Title: The review of literature on evaluation of advanced manufacturing technologies: five concerns strategy, technology, market, organization and structure of innovation diffusion.

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Abstract:

THE REVIEW OF LITERATURE ON EVALUATION OF ADVANCED MANUFACTURING TECHNOLOGIES: FIVE CONCERNS STRATEGY, TECHNOLOGY, MARKET, ORGANIZATION AND STRUCTURE OF INNOVATION DIFFUSION

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INDEPENDENT STUDY
ANNOTATED BIBLIOGRAPHY

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INTRODUCTION

The literature on the evaluation of advanced manufacturing technologies has been widely scattered throughout many academic journals in various disciplines. There are many studies done by other researchers such as Canada and Son similar to the one presented in this paper. But none of these included annotated bibliography instead they provided a list of articles. Also their lists focused only on the justification of manufacturing technologies. This study focuses on the many dimensions of evaluation of advanced manufacturing technologies. Originally this idea was developed by Sage for the emerging technologies with only three dimensions: market, technology and organization. This study adds two more dimensions to this triple dimension analysis: Strategy and Innovation Diffusion Structure. This annotated bibliography cites 139 articles. The articles were published in the following journals:

Academy of Management Review
Production and Inventory Management Journal
Research Management
R&D Management
American Psychologist
Decision Sciences
Personnel
The Journal of Business Strategy
IEEE Transactions on Engineering Management
Management Science
Production and Operations Management
Journal of Manufacturing Systems
California Management Review
Industrial Engineering
Sloan Management Review
IEEE Transactions on Systems Man and Cybernetics
Strategic Management Review
International Journal of Production Research
Technological Forecasting and Social Change
Accounting and Business Research
Omega
European Journal of Operations Management
The Engineering Economist
Journal of Product Innovation Management
Harvard Business Review

Quantitative models that have been developed vary according to time aspects, decision levels, impact areas, constraints or methodologies. Following is a list of different options for different dimensions of a model:

*Different Time Aspects	-Past -Future
*Different Decision Levels	-Corporate -Divisional -Operational
*Different Impact Areas	-Organization -Technology -Market
*Different Constraints	-Economic -Improvement -Capability/Suitability
*Different Methodologies	-Optimization -Simulation -Judgement Based

DESCRIPTION OF THE DIMENSIONS

As indicated the bibliography has five parts, each representing a dimension. Each part contains the literature identifying the related factors in the evaluation process.

Strategy Assessment : Every company has a business strategy which describes its goals and how it wants to reach them. Therefore the strategy of the company should be the start point for technology evaluations. Each other dimension should be assessed on how much they contribute to the strategy. This section contains literature on planning and development of different manufacturing strategies. The time period that this section deals with is future. Basically this gateway assesses where the company wants to be in the future.

1. STRATEGY ASSESSMENT

Boyd S.P., "Function Allocation: Strategies for Deciding What to Automate", Integrating the Automated Factory, Ed by Steven Cousins, SME, 1988, pp 3-11

This paper summarizes the strategies for decision making when introducing automation. The strategies discussed are: comparison of human and machine capabilities, leftover strategy that is automating everything possible and let the human operators get the functions leftover, humanized strategy which is utilizing the human workforce first, economic strategy based on the cost of the new systems and flexible strategy is utilizing human workers and machines at different times. The author suggests an analysis of operational requirements and constraints, function identification and function allocation before the decision process.

Branco K., "Laying the CIM Foundation: A Structured Strategy Based Methodology", Integrating the Automated Factory, Ed by Steven Cousins, SME, 1988, pp 33-44

The strategy discussed in this paper is a more corporate level approach. The strategy suggest business strategy analysis first. The parameters in this analysis are product types, product life cycle, product mix, revenue mix and quantity produced. The second act suggested is formation of two sets of critical success factors: corporate and manufacturing. The third step is defining the hierarchy of the whole CIM process. The next steps are justification, cpm analysis, development of a CIM road map, and making recommendations to management.

Elavia J.D., "Where Do I Start with CIM", Integrating the Automated Factory, Ed by Steven Cousins, SME, 1988, pp 15-32

The article presents a strategy developed by Price Waterhouse to implement Computer Integrated Manufacturing. The author identifies the discrete modules of CIM: design and manufacturing engineering, manufacturing, material handling, operations management, financial and business management. The approach discussed has three main stages: "As-Is" analysis, "To-Be" scenario, implementation planning. The systematic approach lets the managers see the whole elements of the manufacturing system.

Ernst G.R., "Why Automating Isn't Enough", The Journal of Business Strategy, May/June 1989, pp 38-42

This article briefly discusses the necessity of an implementation plan way before introducing any new manufacturing technology. The author claims that focusing too much on automation causes companies to overlook opportunities resulting from business process improvements.

Leonard-Barton D., Deschamps I., "Managerial Influence in the Implementation of New Technology", Management Science, Vol 34, No 10, Oct 1988, pp 1252-1265
This paper presents many hypotheses on managerial influence in implementation of new technology and their testing which accomplished through a telephone survey conducted with a representative sample of 93 salespeople working for a multinational computer manufacturer The findings suggest that the diffusion of an innovation within an organization could be viewed as a two-step managerial process.

