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Inside

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

By Dr. Vallabh H. Dhudshia
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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 13. We hope that you find the information in this series useful.

[Continued on Page 3]

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Calendar of Events

October 2010

12-14 **Solar Power International**
Los Angeles Convention Center
Los Angeles, CA

19-21 **SEMICON Europa**
Messe Dresden
Dresden, Germany

27-29 **DIREC (Delhi International Renewable Energy Conference)**
Expo Centre & Mart, Greater Noida Expwy
Uttar Pradesh, India

November 2010

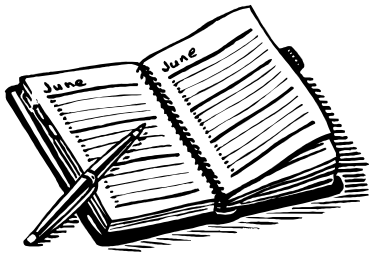
3-4 **6th Annual Clean Energy Conference**
Hynes Convention Center
Boston, MA

8-10 **International Trade Partners Conference**
The Fairmont Orchid
Kohala Coast, HI

December 2010

1-3 **SEMICON Japan**
Makuhari Messe
Chiba, Japan

8-10 **World Energy Engineering Congress**
Washington Convention Center
Washington D.C.



Chapter 13
Reliability Organization

So far, we have described the Reliability Improvement Process (RIP) and techniques. We have not mentioned anything about the people who deploy the RIP and techniques in an organization. Even if the process and techniques are perfect, if they are not deployed properly by the proper people, the result may not amount to anything. It is important that we look at the people who drive the reliability discipline. This chapter describes a typical organization for reliability, its people, and their roles.

The reliability group is a team of individuals who catalyze reliability improvement programs throughout an organization. They may not report to the same manager. The mission of this group is to assure that competitively priced equipment is manufactured that meets or exceeds the customer's reliability requirements.

A reliability group is not responsible for meeting the reliability goals of an equipment line (i.e., we cannot blame the reliability group for failure to meet the equipment reliability goals). However, the group has the responsibility for establishing and facilitating the right environment for the RIP. It is also responsible for providing technical know-how and resources, taking initiative for reliability improvement tasks, and assigning ownership of the improvement process.

13.1 Makeup of a Typical Reliability Group

The typical reliability group includes the following four levels of people:

1. Executive champion
2. Technical champion/reliability manager
3. Reliability engineer
4. Reliability technicians

Now let's describe who they are and what their duties are.

Executive Champion

The executive champion is a high-level person who could occupy any of the following upper management positions:

- President or vice president
- Chief operating officer
- Chief technical officer
- Corporate director of total quality

The role of the executive champion is to:

- Provide executive leadership in reliability improvement matters
- Promote reliability discipline throughout the organization
- Provide resources and funds for the needed reliability improvement programs
- Work closely with the technical champion to develop reliability improvement program plans
- Provide assurance that the reliability improvement programs are supported by all the functional departments
- Mentor the reliability improvement programs
- Ensure that reliability related accomplishments are recognized and rewarded

Technical Champion/Reliability Manager

The technical champion is a middle-level manager with thorough technical knowledge of reliability discipline, including reliability engineering and statistics. His or her duties are to:

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- Establish and facilitate the right environment for the reliability improvement process
- Assist the executive champion in promoting reliability discipline throughout the organization.
- Provide both managerial and technical leadership
- Ensure deployment of effective cross-functional reliability improvement programs
- Ensure that the RIP is continuously applied throughout the life-cycle phases
- Prepare product-specific reliability improvement plans, and get needed approvals and buy-in from all the departments
- Train other participants in reliability concept and improvement tools

Reliability Engineer

The reliability engineer is a degreed or experienced engineer with a thorough technical knowledge of reliability discipline, including reliability engineering and statistics. The duties of this engineer are as follows:

- Provide theoretical and practical tools and techniques to achieve the desired reliability level
- Provide technical leadership to specify, predict, assess, and demonstrate the reliability level
- Assist design engineers to design-in reliability
- Be part of the design and design review teams
- Assist equipment/part buyers to include reliability requirements in the purchases
- Assist manufacturing engineers to build-in reliability
- Conduct reliability tests
- Assist field engineers in collecting the required field data
- Coordinate failure review board activities
- Manage the reliability growth until the desired reliability level is achieved
- Ensure deployment of effective cross-functional reliability improvement programs
- Ensure that the RIP is continuously applied throughout the life-cycle phases
- Be flexible to react quickly to the demands of any reliability issue
- Train design, manufacturing, and field engineers, sales and marketing personnel, and parts buyers in basic reliability concept and reliability improvement tools

