Information Exchange For Your Application & Use of Cost Modeling

APPLIED Co$t MODELING

Volume 16. Issue 3

Inside

Spring 2010

ISSN 1094-9739

Hi-Tech Equipment Reliability A Practical Guide for Engineers and the Engineering Manager

By Dr. Vallabh H. Dhudshia
Reprinted by Permission of the Author[1]

High-Tech Equipment Reliability Series

WWK recently received permission to reprint sections from Dr. Vallabh H. Dhudshia's book, *Hi-Tech Equipment Reliability: A Practical Guide for Engineers and Managers*. This book, first published in 1995, is now *back in print:*

http://www.amazon.com/exec/obidos/ASIN/0595458289/wrighwillikelly

Dr. Dhudshia has been an equipment reliability specialist with Texas Instruments and with Xerox Corporation. He served as a Texas Instruments assignee at SEMATECH for three years. Dr. Dhudshia received a Ph.D. in IE/OR from New York University. He is an ASQ fellow and a senior member of ASME. He has developed and taught courses in equipment reliability overview and design practices. He is an affiliate of WWK, specializing in reliability consulting.

In this issue of Applied Cost Modeling we are reprinting Chapter 12. We hope that you find the information in this series useful.

[Continued on Page 3]

[1]

Editorial Board

Publisher

Published quarterly by:

Wright Williams & Kelly, Inc.
6200 Stoneridge Mall Road
3rd Floor
Pleasanton, CA 94588

Phone 925-399-6246
Fax 925-396-6174
E-mail support@wwk.com

Available at:
http://www.wwk.com
Select "Newsletter"

Calendar of Events

June 2010

20-25 IEEE PVSC 35
Hawai'i Convention Center
Honolulu, HI

30 PVJapan
Pacifico Yokohama
Yokohama, Japan

July 2010

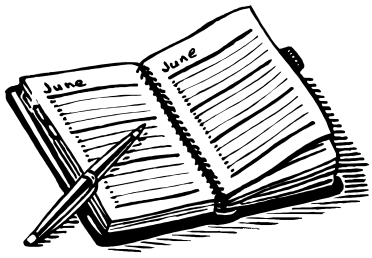
1-2 PVJapan
Pacifico Yokohama
Yokohama, Japan

13-15 SEMICON West/Intersolar North America
Moscone Center
San Francisco, California

15 Plasma Users Group
COO of silicon solar-cell wet processing
Moscone Hall, TechSITE North
San Francisco, California

15 Understanding & Using Cost of Ownership
San Francisco Marriott
San Francisco, California

28-39 SOLARCON India
Hyderabad Conference Center
Hyderabad, India



Chapter 12
How to Buy Reliable Equipment and Parts

Times have altered this activity into an essential ingredient of the Reliability Improvement Process (RIP). How you buy equipment for your use makes a big impact on the reliability level of the equipment. Similarly, how you buy parts makes a big impact on the reliability level of the equipment you manufacture and sell.

In this chapter, we will explore ways to use buying activities to improve the reliability level of the purchased or manufactured equipment.

As mentioned earlier, everyone working on a product line contributes to, and is responsible for, achieving reliability goals. Parts or equipment buyers are no exception to this. They play a crucial role in achieving the reliability goals.

To take full advantage of the buying activities, a company should implement a formal buying process similar to that shown in figure 12.1. Also, a company should make it an essential part of their overall business process. This process effectively uses buying activities for reliability improvements, thus making it an integral part of the reliability improvement program.

Let's examine each process step in detail.

12.1 Select Proper Supplier

Supplier selection is the first step of acquiring anything. If you wish to buy reliable equipment or parts, the general rule for supplier selection is that, whenever possible, you need to select a supplier who is known and has a reputation for supplying reliable products. If the supplier being considered has supplied your company in the past, review the history of quality and reliability of that product. Select a supplier for additional purchases only if you are satisfied with their past performance.