Meredith J., " Managing Factory Automation Projects", Journal of Manufacturing Systems, Volume 6, No 2, pp 75-91
The author puts the emphasis on how difficult and lengthy it is to implement advanced manufacturing technologies such as flexible manufacturing systems and CAD/CAM. He gives examples of companies turning to project management approaches to achieve the benefits of these automated systems within reasonable time and cost limitations. This paper illustrates the major project management concepts and techniques used in a number of industrial automation projects. The author's focus is on project planning, implementation, and control, including the issues of budgeting, scheduling, resource allocation, monitoring, information system design, and post-auditing.

Meredith J., "The Strategic Advantages of the Factory of the Future", California Management Review, Volume 29, No 3, Spring 1987, pp 27-41
This article aims at clarifying the term "Factory of the Future" by identifying its elements and its connections to those elements. The article includes case applications of new technology: Cypress Semiconductor, Illinois Tool works, Intel Corporation, Priam Corporation and Peerless Saw Co. In the article functional area technologies are classified into three major sub classes: Engineering Techniques(CAD, CAE, Group Technology, CAPP), Manufacturing Technologies(NC, CAM, Robots, FMS) and Business Techniques(MRP, JIT). The article also includes the benefits and cost of the new technologies as percentage improvement compared to the old technologies. The article concludes that the factory of the future being smaller than today's factory will be closer to its customers, more responsive and efficient and will employ considerably fewer people. In the article it is also concluded that the training for the factory of the future is a vital issue in the path to success. The article can be considered as a brief introduction to the idea of the "Factory of the Future": contents, advantages and examples. The concluding remarks about sending manufacturing overseas are worth reading.

Meredith J., "Implementing the Automated Factory", Journal of Manufacturing Systems, Volume 6, No 1, pp 1 - 13
This paper introduces the benefits of advanced manufacturing technologies and the high demand in these technologies. The problem discussed in this paper is how to

2. TECHNOLOGY ASSESSMENT (ECONOMICS, FLEXIBILITY, AND OTHER COMPOSITE ASSESSMENT MEASURES)

Airey J., Young C., "Economic Justification of FMS-Counting the Strategic Benefits", Flexible Manufacturing Systems, Ed by Warnecke H.J., and Steinhilper R., IFS Publications, 1985, pp 51-57

This paper starts with a review of traditional approaches to project appraisal such as payback period, return on investment, discounted cashflow, lifecycle costing, break even point, sensitivity analysis, effect of government grants and taxes, and inflation. The paper addresses the approach that justification must be a matter of conviction and not a matter of accounting.

Arbel A., Seidmann A., "Performance Evaluation of Flexible Manufacturing Systems", IEEE Transactions on Systems, Man, And Cybernetics, Vol 14, No 4, July/August 1984, pp 606- 617

This paper presents a hierarchical performance evaluation model for flexible manufacturing technologies which is useful for incorporation of various levels of expertise into an integrated framework

Badiru A.B., "A Management Guide to Automation Cost Justification", Industrial Engineering, February 1990, pp 26-28

The author in this paper presents possible elements of a guideline for managers to use for cost-justification process. The author mainly suggests to be update about the tools currently used for cost justification and to provide documentation.

Balakrishnan S., Wernerfelt B., "Technical Change, Competition and Vertical Integration", Strategic Management Journal, Vol 7, 1986, pp 347-359

This paper starts with a survey of the received theories of vertical integration. Then a model to study how the frequency of technological change interacts with the intensity of competition to influence the optimal level of integration is proposed as well.

Belini V.E., Paulovich D.A., Garrett N.H., Joachim D.R., "Plant Automation Improves product Quality and Efficiency", Industrial Engineering, June 1992, pp 49-51

This paper provides an implementation strategy for automation. The author suggests three main actions : developing a full understanding of the facility to be modified and the people that operate and maintain it, carefully laying out the new system design and planning how the transition will be made from the old to the new within the constraints set forth, involving all interested parties in the planning phase and making sure operators and maintenance personnel actively participate in the execution of the project.

Esposito E., "Technology Measurement", Technological Forecasting and Social Change, Vo; 43, 1993, pp 1-17
A measure for technological measurement is presented in this paper. The author defines five main classes of technological indicators: input measures, output measures, measures based on the precursor events, functional measures and structural measures.

Finnie J., "The Role of Financial Appraisal in Decisions to Acquire Advanced Manufacturing Technology", Accounting and Business Research, Vol 18, No 70, 1988, pp 133-139
This paper is a good summary of the financial appraisal techniques that are evaluating the acquisition of advanced manufacturing technology. The author reviews the literature supporting the point that financial appraisals can not capture all relevant information. He shows that financial appraisal using Discounted Cash Flow imposes a short term decision horizon. His conclusions point out that most of the financial evaluation methods represent short comings.