Reliability Technician

The reliability technician is an experienced technician with thorough technical knowledge of operations, diagnosis, and repair of the equipment and parts. The duties are as follows:

- Support reliability engineers
- Run reliability tests
- Maintain the reliability test machines
- Collect reliability data from the field
- Perform failure analysis of the failed part or parts

13.2 Organizational Structure

The location of the reliability group within an organization requires the following two major considerations: (i) provide management checks and balances to ensure that group functions are kept in their true perspective, and (ii) ensure manufacturing of equipment with a high reliability level at an optimal cost.

Figure 13.1 depicts a typical organization chart that includes a reliability group. As shown in the chart, the reliability group is under the director of engineering and reports to the director of operations with a dotted line structure. This organizational structure falls between the centralized and decentralized organizational structures. This structure appears to be very effective for semiconductor manufacturing equipment suppliers.

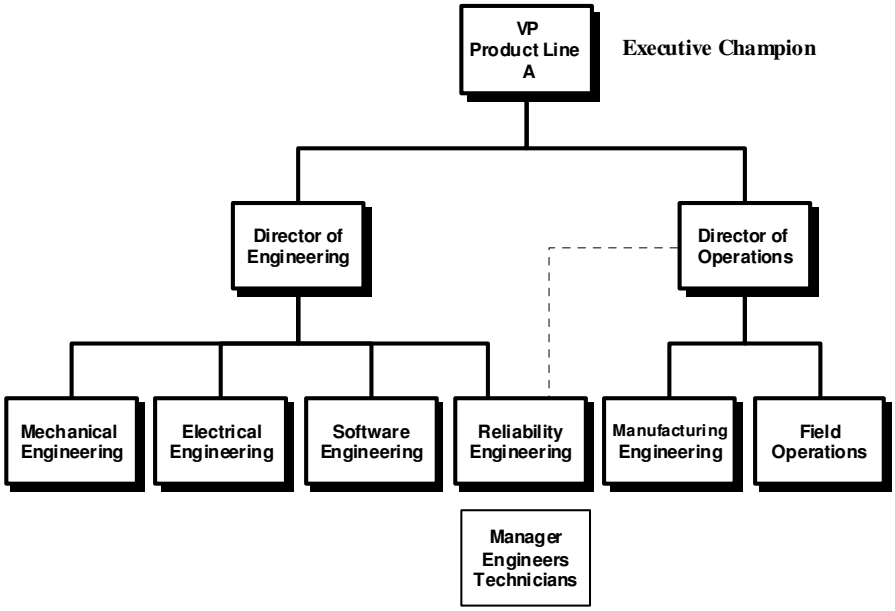
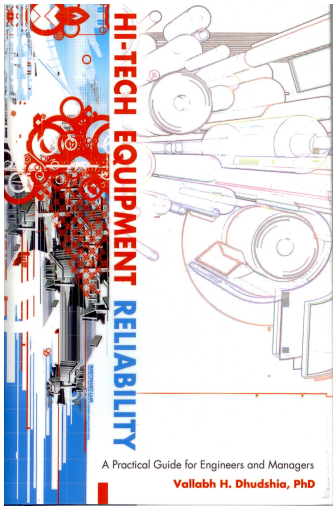


Figure 13.1 A Typical Organizational Structure with a Reliability Engineering Group (Organization)

13.3 Recommended Practices for Reliability Engineers

Working with many large semiconductor manufacturing equipment suppliers reveals that all-round and knowledgeable reliability engineers are very hard to find. Many universities offer courses in reliability. However, they focus more on statistical theory of reliability rather than reliability in design, manufacturing, and operation of equipment. We suggest a different approach to cultivating all-round knowledgeable reliability engineers. Select either design or field engineers and train them in basic statistics and reliability concepts and improvement methodologies. They are the best reliability engineers for any organization.