If you are considering a supplier with whom you have never worked, make sure that the supplier is reputable with an effective quality management system in place to control the quality and reliability of its product. One way to find out whether a sound quality management system is in place is to look for the following indicators:

- Supplier is ISO 9001 or equivalent standard compliant
- Supplier recently received Malcolm Baldrige National Quality Award
- Supplier has gone through a formal assessment of their quality management system, such as SEMATECH's Standardized Supplier Quality Assessment (SSQA), see reference 1.
- Supplier has done its own self-assessment of the quality management system

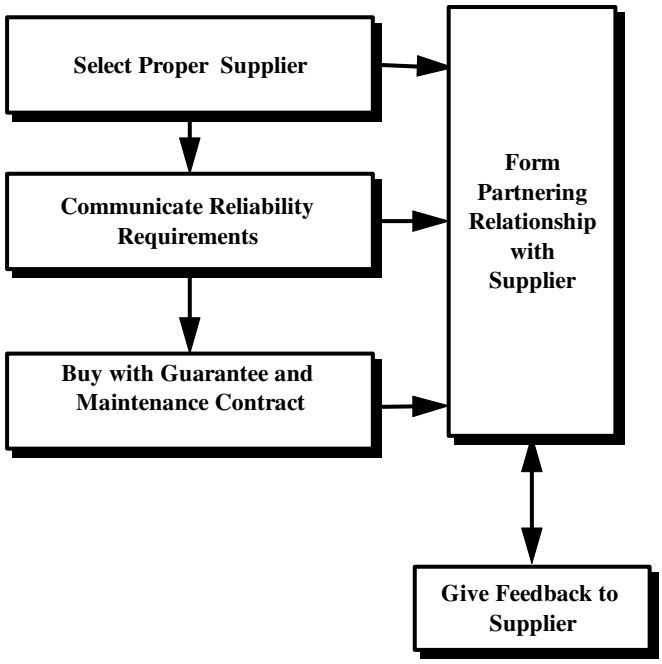


Figure 12.1 Buying Process with the Reliability Improvement Activities

ISSN 1094-9739

An alternative way to find out is to perform a formal assessment of supplier's quality management system of your own.

12.2 Communicate Reliability Requirements

The second step is to make sure that your supplier knows and understands the exact reliability requirements of the product you are going to purchase. These requirements at minimum should include the following:

1. Reliability level and metric (e.g., MTBF = 700 hours)
2. Time factor, such as the age of the equipment when it should attain the reliability level (e.g., four months after installation)
3. Operational conditions, such as:
    a. Temperature and humidity (e.g., temperature range: 70 - 75^{o}F; humidity range: 40 - 50% RH)
    b. Duty cycle (e.g., twelve hours/day)
    c. Throughput rate (e.g., fifteen parts/hour)
    d. Process to be used (e.g., high density plasma etch)
    e. Operator skill level (e.g., grade twelve or equivalent)
    f. PM policies to be followed (e.g., monthly PM policy described in the user's manual)
4. Shipping and installation limitations (e.g., to be shipped by air-cushioned truck and installed by a special installation team)
5. Confidence level for the reliability metric (e.g., 80% confidence in the MTBF value)
6. Acceptable evidence for attaining the required reliability level (e.g., values based on in-house test data, or based on field data)
7. Guarantee/warrantee clause (e.g., minimum monthly MTBF of four hundred hours with 90% confidence)

Every Request for Quotation (RFQ) and Purchase Order (PO) should include the above requirements. An even better idea is to develop a generic specification for the reliability requirements and include it with all the RFQs and POs.

Insist upon a Reliable Product

Let your supplier know that you are serious about the reliability requirements and insist that you will not take any less than the agreed upon reliability level. Before the product is shipped, make sure that your supplier provides credible evidence that the product meets its reliability requirements. If this is not feasible, perform a source inspection before shipment.

12.3 Buy with Guarantee and Maintenance Contract

All RFQs and POs must include a guarantee clause that requires the supplier to guarantee the stated reliability level (e.g., MTBF = 500 hours). It should also include a penalty for not meeting the guaranteed reliability level. For example, if the guarantee level is not met, the supplier must provide free maintenance and spare parts.

If it is feasible, make the maintenance contract a part of the purchase agreement. This technique gives the suppliers an added incentive to provide a reliable product. This is a win/win technique. Suppliers profit from lower maintenance costs if their products have high reliability and the customers benefit from less frequent breakdowns, lower repair cost, and high uptime.

