

# 新產品管理之微世界建構：系統動力學觀點

劉家華、羅世輝、王學銘

E-mail: 9123318@mail.dyu.edu.tw

## 摘要

處於數位時代的今天，企業經營環境以10倍速往前躍進，資訊科技產品的快速生命週期只是其中一個現象，而消費者才是市場的最後決定者。因此消費者對新產品的接受程度及評估偏好則成了新產品成功的重要因素，亦是本研究所關注的焦點。而目前本研究僅針對現有的市場及產業結構，以系統動力學為研究方法，利用模擬的方式，來討論創新擴散的議題。本研究主要的目的便是在探討創新擴散的過程是經由哪些重要、關鍵的因素所構成，並透過擅長於處理高階、多環、非線性系統問題的「系統動力學」為研究方法及工具，來作為創新擴散過程的動態模擬分析方法，並藉此建構出微世界的模型，藉此了解各種模擬結果的動態擴散現象，以及探討其結構背後的主要運作過程和發掘廠商行動決策的可行方案與障礙。而系統動力學模式在此主要的貢獻在於透過內在機制與系統行為間的因果關係，了解洞悉動態性複雜系統的特性。透過模式分析可以發現：（一）整體搭配的重要性；（二）對於管理上的引申；（三）擴大思考的時空範圍。最後，並針對後續進一步研究的發展方向提出建議及說明。

關鍵詞：系統動力學、新產品管理、微世界、動態性複雜

## 目錄

第一章 緒論	--P1
1.1 研究背景	--P1
1.2 研究動機	--P2
1.3 研究目的	--P3
1.4 研究方法	--P5
1.5 研究限制	--P5
1.6 論文架構	--P7
第二章 文獻回顧	--P10
2.1 創新的定義	--P10
2.2 創新擴散的演化觀點	--P12
2.2.1 MODIS的自然法則觀點	--P12
2.2.2 PORTER的產品生命週期觀點	--P12
2.2.3 MODAHL對技術採用者的分類觀點	--P13
2.2.4 ROGERS對技術創新採用者的分類觀點	--P15
2.2.5 BASS的擴散模式	--P16
2.3 系統動力學的簡介	--P18
2.3.1 系統動力學的緣起	--P18
2.3.2 系統動力學的發展	--P18
2.3.3 從工業動力學到系統動力學	--P20
2.4 系統動力學的應用	--P20
2.4.1 系統動力學在社會經濟之應用	--P21
2.4.2 系統動力學對創新擴散之研究	--P22
2.4.2.1 STERMAN的管理飛行模擬器	--P22
2.4.2.2 MILLING的創新擴散模式	--P25
2.5 微世界與學習實驗室	--P27
2.5.1 微世界的特性	--P31
2.5.2 微世界的應用	--P32
第三章 創新擴散之概念模式分析及簡單釋例	--P36
3.1 系統動力學之因果回饋圖	--P38
3.2 系統動力學模式之基本符號	--P40
3.3 系統動力學簡單模型釋例	--P43
3.4 創新擴散之概念模型	--P45
第四章 模式分析及基本測試	--P49
4.1 系統動力學模式的參數估計	--P49
4.2 系統動力學的有效性問題	--P50
4.3 簡單產銷之次系統	--P51
4.4 市場分配之次系統	--P52
4.5 產品吸引力之次系統	--P54
4.6 市場擴散之次系統	--P56
4.7 新產品擴散之模式總覽	--P57
4.7.1 生產成本的學習曲線	--P60
4.7.2 價格改變的吸引曲線	--P62
第五章 管理飛行模擬器之建構	--P64
5.1 管理飛行模擬器的目的	--P64
5.2 管理飛行模擬器之運作概述	--P64
5.2.1 市場狀況	--P65
5.2.2 產銷作業	--P67
5.2.3 財務結構	--P67
5.3 操作界面設計與說明	--P68
5.3.1 主畫面之操作界面說明	--P68
5.3.2 次畫面之操作界面說明	--P69
5.4 管理飛行模擬器測試結果	--P75
5.4.1 模擬結果分析	--P86
第六章 結論與建議	--P91
6.1 管理飛行模擬器的修正	--P91
6.2 未來研究建議	--P93
參考文獻	--P98
附錄一類屬模式總覽	--P107
附錄二類屬模式方程式系統	--P109
附錄三類屬模式變數名稱說明	--P114