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Wright Williams & Kelly, Inc. Launches Spanish Language Web Site

Web Site Recognizes the Growing Greentech Importance of Latin America and Spain

Wright Williams & Kelly, Inc. (WWK), a cost & productivity management software and consulting services company, announced today the launch of its new Spanish language Web site. The addition of Spanish is in recognition of growing role that Latin America and Spain are taking in the greentech/cleantech movement. WWK partnered with the native language services company, CAL Translations, to execute this project.

"This latest addition to our Web presence, which is now over 15 years old, is very exciting," stated David Jimenez, WWK's President. "With the lessons learned by their recent FiT program, it is clear that Spain will be an integral part of the growth in clean power development. Likewise, the Next Generation Utility Latin America (NGU LA) expects 2010 to be a breakout year with the Latin American solar industry talking gigawatts, not megawatts. As a dual citizen of Spain and the US, I am personally dedicated to increasing our support for these important and growing markets."

"CAL Translations is proud to be part of this program," stated Asser de la Cal, Founder at CAL Translations. "WWK has been serving high tech manufacturing industries for almost two decades and we are excited to help them to continue to grow their business in Spain and Latin America. With nearly a half a billion people worldwide speaking Spanish, companies that do not address these markets are missing a high growth opportunity."

CAL Translations was founded in 2009 by native Spanish and English speakers, from Spain and the United States, to provide our clients with the best services available in English to Spanish, and Spanish to English translations. Our mission is to provide our clients with the highest quality translations in all types of documents, whether they are official texts or not, each translation is guaranteed to be carried out both professionally and at the lowest price in the market. CAL Translations consists of the best team of native translators. They have both academic and first-hand knowledge of both English and Spanish. Our expert translators are highly qualified to meet your translation needs. (www.CALtranslations.com)

With more than 3000 users worldwide, Wright Williams & Kelly, Inc. is the largest privately held operational cost management company serving technology-dependent and technology-driven companies. WWK maintains long-term relationships with prominent industry resources including International SEMATECH, SELETE, Semiconductor Equipment and Materials International (SEMI), and national labs and universities. Its client base includes most of the top 20 semiconductor manufacturers and equipment and materials suppliers as well as leaders in nanotechnology, MEMS, thin film record heads, magnetic media, flat panel displays, and solar panels.

Wright Williams & Kelly, Inc. Estrena Página Web en Idioma Español

Sitio Web Reconoce la Creciente Importancia de la Tecnología Verde en América Latina y España

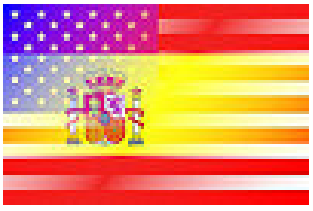
Wright Williams y Kelly, Inc. (WWK), la compañía de servicios de consultoría y software de gestión de costes & de productividad, anuncia hoy el lanzamiento de su nuevo sitio Web en Español. La adicción del Español es en reconocimiento del papel creciente que América Latina y España están tomando en el movimiento de tecnología verde y tecnologías limpias. WWK se asoció con la compañía de servicios de idioma nativo, CAL Translations para ejecutar este proyecto..

"Esta última incorporación a nuestra presencia en la Web, que ahora tiene más de 15 años de antigüedad, es muy emocionante," declaró David Jimenez, Presidente de WWK. "Con la experiencia adquirida por su reciente Programa FiT, es evidente que España va a ser una parte integral del crecimiento en el desarrollo de energía limpia. Del mismo modo, la próxima generación de Utilidad América Latina (NGU LA) prevé que el 2010 será un gran año con la industria solar de América Latina hablando de gigavatios, no megavatios. Como un ciudadano con doble nacionalidad de España y de los EE.UU., personalmente estoy dedicado a aumentar nuestro apoyo a estos mercados cada vez más importantes."

"CAL Translations se enorgullece de formar parte de este programa," declaró Asser de la Cal, fundador de CAL Translations. "WWK ha estado sirviendo a la industria manufacturera de alta tecnología durante casi dos décadas, y estamos encantados de ayudarles a seguir creciendo con su negocio en España y América Latina. Con cerca de medio billón de personas en el mundo de habla española, las empresas que no se ocupan de estos mercados están perdiendo una oportunidad de crecimiento."