12.4 Form Partnership with Supplier

Establish a partnering relationship with your suppliers. Partnering is a business culture that fosters open communication and a mutually beneficial relationship in a supportive environment built on trust. To establish such a relationship:

- Start at the top level manager of both organizations
- Have frequent communications between technical groups
- Employ a non-offensive approach to problem solving
- Let customers review the supplier's design for future generations of equipment or parts
- Let customers and suppliers participate in each other's formal design reviews
- Let customer validate equipment design early by performing alpha or beta test on the new equipment
- Customer provides feedback to supplier as described in the next section

Such a relationship encourages blending of both organizations' core competencies and technologies with complementary strengths and capabilities to gain a competitive advantage, resulting in business performance greater than could be achieved individually. Also, the partners share the risk and rewards of business operations.

Reference 2 is a good source of information for establishing a partnering relationship with suppliers.

12.5 Provide Feedback

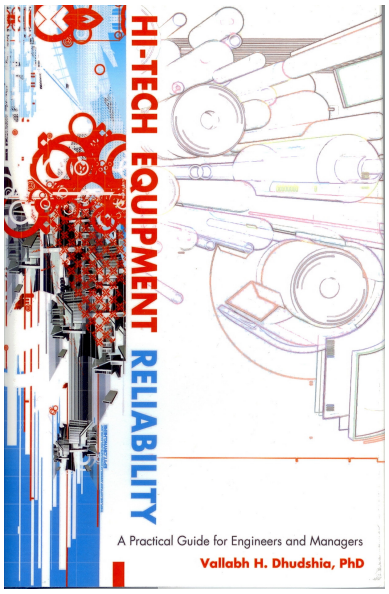
Provide detailed information to your supplier about all the problems and non-conformances you have observed during shipment, installation, start-up, and operations. Work with the supplier to eliminate these problems from future purchases. This may include problem analysis, failure analysis, and corrective action development and testing.

This is very valuable information for the suppliers. No matter how hard they try and how much they spend, they can never duplicate the real-life situation.

The complexity of this step depends upon the size of the supplier. For a small supplier, this step could be a simple information exchange. For a big supplier, this step could be a computerized FRACAS similar to that described in section 8.5 and reference 3.

REFERENCES

1. SEMATECH Partnering For Total Quality, Standardized Supplier Quality Assessment Workbook (Austin, TX: SEMATECH, Inc., 1994).
2. Charles C. Poirier and William F. Houser, Business Partnering for Continuous Improvements (Quality Press, 1993).
3. SEMATECH, Failure Reporting, Analysis and Corrective Action System, Technology Transfer # 94042332A-GEN (Austin, TX: SEMATECH, Inc., 1994).



WWK Hosts Cost of Ownership Seminar at SEMICON West/Intersolar

WWK and SEMI Co-Sponsor Event for the 18th Consecutive Year

Wright Williams & Kelly, Inc. (WWK), the world's preeminent cost of ownership (COO) software and consulting services company, announced today that it will be presenting its highly acclaimed seminar, "Understanding & Using Cost of Ownership" during SEMICON West/Intersolar North America. The seminar will be held at the San Francisco Marriott on Thursday, July 15th from 9am to 5pm and covers all aspects of COO and Overall Equipment Efficiency (OEE) from fundamentals to hands-on applications and has been enhanced to meet the needs of the photovoltaics (PV) industry. Registration for this seminar can be done directly on the Semiconductor Equipment and Materials International (SEMI) Web site at http://www.semi.org or by calling WWK directly.

There is limited seating available for this seminar, so please contact SEMI or WWK today to guarantee your place in this once-a-year event. It is expected that registration will close out shortly for this program. As an added benefit, WWK's software maintenance clients qualify for a 20% discount off the list price of the seminar if they book directly with WWK.

With more than 3000 users worldwide, Wright Williams & Kelly, Inc. is the largest privately held operational cost management software and consulting company serving technology-dependent and technology-driven organizations. WWK maintains long-term relationships with prominent industry resources including SEMATECH, SELETE, SEMI, national labs, and universities. Its client base includes nearly all of the top 20 semiconductor manufacturers, equipment suppliers, materials suppliers, and leaders in nanotechnology, micro-electro-mechanical systems (MEMS), thin film record heads, magnetic media, flat panel displays (FPD), solid state lighting/light emitting diodes (SSL/LED), and photovoltaics (PV).

