A Study on Monte Carlo Simulation for Key Equipment Maintenance Timing Prediction in a Semiconductor Foundry

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ABSTRACT

The semiconductor foundry had entered to dimension of the 12 inch, and procedures of the all process are over five hundred. In which contains the manufacture and measurement process, the manufacture procedure contains thin film, etching, diffusion, chemistry mechanistic polish, cleaning and photo. Measurement includes metal line CD (Critical Dimension) and defect inspection. The key process must define in system of regulation regarding the key is KIP (Key Inline Parameter), and SPC controls the essential control the system regulation control. If over Spec., we must take improvement actions. Equipment is the most main factor when the process over Spec. How can let the equipment stable to produce is a good study for foundry. To establishes a system of effective maintenances, and arrangement the standard maintenance routine maintenance plan. So maintains an equipment allocation and the prediction are the two important working of product manufacture, after product system maintenance determination. According to the preventative maintenance modeling, we can guarantees the equipment properly to achieve the goal. For this research we expectation to establish a model that find the key of equipment in semiconductor foundry. Study semiconductor foundry equipment PM behavior. Use Monte Carlo Simulation to predict next PM timing. It will be able effectively to predict future of condition then will make the proper arrangements for equipment.

Keywords : Preventive Maintenance ; FMEA ; Monte Carlo Simulation

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REFERENCES

一、 中文部分 1. 方鈞等，2000，「建構版導體製程改善之失效模式與效應分析架構及其應用研究」，工業工程學刊，第17卷，第2期，pp.133-146。 2. 王文俊，2005，「認識FUZZY」，台北:全華科技圖書。 3. 林宏祥，2004，「使用蒙地卡羅模擬方法設計預防維修系統」，元智大學工業工程與管理學研究所碩士論文碩士論文。 4. 林俊宏，1998，「台灣加權股價指數模擬與預測--類神經網路之應用」，國立中興大學企業管理學系碩士論文。 5. 沈育樹，2003，「維護管理系統設計與模式分析」，中原大學工業工程研究所博士論文。 6. 吳富春，2001，「礫石河床鮭魚卵存活率之風險評估（二）」，行政院國家科學委員會專題研究計畫成果報告。 7. 吳貴彬、陳相如，2003，「失效模式與效應分析之應用」，第9屆全國品質管理研討會。 8. 柯協助，2000，「失效模式效應分析-企業最佳預防措施」，