Ghobadian A., Stainer A., Liu J., "A Proposed Four Stage Methodology for AMT Investment Appraisal", Proceedings of Mgmt of Tech. IV Ed's Khalil and Bayraktar, IIE, pp 959-968
The model by incorporating intangible impacts into the evaluation process significantly, identifies the appropriate investment easily. The model differentiates advantages of AMT into two general areas: cost and market.

Gold B., "Some Empirical Perspectives on the Economic Effects of Technological Innovations", OMEGA, Vol 14, No 2, 1986, pp 99-118
The paper focuses on first the need to modify expectations covering the economic effects of technological innovations; second the specific errors made in estimating the benefits of technological innovations; third means of intensifying technological improvement effects, and fourth the shortcomings often encountered in evaluating the effects of technological innovations after installment.

Gold B., "Technological Innovation and Economic Performance", OMEGA, Vol 15, No 5, 1987, pp 361-370
This paper focuses on the narrow scope of the economic evaluations of technological innovations. Thru research it is proposed that technological have wider effect in many areas that need to be taken into account.

Grant,R.M., Krishnan,R., Shani,A.B., Baer,R., "Appropriate Manufacturing Technology: A Strategic Approach", Sloan Management Review, Fall 1991, pp 43-54
This paper is a brief introduction to the technology selection process. The model proposed in the paper selects the right technology according to the assessment of

Kaltwasser C., "Know How to Choose the Right CIM Systems Integrator", Industrial Engineering, July 1990, pp 27-29
This paper briefly discusses the benefits of CIM. To receive these benefits the author suggests that a manager must choose a systems integrator well qualified to meet his company's needs. The paper defines systems integrator and presents the issues a manager should consider in choosing one.

Lederer P.J., "The Effect of Financing Decisions on the Economic Evaluation of Manufacturing Technologies", Working Paper
The importance of jointly considering the financing and technology choice decisions when making investments in technology. A model of financing and technology choice decisions considering the differences in the cost structure of new and conventional technologies has been developed.

Martino J.P., "A Comparison of Two Composite Measures of Technology", Technological Forecasting and Social Change, Vol 44, 1993, pp 147-159
This paper presents a comparison between two methods, the scoring model and the planar trade off surface technique. The methods when tested, seemed to give reasonable results on most cases. The scoring model however was found to have an advantage, because it included more variables.

Merchant E., "The Importance of Flexible Manufacturing Systems to the Realization of Full Computer Integrated Manufacturing", Flexible Manufacturing Systems, Ed by Warnecke H.J., and Steinhilper R., IFS Publications, 1985, pp 27-43
This paper itself can be evaluated as a justification for the flexible manufacturing systems. The author claims that the potential impact of the computer on the manufacturing function is enormous, and that CIM will determine the factory of the future. He includes the results of the surveys done in 50 European, 40 Japanese and 25 US plants where FMS is in use. His results conclude that FMS brings an increase in manufacturing productivity and product quality, a decrease in lead time and inventory, and an increase in utilization of capital equipment.

Meredith J., Marianne M.Hill, "Justifying New Manufacturing Systems: A Managerial Approach", Sloan Management Review, Summer 1987, pp 49-61
The authors identify how levels of integration in manufacturing differ, and examines the appropriateness of different justification techniques for each level of integration. The levels of integration identified are : stand alone, cells, linked islands, full integration. The techniques they tested are in four groups : economic, portfolio, analytic and strategic techniques. The conclusions suggest that for each different level a different appropriate technique should be used. For a stand alone level economic techniques like payback, ROI, NPV or cashflow are appropriate, For cells level portfolio techniques like programming models, scoring models, or growth options should be considered. For linked islands level analytic techniques like value

Ramasesh R.V., Jayakumar M.D., "Economic Justification of Advanced Manufacturing Technology", Omega, Vol 21, No 3, 1993, pp 289-306
Focusing on the economic analysis, the paper presents a concise review of the state of the art and propose a four-level justification framework for investment in Advanced Manufacturing Technology.

Sarin S.C., Chen C.S., "A Mathematical Model for Manufacturing System Selection", Flexible Manufacturing Systems, Ed A. Kusiak, North Holland, 1986, pp 99-112
This paper presents an integer programming model which is developed to determine the best mix of manufacturing systems.

Sharif M.N., Sundararajan V., "A Quantitative Model for the Evaluation of Technological Alternatives", Technological Forecasting and Social Change, 24, 1983, pp 15-29
A quantitative model to select the appropriate technology has been developed. The model provides a systematic and analyst-independent methodology for the multicriterion technology selection process, which requires consideration of socioeconomic as well as technological factors.

Singh N., Sushil, "Technology Selection Models for Multi-stage Production Systems: Joint Application of Physical System Theory and Mathematical Programming", European Journal of Operations Research, Vol 4, 1990, pp 248-261
A non-linear 0-1 programming model is presented in this paper. The model is for multi-stage manufacturing systems. The objective of the model is to select an appropriate technology at each stage to minimize the total cost of production.

Son Y.K., "A Comprehensive Bibliography on Justification of Advanced Manufacturing Technologies", The Engineering Economist, Vol 38, No 1, Fall 1992, pp 59-71
A list 274 articles on justification of AMT is presented.