WWK's product line includes TWO COOL® for detailed process step level COO and OEE, PRO COOL® for process flow and test cell costing, Factory Commander® for full factory capacity analysis and activity based costing, and Factory Explorer® for cycle time reduction and work in process (WIP) planning. Additionally, WWK offers a highly flexible product management software package that helps sales forces eliminate errors in product configuration and quotation processes.

COO Papers in Photovoltaics International

Photovoltaics International's 7th edition contains a paper written by Akrion Systems and Wright Williams & Kelly, Inc. The journal can be obtained at http://www.pv-tech.org. The abstract is: This paper, the second in a series covering cost of ownership (COO) studies for photovoltaics (PV), examines the need for saw damage removal and the follow-on processes of precleaning, texturization, and cleaning. The process considerations for wet and plasma approaches are further discussed before taking a detailed look at texturization using random pyramid formation. The paper will conclude with a view of current and future wet process techniques and a COO case study using Akrion Systems' GAMA-Solar as an example.

The third paper will appear in the 8th edition to be published in the late-June 2010 time frame. This paper examines the need for metallization of silicon-based solar cells and how metallization has evolved over the past few years. The technologies and techniques that are being developed for this part of cell manufacturing in the foreseeable future are also discussed. The paper will conclude with a COO case study using the DEK Solar PV3000 as an example.

WWK to Present COO Paper at SEMICON West/Intersolar

Wright Williams & Kelly, Inc. and Akrion Systems will be presenting a paper on the cost of ownership (COO) of wet processing for silicon-based solar cells. The presentation will take place on July 15, 2010 at 12pm at TechSITE North in Moscone Hall North, San Francisco, California as part of the Plasma Users Group forum. The presentation is based on the paper entitled, "Examining cost of ownership of crystalline-silicon solar-cell wet processing: texturization and cleaning" that was first published in Photovoltaics International's 7th edition.

The presentation will examine the need for saw damage removal and the follow-on processes of precleaning, texturization, and cleaning. The process considerations for wet and plasma approaches are further discussed before taking a detailed look at texturization using random pyramid formation. The paper will conclude with a view of current and future wet process techniques and a COO case study using Akrion Systems' GAMA-Solar as an example.

http://semiconwest.org/SessionsEvents/TechSITEs/index.htm

TechSITE NORTH

ISSN 1094-9739

Factory Physics: Clarity and Focus in Operations Management

Michael Hair

If we look at the number and life span of "new" approaches to operations management (and how managers choose among them) over the last few decades, we might conclude that it is more like following the fashion trends than a scientific methodology.

The authors of the extremely valuable book, Factory Physics® (Hopp & Spearman. 2008. New York: McGraw-Hill/Irwin) present a comprehensive, yet accessible, text on operations management. They show that, despite the weaknesses of any one method, the greatest value-add lies in knowing which methods to use in your business. In short, they lay out a structured and quantitative approach to operations management. To illustrate the value of this approach, ask yourself if you see your company in any of these scenarios:

- Your production planners spend their days firefighting, despite having expensive software that is supposed to help them.
- You would like to put your Work-In-Process (WIP) and Cycle Time (CT) metrics in context, but question the value of comparing ("benchmarking") your company's performance to others.
- You suspect your WIP is too high, but you are concerned that a Kanban system in your environment would be too complex.

I will describe how each of these dilemmas can be addressed.

No More "Flavor of the Month"

As often happens, individuals with insight work to determine what approaches (perhaps new approaches) will make their company successful, given their objectives, products, processes, and competition. They come up with something that works, and their success stories are publicized. Others try to apply the methods, often to situations for which they are ill-suited, resulting in failure. Then the failures are publicized, and the methods become less popular and people wait for the new "Flavor of the Month", normally brought in by some consultants.