## 參考文獻

- 1.吳國卿等譯，2001，刻不容緩（原著:MODAHL, MARY, 2000, NOW OR NEVER），台北:經典傳訊文化 股份有限公司
- 2.汪維揚，1996，從組織分析探討資訊系統規畫方法之研究，國立中山大學資管研究所碩士論文
- 3.徐作聖等譯，2000，創新管理（原著:AFUAH, ALLAN, 1998, INNOVATION MANAGEMENT），台北:華泰文化事業股份有限公司
- 4.高文泰，1998，以系統動力學研究不同經濟情況下激進及保守銀行之策略對呆帳之影響，國立中山大學企業管理學系碩士論文
- 5.郭進隆譯，1994，第五項修練 - 學習型組織的藝術與實務（原著:SENGE, PETER M., 1990, THE FIFTH DISCIPLINE），台北:天下文化出版社
- 6.陶在樸，1999，系統動態學，台北:五南圖書出版社
- 7.黃建樺，1993，新產品發展過程資源配置之探討，國立中興大學企業管理研究所碩士論文。
- 8.楊世祺，1997，新產品發展過程之資源配置 - 以高科技、傳統產業為例，國立政治大學企業管理研究 碩士論文。
- 9.齊若蘭譯，1995A，第五項修練 II 實踐篇 - 思考、演練與超越（原著:SENGE, PETER M., ET AL., 1994, THE FIFTH DISCIPLINE FIELDBOOK），台北:天下文化出版股份有限公司
- 10.劉小芳，1996，跨國流行商品擴散模型之比較研究，國立暨南國際大學國際企業學系碩士論文
- 11.樂為良譯，1999，變動法則 - 透視未來走勢的科學占卜術（原著:MODIS, THEODORE, 1998, CONQUERING UNCERTAINTY），台北:聯經出版事業公司
- 12.鄭三俠譯，1995，新產品研發（原著:THOMAS, ROBERT J., 1993, NEW PRODUCT DEVELOPMENT），台北:智勝文化事業有限公司
- 13.蕭淑惠，1996，創新擴散模型之研究 - 以數據機為例，國立交通大學經營管理研究所論文
- 14.鍾志明，1999，新產品發展過程之資源配置與績效之關係 - 以國內製造業為例，國立政治大學企業管理研究所博士論文。
- 15.蘇懋康，1989，系統動力學原理及應用，上海