Son Y.K., Park C.S., "An Economic Evaluation Model for Advanced Manufacturing Systems", The Engineering Economist, Vol 34, No 1, Fall 1988
The paper focuses on the fact that stable product and mass production are no more valid. A multi stage investment decision model is proposed to consider all benefits in introducing advanced manufacturing technologies, including improvement in productivity, quality and flexibilty.

Staples G.R., "FMS - Convincing the Board", Flexible Manufacturing Systems, Ed by Warnecke H.J., and Steinhilper R., IFS Publications, 1985, pp 21-25
The paper addresses the fact that every board of directors is a unique combination of personalities, interests, disciplines and experience and this must be recognized when trying to convince it that an investment in FMS would be a good investment.

Tipnis V.A., Misal A.C., "Economics of Flexible Manufacturing Systems", Integrating the Automated Factory, Ed by Steven Cousins, SME, 1988, pp 131-139
This paper presents a systematic FMS justification methodology, with computer aids. The model actually is an assessment of cost and risk performance of the advanced manufacturing systems. This model has five steps: determining performance levels, determining time/cost savings, performing risk analysis, allocating costs, and determining benefits. The author concludes with identifying the obstacles for FMS justification. All of those obstacles turn out to be due partial implementation rather than a full implementation. The gains of FMS are hindered due to partial implementation.

Troxler J., Blank L., "A Comprehensive Methodology for Manufacturing System Evaluation and Comparison", Journal of Manufacturing Systems, Volume 8, No 3, pp 175-183
This paper presents a comprehensive methodology that systematically identifies the relevant decision factors and incorporates them in a procedure to indicate the value of the system to the user. The model has four major attributes which are also divided into several factors. These attributes are: suitability, capability, performance and productivity. This model is recommended for both justification planning studies and postimplementation tracking analysis.

Wheelwright S., "Manufacturing Strategy: Defining the Missing Link", Strategic Management Journal, Vol 5, 1984, pp 77-91
This paper presents the eight dimensions of the manufacturing strategy. According to this paper, manufacturing strategy has three levels: corporate strategy, business strategies and functional strategies.

Wilner N., Koch B., Klammer T., "Justification of High Technology Capital Investment - An Empirical Study", The Engineering Economist, Vol 37, No 4, Summer 1992, pp 341-351
The paper presents the results of a survey done among companies who has acquired high technologies recently to study the justification methods used. The survey results provide that some evidence that the analysis process considers a wide variety of factors in reaching investment decisions.

Wolf C., Abdel-Malek L., "Measuring the Impact of Life Cycle Costs, Technological Obsolescence, and Flexibility in the Selection of FMS Design", IE Working Paper, New Jersey Institute of Technology
A quantitative measure that facilitates comparison of alternative FMS designs with respect to system's flexibility, life cycle cost, and maintenance of its competitive ability, is presented in this paper.

Blass K., "World-Class Strategies Help Create A World-Class CIM Facility", Industrial Engineering, November 1992, pp 26-29
This paper focuses on the new manufacturing center of Allen-Bradley named EMS1. This facility was implemented in three phases: 1.meeting existing demands for capacity, integrating new production capability using CAD data and achieving new printed circuit board implementation in just one day, 2.increasing throughput and quality while decreasing inventory, 3.computer integration of the facility and continuing quality improvements.

Bommer, Janaro, Luper, "A manufacturing strategy model for international technology transfer", Technological Forecasting and Social Change, 39, 1991
The authors modify so called Hill model for technology transfer. The Hill model had four major components: corporate objectives, marketing strategy, order-winning criteria, manufacturing strategy. The restructured model divides the factors related to the manufacturing strategy into two groups: process and infrastructure. According to the findings of the authors, selection of appropriate manufacturing process and supporting infrastructure with regard to technoware, humanware, infoware, and orgaware requirements depends on the existence of appropriate host country conditions.

Brooks L., Wells C., "Role Conflict in Design Supervision", IEEE Transactions on Engineering Management, Vol 36, No 4, November 1989, pp 271-281
This paper differentiates the responsibilities of design supervisor in design department with CAD and without CAD. The author proposes three models of CAD organization: Pre-CAD, Post-CAD, and an integrated CAD organization. The main conclusion of the paper is that problems with the role of the first line supervisor revolve around him not being a regular competent up to date user of CAD. According to the authors the traditional role of the supervisor is passed to a lead designer whose activities are split between working on his own design tasks as an experienced CAD user, and supervising the work of a small group of subordinates.

Charlie von Ohsen, "Implementing CIM in a Small Company", Industrial Engineering, November 1992, pp 39-42
This paper presents a basic model for small companies to implement computer integrated manufacturing. According to the author there are three phases: defining the business needs, selecting software, selecting hardware. The author also identifies 6 distinct requirement: module integration, future system growth, system security, training, and system maintenance.