電子量測與品管，pp.54-57。 9. 柯煇耀，2005，「可靠度保證」，台北:中華民國品質學會。 10. 倪愛偉、翁剛、吳克勤、謝里陽，2007，「確定RCMⅡ中最佳維修間隔期數學模型的適用條件」，上海:機械設計，第24卷，第2期，pp.7-10。 11. 徐桂祥，1996，「灰色系統在商情預測上之研究」，國立雲林科技大學資訊管理技術研究所碩士論文。 12. 陳家榮、顏榮祥，1999，「國內生活與工業用需求預測方法之探討」，台灣土地金融季刊，第36卷，第2期，pp.63-75。 13. 陳道宏，2003，「檢測PCBA之FMEA系統建立」，元智大學工業工程研究所碩士論文。 14. 郭晉源，2006，「晶圓測試廠維護策略對生產績效影響之研究」，國立清華大學工業工程與工程管理學研究所博士論文。 15. 郭晉源，2006，「半導體晶圓廠設備設機台維護保養預測之研究」，勞工安全研究季刊，第14卷，第2期，pp.24-132。 16. 張少華，2006，「使用灰色理論及遺傳演算法於設備維護時間點預測」，國立清華大學工業工程與工程管理學研究所碩士論文。 17. 張浩如，2000，「常用統計套裝軟體的U(0,1)亂數產生器之探討」，國立政治大學統計學系碩士論文。 18. 葉怡成，2003，「應用類神經網路」，台北:儒林圖書公司。 19. 楊義明、曹健齡，1997，「失效模式與效應分析的作業方式」，品質管制月刊，第10卷，第4期，pp.55-59。 20. 鄭春生，1999，「品質管理」，台北:育友圖書有限公司。 21. 蔣旭政，1999，「應用物件導向資料庫技術建構同步模擬的環境」，中原大學工業工程學系碩士論文。 22. 劉鴻第，2005，「蒙地卡羅法在軍事作業之應用—評估彈道飛彈攻擊機場之情況」，逢甲大學工業工程與系統管理學研究所碩士論文。 23. 關季明，2003，「維護度工程與系統所善度」，台北:中華民國品質學會，pp.23。 二、英文部分 1. AIAG, 1995,“ Reference manual: potential failure mode and effects analysis (FMEA) ”, AIAG, USA. 2. Barbara, G., 2007,“ Crystal Ball 7.3 User Manual ”, Oracle. 3. Chaitin, G.J., 2001,“ Exploring Randomness ”, Springer-Verlag. 4. Cheng, W. X., Chen, L. Q., Gong, S. G. and Ding Y. Z., 2006,“ Readiness simulation of ship equipment based on Monte-Carlo method ”, China Ordnance Society, Vol.6. 5. Chien, C., Hsiao, A. and Wang, I., 2004,“ Constructing Semiconductor manufacturing performance index and applying data mining for manufacturing data analysis ”, Journal of the Chinese Institute of Industrial Engineers, Vol. 21, No.4, pp.313-327. 6. Djuric, P., Perkel, J., Vidakovic, B. and Novosel, D., 2006,“ New probabilistic method for estimation of equipment failures and development of replacement strategies ”, Proceedings of the 39th Annual Hawaii International Conference on System Sciences, pp.246.1. 7. De Lemos, Z., 2004,“ FMEA software program for managing preventive maintenance of medical equipment ”, Proceedings of the IEEE 30th Annual Northeast Bioengineering Conference, pp.247-248. 8. Dong, Y. L., Gu, Y. J. and Yang, K., 2003,“ Criticality analysis on equipment in power plant based on Monte Carlo simulation ”, Proceedings of the Chinese Society for Electrical Engineering, Vol.8. 9. Gao, W., Liu, N., Tan, K., Wang, L., Liang, G. and Li, W., 2003,“ Decision on maintenance period for power transformer based on Monte Carlo simulation of reliability ”, Proceedings of the IEEE International Conference on Properties and Applications of Dielectric Materials, Vol.1, pp.479-482. 10. Hayter, J.A., 1996,“ Probability and Statistics for Engineers and Scientists ”, PWS publishing company, Boston, pp.271. 11. Houshyar, A., 2005,“ Reliability and maintainability of machinery and equipment, part 2: Benchmarking, life-cycle cost, and predictive maintenance ”, International Journal of Modeling and Simulation, Vol.25, pp. 1-11. 12. James E., 1998,“ Risk analysis: two tools you can use to assure product safety and reliability ”, The Validation Consultant. 13. John von Neumann, 1946,“ The Principles of Large-Scale Computing Machines ”, Reprinted in Ann. Hist. Comp., Vol.3, pp.263-273. 14. Julong, D., 1982,“ Control problems of grey systems ”, System & Control Letters, Vol.5, pp.228-294. 15. Kalos, M.H. and Whitlock, P.A., 1986,“ Monte Carlo Methods ”, Vol.1, John Wiley and Sons, New York. 16. Lebell, D. and Krasner, O.J., 1997,“ Selecting Environmental Forecasting from Business Planning Requirements ”, The Academy of Management Review, Vol.2, No.3, pp.373-383. 17. Lehmer, D.H., 1951,“ Mathematical methods in large-scale computing units ”, Proceedings of the Second Symposium on Large Scale Digital Computing Machinery, Harvard University Press, pp.141-146. 18. Manno, I., 1999,“ Introduction to the Monte Carlo Method ”, Akademiai Kiado. 19. Moon, M.A., 2005,“ What is world class forecasting? A perspective on 20 years research ”, Proceedings of the 2005 Crystal Ball User Conference. 20. Park, S.K. and Miller, K.W., 1988,“ Random number generators: good ones are hard to find ”, Communications of the ACM, Vol.31, pp.1192-1201. 21. Press, W. H., Flannery, B. P., Teukolsky, S. A. and Vetterling, W. T., 1992,“ Numerical Recipes in FORTRAN 77: The Art of Scientific Computing ”, Cambridge University Press, pp.295-299 and 306-319, 2nd Edition. 22. Rubinstein, R.Y. and Kroese, D.P., 2007,“ Simulation and the Monte Carlo Method ”, John Wiley & Sons, 2nd Edition. 20. Robert, C.P. and Casella, G., 2004,“ Monte Carlo Statistical Methods ”, Springer-Verlag, 2nd Edition. 23. Sachs, N., 1993,“ Failure analysis of mechanical components ”, Maintenance Technology Magazine. 24. Seung, J. R. and Kosuke, I., 2003,“ Using cost based FMEA to enhance reliability and serviceability ”, Advanced Engineering Informatics Vol.17, July - October, pp.179-188. 25. Wang, J., Hou, T., Chen, L. and Xu, X., 1999,“ Conformational analysis of peptides using Monte Carlo simulations combined with the genetic algorithm ”, Chemometrics and Intelligent Laboratory Systems, Vol.45, No.1, pp.347-351. 26. Wichmann B.A. and Hill I.D., 1982,“ An efficient and portable pseudo-random number generator ”, Applied Statistics, Vol. 31, No.2, pp.188-190. 三、線上文獻 1. Mathews, J.H., 2005,“ Module for Monte Carlo Pi ”, California State Univ. Fullerton Department of Mathematics Fullerton, 2/26/2008. http://math.fullerton.edu/mathews/n2003/MonteCarloPiMod.html 2. Writer, J.W., 6/1/2004,“ Monte Carlo Simulation Basics ”, Vertex42. com., 2/21/2008, http://vertex42.com/ExcelArticles/mc/MonteCarloSimulation.html 3. Nikos, D., 4/25/1995,“ Introduction to Monte Carlo Methods ”, Max-Planck-Institut fu"r Plasmaphysik (IPP), 2/24/2008. http://www.ipp.mpg.de/de/for/bereiche/stellarator/Comp_sci/CompScience/csep/csep1.phy.ornl.gov/mc/mc.html 4. Nakisa, R.,“ Monte Carlo method ”, 6/11/2002, Wikipedia the free encyclopedia, 2/24/2008. http://en.wikipedia.org/wiki/Monte_Carlo_Simulation 5. Michael, H.,“ Stanis?aw Ulam ”, 1/31/2002, Wikipedia the free encyclopedia, 2/8/2008. http://en.wikipedia.org/w/index.php?title=Stanislaw_Ulam&oldid=188187038 6. 彰基醫品部，「失效模式與效應分析」，11/24/2005，根本原因分析（RCA），彰化健康照護品質（Changhua Healthcare Quality），2/28/2008，http://www.qi.org.tw/tqm/aims/fmea/fmea_c.asp