交通大學出版 二、英文部分 1.ABERNATHY, J. W., & J. M. UTTERBACK, 1998, PATTERNS OF INDUSTRIAL INNOVATION, STRATEGIC MANAGEMENT OF TECHNOLOGY AN INNOVATION, ED. R. A. BURGELMAN & M. A. MAIDIQUE, 141-148, HOMEWOOD, IRWIN. 2.BARLAS, Y., 1996, "FORMAL ASPECTS OF MODEL VALIDITY AND VALIDATION IN SYSTEM DYNAMICS," SYSTEM DYNAMICS REVIEW, VOL. 12, NO. 3, PP. 183-210 3.BASS, FRANK M., 1969, A NEW PRODUCT GROWTH MODEL FOR COUSUMER DURABLES, MANAGEMENT SCIENCE, 15(5), JANUARY PP. 215-227. 4.BEINHOCKER, E., 1991, WONDER(A) AND (B), CASE STUDY AVAILABLE FROM JOHN STERMAN, SLOAN SCHOOL OF MANAGEMENT, MIT, CAMBRIDGE MA. 5.BELL, J. W. & PETER M.SENGE, 1980,"METHODS FOR ENHANCING REFUTABILITY IN SYSTEM DYNAMICS MODELING," IN A. A. LEGASTOR, JR. ET AL., STUDIES IN THE MANAGEMENT SCIENCE, VOL. 14, PP. 61-74 6.BLYTHE, JIM, 1999, INNOVATIVENESS AND NEWNESS IN HIGH-TECH CONSUMER DURABLES, JOURNAL OF PRODUCT & BRAND MANAGEMENT, VOL.8 , PP.415-429. 7.BREHMER, B., 1990, STRATEGIES IN REAL TIME, DYNAMIC DECISION MAKING, IN R. HOGARTH(ED.), INSIGHTS IN DECISION MAKING UNIVERSITY OF CHICAGO PRESS, CHICAGO, 262-279. 8.BREHMER, B.,1992, DYNAMIC DECISION MAKING:HUMAN CONTROL OF COMPLEX SYSTEMS,ACTA PSYCHOLO -GICA, 211-241. 9.BYE, P., & J. CHANARON, 1995, TECHNOLOGY TRAJECTORIES AND STRATEGIES, INTERNATIONAL JOURNAL OF TECHNOLOGY MANAGEMENT 10(1), 45-46. 10.CARLSON, E., 1990, FIBERGLASS'S LONG LIFE IS SINKING SAILBOAT PRODUCERS, WALL STREET J.,AUGUST 31, B2. 11.COOPER, ROBER G. & ELKO J. KLEINSCHMIDT, 1991, NEW PRODUCT : THE KEY FACTORS IN SUCCESS 12.CRAWFORD, C. MERLE, & BENEDETTO, C. ANTHONY DI, 2000, NEW RODUCTS MANAGEMENT, MCGRAW -HILL 13.DIEHL, E., 1992, EFFECTS OF FEEDBACK STRUCTURE ON DYNAMIC DECISION MAKING, PH.D.DISSER -TATION, MIT SLOAN SCHOOL OF MANAGEMENT. 14.FORRESTER, JAY W. AND PETER M. SENGE, 1980, "TEST FOR BUILDING CONFIDENCE IN SYSTEM DYNAMICS MODELS," IN A. A. LEGASTOR, JR. ET AL. ( EDS. ) , STUDENTS IN THE MANAGEMENT SC -IENCE, VOL. 14, ( PP.209-228 ) 15.FORRESTER, JAY W., 1958, INDUSTRIAL DYNAMICS: A MAJOR BREAKTHROUGH FOR DECISION MAKERS, HARVARD BUSINESS REVIEW, PP. 37-66. 16.FORRESTER, JAY W., 1961, INDUSTRIAL DYNAMICS, CAMBRIDGE, MASS.:MIT PRESS. 17.FORRESTER, JAY W., 1968A, PRINCIPLES OF SYSTEMS, CAMBRIDGE, MASS.:MIT PRESS. 18.FORRESTER, JAY W., 1969, URBAN DYNAMICS, CAMBRIDGE, MASS.:MIT PRESS. 19.FORRESTER, JAY W., 1971A, WORLD DYNAMICS, CAMBRIDGE, MASS.:MIT PRESS. 20.FORRESTER, JAY W., 1971B,"COUNTERINTUITIVE BEHAVIOR OG SOCIAL SYSTEMS," TECHNOLOGY REVIEW, ALSO IN COLLECTED PAPERS OF JAY W. FORRESTER, 1975, CAMBRIDGE, MASS.:MIT PRESS. 