Crocker O., Guelker R., " The Effects of Robotics on the Workplace ", Personnel, September 1988, pp 26-36
This paper discusses the changes in the workplace due to the introduction of Robotics. These changes are classified as societal changes, structural changes, and

conclusions on the data that they collected from a 1987 nationally representative sample of US establishments in 21 metal-working and machinery-manufacturing industries. Without the kinds of connections to trade associations, to equipment manufacturers, and to special order customers - which help to transfer technical know-how and therefore underwrite the risks of adopting a new process technology - the results of the study would suggest that the isolated small firm that relies on traditional techniques is not likely to even attempt the necessary retooling of machines and people.

King W.R., Ramamurthy K., "Do Organizations Achieve Their Objectives from Computer-Based Manufacturing Technologies", IEEE Transactions on Engineering Management, Vol 39, No 2, May 1992, pp 129-140

This paper presents the results of an empirical study of 222 U.S. manufacturing firms aiming to identify whether or not the organizations are achieving their objectives from CAM based technologies. The findings of the study show that a considerable gap exists between the firms' expectations and their perceived achievements. The results also indicate that manufacturing firms in US are currently more concerned with addressing micro-level operational issues through AMT's rather than the more strategic benefits.

Kohler, Schmierl, "CIM - technological and organizational change in West German capital goods industry", Journal of Manufacturing Systems, Vol 10, No 1

This article presents the findings of a research aiming investigating the actual diffusion of CIM technologies and related developments in the organization of production and work. The findings were based on the results of a survey in West Germany. Those findings show that the utilization of CIM components and their integration is limited; yet promises dynamic growth and extensive dissemination in the near future. According to the author the chosen strategy for implementing CIM components and Systems plays an important role in determining the direction of technological and organizational change in companies.

Kunnathur A.S., Sundararaghavan P.S., "Issues in FMS Installation: A Field Study and Analysis", IEEE Transactions on Engineering Management, Vol 39, No 4, November 1992, pp 370-377

This paper is based on plant visits and interviews conducted as a part of the field study of five distinct FMS installations. The authors develop a guideline for the management of automation projects. They recommend to include input from functional units on an on-going basis, to encourage MIS participation for analysis of software capabilities and limitations, to set up a master plan for initiating and monitoring automation projects, to use evaluation criteria tailored to automation projects, to build infrastructure needed for automation projects in the long term, and to plan for integrating automation into the portfolio of manufacturing facilities.

Margirer,G., "Flexible Automated Machining in France: results of a survey", Journal of Manufacturing Systems, Vol 6, No 4
This paper presents the findings of a survey concerning the flexible automation of machining processes in France. The author claims that flexibility cannot be measured in absolute terms, but only by taking into account the degree of automation which is achieved. The author tries to find answers to the following questions: to what extent have flexible automated machining systems been developed in France?, what economic reasons are behind their introduction by the industrialists in this sector?, what are the characteristics of the equipment which has already been installed, and what is its degree of flexibility? Their findings show that industrialists choose FMS in order to reduce in-process inventory and to raise productivity. the increase in product diversity, which is an important parameter of flexibility, plays only a subsidiary part in the choice.

Marks P., "CIM Directions", Integrating the Automated Factory, Ed by Steven Cousins, SME, 1988,
The authors observe the three dimensions of CIM integration. They define those dimensions as: inside to outside, being coordination with outside suppliers and customers, beginning to end, being linking functions like design and manufacturing, and top to bottom, being commitment from top management thru line worker.

Mehra S., Inman A., "Determining the Critical elements of Just-In-Time Implementation", Decisions Sciences, Vol 23, 1992, pp 160-174
This paper identifies the elements if JIT implementation that are required to ensure successful implementation. A number of implementation elements were identified and grouped into a hierarchical structure consisting of our broader elements. Four major groups were: management commitment, JIT production strategy, JIT vendor strategy, and JIT education strategy. The criteria used for judging level of success in JIT implementation were : downtime reduction, inventory reduction, workspace reduction, increased quality, labor utilization, equipment utilization, increased inventory turns. The authors conclude with a new version definition of JIT: JIT is a production strategy that strives to achieve excellence in manufacturing by reducing setup times and in house lot sizes through the use of group technology, cross training of employees, and sound preventive maintenance.

Meredith J, "The Role of Manufacturing Technology in Competitiveness: Peerless Laser Processors", IEEE Transactions on Engineering Management, Vol 35, No 1, February 1988, pp 3-10
This paper presents a case study on a successful manufacturing technology experience. With this case study the author makes six observations: the new manufacturing technologies appear to require a champion at the top of the organization for their successful and continuing employment, the new technologies may be particularly amenable to employment, creativity in the design and use of technologies is mandatory, the use of the technology must also be a learning process

to maximize its competitive performance, the firm's infrastructure must be able to support the technology or be modified to do so, the benefits of the new technologies appear to lie in creating new market, offering economic customization, tying the firm closer to its customers and improving the image of the firm.

Mullin A.W., " Preparing for New Technology ", Education and Training in Robotics, ed T.M.Husband, IFS Publications, 1986, pp 33-41
This paper presents the strategy followed by Ford Motors to introduce Robotics into manufacturing. The paper supplies new layout of the assembly line with installed robots. The strategy is basically developing a training program consisting of different levels for different skill requirements.