The authors of Factory Physics® help practitioners avoid all this by developing a "science of manufacturing". Their primary goal is "to provide the reader with an organized framework from which to evaluate management practices and develop useful intuition about (their) manufacturing systems." Beginning with a historical overview of operations management, they highlight the contributions, as well as the flaws, arising from each major development in the field. Armed with an improved understanding of the traditional operations management tools, as well as some new concepts, the rest of the book describes a framework for using these approaches to manage a manufacturing operation.

To demonstrate the value of this approach, I will address briefly what the book has to say about the three scenarios above. Each represents an insight that I believe is significant, but is not well known in the operations management community.

Turning Firefighters into Planners: The Central Flaw of Material Requirements Planning (MRP)

MRP is invaluable for coordinating large numbers of materials purchases to a Master Schedule. Its expanded version (Enterprise Requirements Planning or ERP) seems complex, but the central calculations are easy to understand. Nonetheless, many companies struggle with their MRP systems, constantly revising purchase orders and production schedules.

The problem lies in a fundamental assumption made by all MRP systems, which is all production lead times are fixed. In reality, they are highly variable. High capacity utilization will increase lead times, and low capacity utilization will decrease them – which apply to the lead times from your vendors and for your internal production lead times. The resulting errors lead to constant rescheduling, but there is hope. Factory Physics® describes how to minimize this while preserving the benefits of your MRP system, ultimately reducing the occurrence of firefighting, improving the reliability of order completion dates and, in turn, on-time deliveries.

Realistic Goals: Being Lean Without Starving

Some Lean authors imply that having no inventories ("Zero Inventories") should be the goal. However, in reality, with no inventories of WIP there will be no production. So how “lean” should an operation be?

Defining “performance” as the ability to produce more output with a given level of WIP, a method of "internal benchmarking" is described, where a company can determine the "Best Case", "Worst Case", and “Practical Worst Case” performance that can be expected from their processes. The actual processing times required for the process steps are kept constant across all three cases. However, each case assumes a particular approach to manage the process, and this leads to extremely different (theoretical) performance. A manager can then compare the actual process performance to the three calculated cases.

For each calculated case, two graphs are developed. The first shows throughput as a function of WIP, and the second shows CT as a function of WIP. Once these curves are created, a manager can compare the actual performance of an operation to the curves and prioritize efforts towards those that show the most opportunity for improvement. These curves also highlight the level of WIP below which throughput will be severely reduced. Since this is a custom calculation for each individual operation, it avoids the mistake of comparing pears to apples.

Pulling Without Kanban: The CONWIP Approach

Most books and articles on Pull systems focus on describing the Kanban mechanism, rather than the root cause of why Pull systems are helpful. Factory Physics® shows that the main contribution of Kanban systems is that they limit the WIP inventory levels and, in turn, cycle times. This WIP reduction is a direct result of all Pull systems, not just Kanban.

Contrary to some authors, setting up and maintaining a Kanban system with the correct number of cards at each step of the operation is not trivial. A simpler Pull system is described, called CONWIP (for "Constant WIP"), which achieves most of the benefits of a Kanban system but with much less effort. This leaves operators and planners free to focus on their work, rather than struggling to maintain the system.

ISSN 1094-9739

Putting It To Work

As an experienced Industrial Engineer, I have seen first-hand much of what is discussed in the text, both the good and the bad. The three concepts that I have highlighted are just the tip of the iceberg; every section has similar valuable insights. It is true that some sections utilize significant mathematical and statistical calculation. However, the practitioner is not left behind: the proofs are very clear. And if need be, they can be skipped and the concepts will still be understood. In fact, many useful "intuition-building exercises" are included to help the reader solidify his understanding.

So, whether implementing Lean methods, searching for low cost solutions to increase capacity, or developing an overall operations strategy, finding the correct methodology to support every unique situation is critical. This approach is especially helpful in defining what "improvement" means, and in setting expectations and priorities.

Michael Hair is a Professional member of Motu Novu (http://www.motunovu.com), an international federation of independent professionals, entrepreneurs, and executives. He resides in Beaverton, Oregon and can be reached at 503-544-6862 or at mhair@motunovu.com and would be glad to apply his knowledge to your operation and help you get started.

This and other recommended books can be found on the WWK Web site at:

http://www.wwk.com/amazon.html