21.FORRESTER, JAY W., 1989, "THE SYSTEM DYNAMICS NATIONAL MODEL:MACROBEHAVIOR FROM MICROSTRUCTURE," COMPUTER-BASED MANAGEMENT OF COMPLEX SYSTEMS, MILLING, PETER M. & ZAHN ,E. O. K., PP. 3-12. 22.FORRESTER, JAY. W. & PETER M. SENGE, 1980,"TEST FOR BUILDING CONFIDENCE IN SYSTEM DYNAM -ICS MODELS," IN A. A. LEGASTOR, JR. ET AL., STUDIES IN THE MANAGEMENT SCIENCE,VOL14, PP. 209-228 23.FORRESTER, JAY. W. 1968B, A RESPONSE TO "ANSOFF AND SLEVIN," MANAGEMENT SCIENCE,VOL.14, PP.601-618. 24.FORRESTER, JAY. W., 1973, THE LIFE CYCLE OF ECONOMIC DEVELOPMENT, THE MIT PRESS. 25.FREEMAN, C., 1982, THE ECONOMICS OF INDUSTRIAL INNOVATION, MA:MIT PRESS 26.FUNKE, J., 1991, SOLVING COMPLEX PROBLEMS: EXPLORATION AND CONTROL OF COMPLEX SYSTEMS, IN R. STERNBERG AND P. FRENCH(EDS.),COMPLEX PROBLEM SOLVING: PRINCIPLES AND MECHANISMS ,LAWRENCE ERLBAUM ASSOCIATES, HILLSDALE, NJ. 27.GEORGESCU-ROEGEN, N. 1971, THE ENTROPY LAW AND THE ECONOMIC PROCESS, CAMBRIDGE, MA, HARVARD UNIVERSITY PRESS. 28.GORT, M. AND S. KLEPPER, 1982, TIME PATHS IN THE DIFFUSION OF PRODUCT INNOVATIONS, ECONOMIC J., 630-653. 29.GRAHAM, A. K., J. D. MORECROFT , P. M. SENGE AND J. D. STERMAN, 1992, MODEL SUPPORTED CASE STUDIES FOR MANAGEMENT EDUCATION, EUROPEAN J. OPERATIONAL RES., 59, 151-166. 30.HAUTHAKKER, H. S. AND L. C. TAYLOR, 1970, CONSUMER DEMAND IN THE UNITED STATES,HARVARD UNIVERSITY PRESS, CAMBRIDGE, MA. 31.HOMER, J., 1987, A DIFFUSION MODEL WITH APPLICATION TO EVOLVING MEDICAL TECHNOLOGIES, TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE, 197-218. 32.KAMPMANN, C. AND J. STERMAN, 1992, DO MARKETS MITIGATE MISPERCEPTIONS OF FEEDBACK IN DYNAMIC TASKS, PROCEEDINGS OF THE 1992 INTERNATIONAL SYSTEM DYNAMICS CONFERENCE,UTRECHT , THE NETHERLANDS. 33.KLEINMUNTZ, D., AND J. THOMAS, 1987,THE VALUE OF ACTION AND INFERENCE IN DYNAMIC DECIS -ION MAKING, ORGANIZATIONAL BEHAVIOR AND HUMAN DECISION PROCESS, 39, 341-364. 34.KLEPPER, S. AND E. GRADY, 1990, THE EVOLUTION OF NEW INDUSTRIES AND THE DETERMINANTS OF MARKET STRUCTURE, RAND J. ECONOMICS, 21, 27-44. 35.LEGASTO, A. A. & J. MACIARIELLO, 1980, "SYSTEM DYNAMICS: A CRITICAL REVIEW," IN A. A. LEGASTO, JR. ET AL., STUDIES IN THE MANAGEMENT SCIENCE, VOL. 14, PP. 23-43 36.LYNEIS, JAMES M.,1980, CORPORATE PLANNING AND POLICY DESIGN:A SYSTEM DYNAMICS APPROACH ,MASS.:MIT PRESS. 37.MAHAJAN, V. AND Y. WIND(EDS.), 1986,INNOVATION DIFFUSION MODELS OF NEW PRODUCT ACCEPTANCE ,BALLINGER, CAMBRIDGE, MA. 38.MAHAJAN, V., E. MULLER AND F. BASS, 1990, NEW PRODUCT DIFFUSION MODELS IN MARKETING: A REVIEW AND DIRECTIONS FOR RESEARCH, J. MARKETING, 1-26. 39.MEADOWS, D. L., 1970, DYNAMICS OF COMMODITY PRODUCT CYCLES, MASS: WRIGHTALLEN PRESS. 40.MEADOWS, ET AL., 1972, THE LIMITS TO GROWTH, NEW YORK: UNIVERSE BOOKS. MILLING, P.