Osborne D., "Training - The Key to Success in the Use of Robots", Education and Training in Robotics, ed T.M.Husband, IFS Publications, 1986, pp 61-68
This paper presents the advantages of training before introducing robotics. According to the author early act is the main key to success. A guide line for the training program is also provided.

Parthasarthy R., Sethi S.P., "The Impact of Flexible Automation on Business Strategy and Organizational Structure", Academy of Management Review, Vol 17, No 1, 1992, pp 86-111
This article presents a framework for explaining the technology strategy-structure relationship in the context of the current trends toward flexible automation. By linking technology choices directly to a firm's external environment and by invoking the concept of "fit" the framework places technology and strategy in a reciprocal relationship. The framework is used as a basis for examining the specific linkages arising from flexible automation and the posited relationship of this automation with strategy and structure. A set of research propositions is offered suggesting that superior performance can result when strategy and structure are congruent with the competencies and constraints of the firm's technological choice.

Rahimi M., Hancock P., Majchrzak A., "On Managing the Human Factors Engineering of Hybrid Production Systems", IEEE Transactions on Engineering Management, Vol 35, No 4, November 1988, pp 238-249
The paper focuses on managing human factors in the transition toward total automation. During this period the manufacturing systems consist of production equipment that is neither completely manually or automated. The authors used hierarchical decomposition to break down the hybrid production system which is reported to have three sublevels: human resource utilization, worker-machine environment, and intelligent machine.

Rosato P.J., "Training Strategies for Robotic Implementation", Education and Training in Robotics, ed T.M.Husband, IFS Publications, 1986, pp 69-80
This paper focuses on different training strategies that should be implemented to ensure success in implementing robotics technology. The author compares and contrasts several training strategies identified from the literature.

Senker P., " Coping with New Technology: The need for Training", Education and Training in Robotics, ed T.M.Husband, IFS Publications, 1986, pp 3-11
This paper introduces a summary of the technical development of manufacturing in the last 200 years. The paper is concerned about the need for new skills in an environment of employment contraction in manufacturing. The paper discusses the strategic management of advanced manufacturing technologies to identify the new skills required.

Turnage J., "The Challenge of New Workplace Technology for Psychology", American Psychologist, Vol 45, No 2, February 1990, pp 171-178
This paper reviews the research on the impact of new technologies on the individual employee, on management methods and on organizational structure. New workplace technologies pose many challenges for industrial and organizational psychologists, including how they may contribute to systematic research aimed toward productivity improvement. This review concludes that technological innovation will not be adopted and thus will not improve US productivity unless a balance is achieved between technological development and human resource management needs.

4. MARKET ASSESSMENT

Baker K., Hozier G., Rogers R., "Supply-Side Marketing:Risks and Benefits", Research Management, Sep-Oct 1987, pp 26-30
This paper reviews the continuing difficulty with the marketing-R&D interface and evaluates the new concept of supply-side marketing from a classical marketing management perspective.

Baker K.G., Albaum G.S., "Modeling New Product Screening Decisions", Journal of Product Innovation Management", Vol 1, 1986, pp 32-39
The performance of several different types of evaluating potential new products at various stages have been contrasted. Many intearctions of marketinf with other factors have been identified.

Bragaw L., Leslie J., "Business Simulations: Their Use to Stimulate Technological Innovation and Change", Proceedings of Mgmt of Tech IV, 1994, Ed's Khalil and Bayraktar, IIE, pp 721-729
Although the paper focuses on simulation of innovation, it also identifies the impacts of innovations on the market.

Brockhoff K., Chakrabati A.K.,"R&D/Marketing Linkage and Innovation Strategy", IEEE Transactions on Engineering Management, Vol 35, No 3, August 1988, pp 167-174
The R&D/marketing interface issues under different conditions of perceived dynamics of technological environment in West German firms have been explored.

Chenier A., Ingham J., "Success Factors of Technological Innovations Generated in a Techno-Push Fashion: An Exploratory", Proceedings of Mgmt of Tech IV, 1994, Ed's Khalil and Bayraktar, IIE, pp 173-182
This exploratory and qualitative study attempts to identify factors that may have an impact on the performance of technological innovations. Many interaction relationships have been identified as well. (Marketing etc)

Drucker P., "The Discipline of Innovation", Harvard Business Review, May-June 1985, pp 67-72
The sources and impacts of innovation have been discussed. The impacts on marketing issues have been discussed as well.

Harrison R., Hart M., "Innovation and Market Development: the Experience of Small Firms in a Peripheral Economy", OMEGA, Vol 15, No 6, 1987, pp 445-454
The paper summarizes some results from a study of innovation in the small firm in Northern Ireland. The major focus is on the relationship between performance, as measured by changes in turnover and export market development, and innovation.

McLoughlin I., Rose H., Clark J., "Managing the Introduction of New Technology", OMEGA, Vol 13, No 4, 1985, pp 251-262
The findings from two case studies present how managers developed contrasting approaches to the problem implementation in the context of opportunities and constraints presented by product markets and technological advance.

McIntyre S., "Market Adaptation as a Process in the Product Life Cycle of Radical Innovations and High Technology Products", Journal of Product Innovation Management, June 1988, Vol 5 No 2 pp 140
Market/innovation interface has been discussed.