CAL Translations fue fundada en 2009, por personal nativo originario de España y de los Estados Unidos para poner a disposición de nuestros clientes los mejores servicios de traducción, del idioma Español a Inglés, así como del idioma Inglés a Español. El enfoque de nuestro trabajo es proporcionar a nuestros clientes la mejor calidad de traducción en todo tipo de textos y documentos, oficiales o no, siempre realizados con profesionalidad y asegurando un abaratamiento del coste. CAL Translations dispone de los mejores traductores nativos, formados académicamente, como a través de diversas visitas de media-larga duración en España y Estados Unidos. Nuestro personal está altamente cualificado para dotarle de garantías inmejorables. (www.CALtranslations.com)

Con más de 3000 usuarios en todo el mundo, Wright Williams & Kelly, Inc. es la mayor compañía privada de administración y servicio de costes operativos de las empresas dependientes de la tecnología y de base tecnológica. WWK mantiene relaciones a largo plazo con recursos de la industria, incluyendo destacados como International SEMATECH, SELETE, Equipo y Materiales Semiconductores Internacional (SEMI), los laboratorios nacionales y universidades. Su base de clientes incluye la lista de los 20 mejores fabricantes de equipo y materiales semiconductores y proveedores de materiales, así como líderes en la nanotecnología, MEMS, cabezales de grabación de película delgada, medios magnéticos, pantallas planas, y paneles solares.



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2010 Equipment Survey Results

What a difference a year makes - again!
The annual Wright Williams & Kelly, Inc. semiconductor equipment survey has uncovered some interesting changes since the 2009 survey was conducted. Some of these changes can be explained by the different economic conditions, but some hint at fundamental changes in the way semiconductor business will be conducted in the future.

The 2009 survey had insufficient responses for analysis in the area of test and metrology. Thus, we cannot infer anything in this area. The areas with interesting changes since the last survey are listed below and a complete breakdown is listed at the end.

Litho
The results in the litho section follow no discernable pattern. While high index immersion and direct write moved in from the 2009 responses of "never" to 2017+ and 2015 respectively and nano-resists moved in one year to 2015, double patterning (both single and double resist steps) moved out one year (2011 and 2010 respectively) and imprint moved from 2014 to "never." EUV remained unchanged at a median date of 2015.

The 2009 respondents reported that double patterning was expected earlier than was expected in 2008. Thus, for 2010 we expect that the various flavors of double patterning are being accepted even with the inherent issues of lower productivity. That isn't surprising since utilization rates have not been the issue over the past year, so excess capacity in litho could be absorbed by double patterning. The question is will this opinion change as the economy continues to recover. While double patterning was examined in this survey, we believe there is now a need to add multiple patterning as a more distinct option.

Manufacturing
The big question is whether or not 450mm. In 2008, 56% responded that 450mm would never happen. In 2009, the percentage responding "never" had dropped significantly (17%), with production expected in 2015. The 2010 survey shows 450mm moving out again with a median response of 2017+ and 38% responding "never."

A related question is with regard to the implementation of 300mm Prime advances. The expected production year of 2009-2010 was about the same as reported in the surveys of both prior years, but in 2009 17% indicated that 300mm Prime advances will never be implemented. It was our opinion that this was related to then-current economic conditions since 300mm Prime focuses on productivity improvements that may have been perceived as not needed during a significant downturn. With the economic upturn, we have seen this move to 2011 but with 0% responding "never."

The good news is that in the 2009 survey, 83% of respondents indicated they expect the semiconductor industry to recover in 2010; while 100% of 2010 respondents said the same.

Consumer Electronics

New to the 2009 survey were several questions about expected consumer electronics purchases as these are a driving force for the industry. Not surprising, the median year for the next laptop purchase is 2010. But the median year for a netbook purchase is "never" and desktop moved from "never" to 2013. So, were netbooks just a fad? Has the combination of power and larger displays brought desktops back into favor?

The 2010 results for the areas discussed are summarized in the following table.

Litho	**Median Year**	**% Never**
193-nm High Refractive Index Immersion	2017+	
Direct Write	2015	
Double Patterning (2 resist steps)	2010	
Double Patterning (1 resist step)	2011	
EUV	2015	
Imprint	Never	79%
Directed Self Assembly Nano-Resists	2015	
Manufacturing		
450mm wafers	2017+	38%
Equipment with Energy Saving "Sleep" States	2011	
Equipment Suppliers using Remote Diagnostic Capability	2011	
Manufacturing Capacity, Utilization and Cycle Time Simulation	2011	
Implementation of 300mm Prime Advances	2011	
Semiconductor Upturn	2010	
Consumer Electronics		
Desktop PC	2013	43%
Laptop PC	2010	
Netbook PC	Never	65%
Interior LED Lighting	2011	
Solar Electrical System (on Grid)	2017+	43%

For those interested in participating in the 2011 survey and receiving the results as they are available, please check back with WWK in early February 2011.