M., 1986A, DIFFUSIONSTHEORIES AND INNOVATIONS -MANAGEMENT, INNOVATION-UND TECHNOLOGIEMANAGEMENT, ED. E. K. O. ZAHN, 49-70, BERLIN:DUNCKER & HUMBLOT. 42.MILLING, P. M., 1986B, DECISION SUPPORT FOR MARKETING NEW PRODUCTS, SYSTEM DYNAMICS:ON THE MOVE. SEVILLE, ED. J. ARACIL, J. A. D. MACHUCA, AND M. KARSKY, 787-793. 43.MILLING, P. M., 1991A, QUALITY MANAGEMENT IN A DYNAMIC ENVIRONMENT, THE CYBERNETICS OF COMPLEX SYSTEMS- SELF-ORGANIZATION, EVOLUTION, AND SOCIAL CHANGE, ED. F. GEYER, 125-136 .SALINAS, CA:INTERSYSTEMS PUBLICATIONS. 44.MILLING, P. M., 1991B, AN INTERGRATIVE VIEW OF R&D AND INNOVATION PROCESSES, MODELLING AND SIMULATION 1991 SAN DIEGO, CA, ED. E. MOSEKIDE, 509-514. 45.MILLING, P. M., 1996A, INVENTION, INNOVATION, DIFFUSION, EINE SIMULATIONSANALYSE DES MANagements NEUER PRODUKTE, BERLIN:DUNCKER & HUMBLOT(FORTHCOMING). 46.MILLING, P. M., 1996B,MODELING INNOVATION PROCESSES FOR DECISION SUPPORT AND MANAGEMENT SIMULATOR, SYSTEM DYNAMICS REVIEW, VOL. 12, NO. 3, 211-234. 47.MILLING, P. M., AND F. H. MAIER, 1993, THE IMPACT OF PRICING STRATEGIES ON INNOVATION DIFFUSION AND R&D PERFORMANCE, SYSTEM DYNAMICS: AN INTERNATIONAL JOURNAL OF POLICY MODEL -ING 6: 27-35. 48.PORTER, M.E.,1980,COMPETITIVE STRATEGY:TECHNIQUES FOR ANALYZING INDUSTRIES AND COMPETIT -ION, NY:THE FREE PRESS. 49.PORTER, M. E., 1990, THE COMPETITIVE ADVANTAGE OF NATIONS, NY:FREE PRESS, P.780 50.PORTER, M.E., 1983, CASES IN COMPETITIVE STRATEGY, FREE PRESS, NEW YORK. 51.RICHARDSON, G.P. & ALEXANDER L. PUGH III,1982,INTRODUCTION TO SYSTEM DYNAMICS MODELING WITH DYNAMO, THE MIT PRESS. 52.ROBERTS, E. B., (EDS.), 1978, MANAGERIAL APPLICATION OF SYSTEMS DYNAMICS, MIT PRESS. 53.ROBERTS, EDWARD B. ED., 1981, MANAGERIAL APPLICATIONS OF SYSTEM DYNAMIC, MASS., MIT PRESS. 54.ROGERS, EVERETT M., 1971, COMMUNICATION OF INNOVATION, NY:THE FREE PRESS. 55.ROSENBERG, N., 1982, INSIDE THE BLACK BOX:TECHNOLOGY AND ECONOMICS, CAMBRIDGE: CAMBRIDGE UNIVERSITY PRESS. 56.SALTER, M., 1969, TENSOR CORPORATION, CASE 370-041, HARVARD BUSINESS SCHOOL PUBLISHING DIVISION, BOSTON, MA. 57.SENGE, P. & J. D. STERMAN, 1992, SYSTEMS THINKING AND ORGANIZATIONAL LEARNING: ACTING LOCALLY AND THINKING GLOBALLY IN THE ORGANIZATION OF THE FUTURE, IN T, KOCHAN AND M. USEEM(EDS.), TRANSFORMING ORGANIZATIONS, OXFORD UNIVERSITY PRESS, OXFORD, 353-371. 58.SENGE, P., 1980, A SYSTEM DYNAMICS APPROACH TO INVESTMENT FUNCTION FORMULATION AND TESTING, SOCIOECONOMIC PLANNING SCIENCES, 269-280. 59.SMITH, V., G.SUCHANEK AND A. WILLIAMS, 1988,BUBBLES,CRASHES, AND ENDOGENOUS EXPECTATION IN EXPERIMENTAL SPOT ASSET MARKET ECONOMERTRICA, 56, 1119-1152. 60.STEELE, L. W., 1989, MANAGING TECHNOLOGY, NEW YORK:MCGRAW-HILL. 61.STERMAN, J. D., 1988, PEOPLE EXPRESS MANAGEMENT FLIGHT SIMULATOR, SIMULATION GAME (SOFTWARE), BRIEFING BOOK, AND SIMULATOR GUIDE, AVAILABLE FROM AUTHOR, MIT SLOAN SCHOOL OF MANAGEMENT, CAMBRIDGE, MA. 62.STERMAN,J.D.,1989A,MISPERCEPTIONS OF FEEDBACK IN DYNAMIC DECISION MAKING ORGANIZATIONAL BEHAVIOR AND HUMAN DECISION PROCESSES, 301-335. 63.STERMAN, J. D., 1989B, MODELING MANAGERIAL BEHAVIOR: MISPERCEPTIONS OF FEEDBACK IN A DYNAMIC DECISION MAKING EXPERIMENT, 321-339. 64.STERMAN, J. D., 1992, TEACHING TAKES OFF: FLIGHT SIMULATORS FOR MANAGEMENT EDUCATION, OR/MS TODAY, 40-44. 65.STERMAN,J. D.,1993, BOOM BUST AND FAILURES TO LEARN IN EXPERIMENTAL MARKETS, MANAGEMENT SCIENCES, VOL.39, NO. 12, 1439. 66.VERYZER, ROBERT W.,JR&J. WESLEY HUTCHINSON,1998,THE INFLUENCE OF UNITY AND PROTOTYPICAL -ITY ON AESTHETIC RESPONSES TO NEW PRODUCT DESIGNS, JOURNAL OF CONSUMER RESEARCH,VOL.24 ,PP.374-394. 67.VERYZER, ROBERT W., JR, 1998A,DISCONTINUOUS INNOVATION AND THE NEW PRODUCT DEVELOPMENT PROCESS,JOURNAL PRODUCT INNOVATION MANAGEMENT , 15, PP.304-321. 68.VERYZER,ROBERT W.,JR,1998B, KEY FACTORS AFFECTING CUSTOMER EVALUATION OF DISCONTINUOUS, JOURNAL OF PRODUCT INNOVATION MANAGEMENT ,15. PP 136-150.