Meredith J, "The Strategic Advantages of New Manufacturing Technologies for Small Firms", Strategic Management Journal, Vol 8, 1987, pp 249-258
The author discusses the point that not only large companies can benefit from advanced manufacturing technologies. After describing the new technologies, their benefits and risks, he presents two case studies of small firms that made strategic use of these benefit. He concludes that selective investment at critical points in the production process will be the key factor for small firms. This critical point may be in design with CAD, or in manufacturing with CAM. The market conditions are highlighted as the baseline for selecting the critical point.

More R., "Improving the Organizational Adoption Rate for High-Technology Industrial Products", Journal of Product Innovation Management, 2, 1984, pp 182-189
This paper presents a good framework of the relationship of the market variables with the business strategy.

Roller L.H., Tombak M.M., "Competition and Investment in Flexible Manufacturing Systems", Management Science, Vol 39, No 1, January 1993, pp 107-114
The effects of the market structure on the FMS acquisition are studied in this paper. The resultant market condition attained through acquisition is forecasted by a two-stage model developed in this paper.

5. INNOVATION STRUCTURE ASSESSMENT

Abrahamson E., Rosenkopf L., "Institutional and Competitive Bandwagons: Using Mathematical Modeling As a Tool to Explore Innovation Diffusion", Academy of Management Review, Vol 18, No 3, 1993, pp 487-517

This paper deals with the so called "bandwagon pressure", which can be caused by the sheer number of organizations adopting an innovation, prompting other organizations to adopt this innovation. The model developed considers differences in the characteristics of the organizations as well. The bandwagons were found to diffuse technically inefficient innovations or reject efficient ones.

Bhargava S.C., Kumar A.A., Mukherjee A., "A Stochastic Cellular Automata Model of Innovation Diffusion", Technological Forecasting and Social Change, Vol 44, 1993, pp 87-97

During the course of the research it was found that the growth for a given market potential can be determined by a parameter that quantifies chance preferences of individuals for the product and can be estimated from field surveys.

Bommer M.R.W., Janaro R.E., Luper D.C., "A Manufacturing Strategy Model for International Technology Transfer", Technological Forecasting and Social Change, Vol 39, 1991, pp 377-390

The model developed here, can encompass the factors important to the strategic decisions of international transfer of technology, which includes the purpose and mode of the transfer as well as the environmental conditions of the recipient country.

Carriere J., Julien P., "Sectorial New Tecchnology Adoption Rates and Patterns in Small and Medium Manufacturing Firms", Proceedings of Mgmt of Tech IV, 1994, Ed's Khalil and Bayraktar, IIE, pp 132-142

This paper presents the results of a survey on new technology adoption patterns in ten manufacturing sectors of the Quebec economy. Sectorial results are analyzed according to a diversity and an intensity index of adoption.

Ehrnberg E., Jacobsson S., "Technological Discontinuity and Competitive Strategy", Technological Forecasting and Social Change, Vol 44, 1993, pp 27-48

This paper identifies the dynamics of the innovation diffusion process of Flexible Manufacturing Systems. It lists the major factors and examines Europe as a case study. It has been found that the nature of the change of the technology base and the rate of diffusion are the major factors of technological discontinuity in this field.

Filippini L., "A Note on the Diffusion of Innovation", Technological Forecasting and Social Change, Vol 44, 1993, pp 283-290
The focus of the paper is the process of substitution between technologies in a framework of increasing returns to scale. The paper lists the interaction between capacity expansion and market demand as explanations of the diffusion of technologies into their niches.

Gerwin D., "A Theory of Innovation Processes for Computer-Aided Manufacturing Technology", IEEE Transactions on Engineering Management, Vol 35, No 2, May 1988, pp 90-100
Based on the concept of uncertainty, a theory of the innovation process for a radical manufacturing technology, computer aided manufacturing. The innovation process is analyzed in three phases: adoption, preparation, implementation

Harvey J., Lefebvre L.A., Lefebvre E., "Exploring the Relationship Between Productivity Problems and Technology Adoption in Small Manufacturing Firms", IEEE Transactions on Engineering Management, Vol 39, No 4, November 1992, pp 352-358
This paper presents the results of a survey done among 100 small manufacturing firms to explore the decision process to adopt new manufacturing technologies. Small manufacturing firms that adopt new manufacturing technologies, were found to exhibit different productivity profiles from other firms. They appeared to have fewer problems in a number of critical areas, to be better managed and better equipped to face competitors.

Kalaitzandonakes N.G., Boggess W.G., "A Dynamic Decision-Theoretic Model Technology Adoption for the Competitive Firm", Technological Forecasting and Social Cahange, No 44, 1993, pp 17-25
This paper focuses on the technology adoption problem of the competitive firm. The firm is assumed to allocate a quasi fixed factor between a traditional and a new technology. In the presence of costs of adjustment and learning, the adoption problem is formulated as an optimal control problem.

