by the organization, then the following recommendations used in conjunction with Appendix A of the Assessment Guide will help in selecting specific improvements.

1. **Design the Product and Manufacturing Processes.** Ensure that policy requires that reliability be addressed in designing the product and the processes used to manufacture that product. Ensure that manufacturing personnel are involved during the design phase so that manufacturing considerations are addressed in the design, the need for new or revised processes can be anticipated, and long-lead items can be identified. Ensure that the design of packaging addresses reliability to prevent damage during shipping. If appropriate, use a reliability-centered maintenance approach to developing the maintenance program for the product/system.

2. **Critical Items.** Ensure that all programs identify critical items, quantify the risk of failure of these items, and develop alternatives for mitigating those risks. Make critical items management a special topic for design reviews.

3. **The Operating Environment.** Take steps to ensure that the environment in which our products are used, including packaging, handling, and transportation; storage; installation; operating; and support; is sufficiently understood and accounted for in the design.

4. **Fault Tolerance and Redundancy.** Require that fault tolerance/redundancy be used judiciously and based on analysis of the configuration. Require that redundancy be used whenever other design approaches cannot prevent single-point critical failures (i.e., failures that cause death, serious injury, complete loss of the product or system, or any other failure deemed by the organization to be critical).

5. **Parts Selection and Control.** Implement or strengthen a process for efficiently selecting parts and materials. Implement or strengthen a program for mitigating the effects of obsolescence.

6. **Supplier Control.** Implement or strengthen a system for controlling suppliers to ensure that they are an integral part of efforts to design and manufacture reliable products. When advantageous to the organization, mentor suppliers in reliability methods and tools.

7. **Software Reliability.** Ensure that the organization's reliability strategy requires that software be addressed as an integral part of the product/system. Treat software errors as product/system failures and conduct failure analysis and corrective action as would be done for hardware failures. Determine if CMMI certification would be an added value for the organization.

8. **Human Reliability.** Take steps to ensure analyses and studies are conducted to address human reliability. Ensure that policy requires that human factors engineering be a part of the organization's overall design approach. If data is not currently collected on human errors, determine if collecting such data would improve design or manufacturing, reduce costs, improve safety, or otherwise benefit the organization.

9. **Program Risks.** Develop or strengthen a risk management program. Ensure that the results of reliability analysis be an input to the risk management program. Identify the reliability tools that will be used to provide inputs to the risk management program.

10. **Reliability Tools.** Implement or strengthen a process for identifying the reliability tools applicable to our products.
    - Determine if the tools now being used are useful for identifying design weakness and achieving the reliability requirement. If they are not, determine how these tools can be used more effectively and what other tools would be value-added.
    - Ensure that all programs are collecting data from developmental testing useful for reliability and other analyses.
    - Ensure that data collected from developmental testing is used to identify weaknesses in the design and to improve the design.

AREA 4: ASSESSING RELIABILITY PROGRESS

If this area is rated below an acceptable level as determined by the organization, then the following recommendations used in conjunction with Appendix A of the Assessment Guide will help in selecting specific improvements.

1. Assessment **Methods.** Implement or improve the methods used to assess the progress being made toward the reliability requirement of a product during its design and development. Make assessments a part of design reviews.

2. **Assessment Purposes.** Ensure that the assessment methods allow the determination of whether the reliability goals and requirements will be met, the evaluation of the impact of design decisions on reliability, and the understanding of how the design can fail, causes of these failures, and how to reduce the probability of these failures.

3. **Data Collection.** Evaluate the data are being collected during design and development.
   - Determine if the data is adequate for assessing progress. Conduct studies to determine how the data can be used more effectively.
   - Determine if additional data should be collected.

AREA 5: MEASURING PRODUCT RELIABILITY

If this area is rated below an acceptable level as determined by the organization, then the following recommendations used in conjunction with Appendix A of the Assessment Guide will help in selecting specific improvements.

1. **Reliability Achievement.** Ensure methods are available and being implemented to determine if the reliability goals and requirements have been achieved for the "final" product configuration.

2. **Use of Reliability Data.** Assess the data being used to validate the level of reliability achieved.
   - Evaluate how the data are being used to measure the reliability achieved. Determine how the data could be used more effectively to provide more meaningful measures (e.g., with confidence intervals).
   - Determine if there is other information that should be used in conjunction with the data?

3. **Measurement Methods.** Determine if the measurement methods are reasonably "accurate" and are providing high assurance that the requirements have been met. Implement improvements if they are not.

AREA 6: ENSURING RELIABLE PERFORMANCE

If this area is rated below an acceptable level as determined by the organization, then the following recommendations used in conjunction with Appendix A of the Assessment Guide will help in selecting specific improvements.

1. **Operational Reliability.** Evaluate the steps being taken to ensure that the operational reliability of a product approaches its inherent design reliability and does not degrade over its operational life.

2. **Manufacturing Community Participation.** Determine if the manufacturing community is sufficiently involved in the design of the product, as part of a concurrent engineering approach.
   a. Ensure that tailored process controls (screens, testing, etc.) are designed to be used during the manufacturing phase.
   b. Ensure that the reliability program includes a procedure for identifying and eliminating defects that might be introduced during the manufacture, packaging and handling, and shipping (transportation) of products.

3. **Quality Processes.** Ensure that **g**ood quality and process control procedures are developed and implemented.

4. **Customer Complaints.** Evaluate how customer complaints are handled. Ensure that complaints are used as another source of information for efforts to continually improve our products and processes.

5. **Operational Use Data.** Determine the data now collected from operational use of the product/system.
   a. Evaluate whether the data are sufficient. If not, develop means for collecting additional data.
   b. Evaluate warranties now used to determine if effective use is being made of the data collected through warranty returns. Take steps to improve the use of the data in improving design, eliminating manufacturing errors, reducing damage in shipping and handling, etc.

6. **Root Cause Analysis.** Ensure that failure and root-cause analyses are being conducted of defective/failed returned products.

7. **Maintenance Planning.** If a reliability-centered maintenance approach was used to develop a maintenance program, use field data to refine and update the maintenance program.

8. **Trend Analysis.** Determine if trend analysis of the performance of products/systems is being conducted. If it is not, consider implementing trend analysis as a part of an overall product and process improvement effort.
   - When negative trends are suspected, ensure that appropriate actions are taken as a result. These can include but are not limited to re-characterizing the operating environment, changing design margins, revising operating and maintenance instructions, and so forth.
   - If not now done, consider trending by customer, operating environment, or product type to provide more insight into the causes of field failures, the range in stresses encountered by the product, the need to provide operating or maintenance training to specific customers, and so forth.