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Updates Planned to SEMI COO Standards E35 and E140

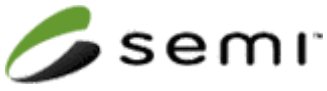
In July, the SEMI Standards North America Metrics Technical Committee approved two new activities to update SEMI Standards E35-0307 (Guide to Calculate Cost Of Ownership [COO] Metrics for Semiconductor Manufacturing Equipment) and E140-0305 (Guide to Calculate Cost Of Ownership [COO] Metrics for Gas Delivery Systems). Some of the planned revisions include:

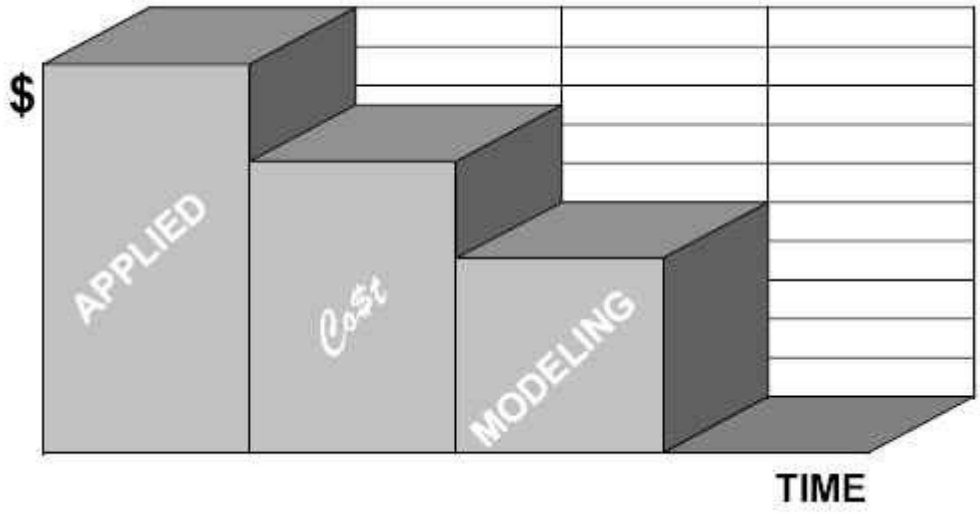
- Correcting some known errors (e.g., definition of consumable to consumable part),
- Harmonizing with E149-0708 (Guide For Equipment Supplier-Provided Documentation for the Acquisition and Use of Manufacturing Equipment) and planned revisions to E10-0304E (Specification for Definition and Measurement of Equipment Reliability, Availability, and Maintainability [RAM]), and
- Expanding the scope of E35 to include related industries (flat panel display [FPD], photovoltaic [PV], micro-electro mechanical systems [MEMS], light emitting diode [LED], and hard disk drive [HDD]).

The reactivated Equipment COO Task Force (TF) will meet during the SEMI Standards Fall meetings on Tuesday, November 9, from 1:00 – 4:00 PM at SEMI Headquarters in San Jose, CA. You may attend the meeting in person or participate remotely by e-mail, teleconference, and online by Microsoft Live Meeting. For more meeting information, please see the SEMI Standards Web site at http://www.semi.org/en/standards/ctr_039313.

If you are interested in actively participating on the TF, please contact the co-chairs so they can add you to the TF membership and e-mail distribution lists (e.g., to receive copies of proposed revision drafts, meeting announcements, and minutes). The co-chairs are Daren Dance (Wright Williams & Kelly, Inc. [WWK]; 435-730-7643; d.dance@wwk.com) and David L. Bouldin (Fab Consulting, 972-727-3591, david.bouldin@sbcglobal.net). The SEMI Standards Regulations now require that all meeting participants be registered as SEMI Standards Program Members, which is free. To register, please see the SEMI Standards Web site at http://dom.semi.org/standards/stdsmbr.nsf/Mapp!openform.

Take advantage of this opportunity to contribute to improvements in these SEMI Standards and network with other COO industry experts!





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