Kamath R.R., Mansour-Cole D.M., Apana R., "Functional Perspectives on Innovation: The Correlates of Innovation in the Marketing and Manufacturing Functions", IEEE Transactions on Engineering Management, Vol 40, No 3, August 1993, pp 293-299
Innovation decisions in the manufacturing and marketing functions has been investigated. It is proposed that manufacturing managers link their innovation decisions to their assessment of the product's uniqueness in comparison with competitors' products, whereas marketing managers link their innovation decisions with their clarity of innovation objectives based on the customers' needs.

Kelley M.R., Brooks H., "External Learning Opportunities and the Diffusion of Process Innovations to Small Firms", Technological Forecasting and Social Cahange, No 39, 1991, pp 103-125
This paper focuses on explaining which types of small firms have failed to adopt well-known improvements in process technology. It has been found that certain types of organizations are better positioned than others to generate and to adopt innovations.

Kumar U., Kumar V., "Technological Innovation Diffusion: The Proliferation of Substitution Models and Easing the User's Dilemma, IEEE Transactions on Engineering Management, Vol 39, No 2, May 1992, pp 158-168
In this paper, the proliferation, assumptions, motivation, and behavior of various substitution models of the technological diffusion process are explored. The development, motivation, and assumptions of various deterministic and binary substitution models have been discussed and compared on the basis of mathematical characteristics.

Lewis L.K., Seibold D.R., "Innovation Modification During Intraorganizational Adoption", Academy of Management Review, Vol 18, No 2, 1993, pp 322-354
A theoretical framework illustrating key sets of constructs and processes, both at the individual level and at the organization level, that constitute the intraorganizational adoption of innovations, has been proposed in this paper. The framework illustrates how socialization, social influence, and structuration processes in organizations operate to influence the degree of fidelity (match between design/intended use and actual use) and uniformity (similarity across users) in innovation processes.

Mansfield E., "New Evidence on the Economic Effects and Diffusion of FMS", IEEE Transactions on Engineering Management, Vol 40, No 1, February 1993, pp 76-78
This paper studies the diffusion of Flexible Manufacturing Systems in USA, Japan, and Western Europe. One of the findings of Mansfield is that FMS can be justified easier in Japan than US.

Miller R., Blais R.A., "Modes of Innovation in Six Industrial Sectors", IEEE Transactions on Engineering Management, Vol 40, No 3, August 1993, pp 264-273
In this paper patterns of innovation in six different sectors are analyzed: pharmaceuticals, financial services, software services, pulp and paper, metallic products, and apparel. Four different styles of innovation has been observed: science-based product innovators, entrepreneurial fast-track experimenters, global cost leaders, conventional reliance on information technology and process adaptation.

Murdick R.G., Georgoff D.M., "Forecasting: A Systems Approach", Technological Forecasting and Social Change, No 44, 1993, pp 1-16
This paper discusses current forecasting nomenclature limitations and suggests that technique selection should include the total forecast system. It next presents a model that identifies system components and dimensions and characteristics of components.

Nieto M., "Model for the Strategic Management of Technological Innovation", Proceedings of Mgmt of Tech IV, 1994, Ed's Khalil and Bayraktar, IIE, pp 222-231
The paper focuses on the systematic decision making progress. According to the research the decisons are grouped on three levels: strategic analysis of technology, formulating the technological strategy, and implementing technological strategy.

Prasad L., Rubinstein A.H., "Conceptualizing Organizational Politics as a Multidimensional Phenomenon: Empirical Evidence from a Study of Technological Innovations", IEEE Transactions on Engineering Management, Vol 39, No 1, February 1992, pp 4-12
This paper aims at operationalizing organizational politics (OP) in a way that can be useful for analyzing the technological innovation process. The OP has been measured along two dimensions: General Innovation-Related Organizational Politics, Project Specific Organizational Politics at Formulation and Implementation stages of the technological innovation process.

Quinn J.B., "Managing Innovation: Controlled Chaos", Harvard Business Review, May-June 1985, pp 73-84
Patterns of successful and unsuccessful innovation cases have been presented.

Reddy M.N., Aram J.D., Lynn L.H., "The Institutional Domain of Technology Diffusion", Journal of Production Innovation Management, Vol 8, 1991, pp 295-304
In this paper it has been suggested that the institutional scope for understanding technology diffusion, in addition to supplier and user organizations and industries, should include organizations that manufacture technological complementaries, institutions that possess vertical complementary assets, and the nonmarket sector.

Riis J., Sun H., "Technological Innovations and Organizational Changes under the Guidance of Manufacturing Strategy", Proceedings of Mgmt of Tech IV, 1994, Ed's Khalil and Bayraktar, IIE, pp 259-267
A model which identifies the intearction of technological innovations and organizational changes under the guidance of manufacturing is presented. Four subsytems Strategy, Technology, Organization and Management have been studied. (MOST Model)

Rothwell R., "Successful Industrial Innovation: Critical Factors for the 90's", R&D Management, Vol 22, No 3, 1992, pp 221-239
This paper traces developments in the dominant perceived model of industrial innovation from the simple linear 'technology push' and 'need pull' model of 60s thru the 'coupling model' of the 80s to the integrated model of today.

Sage A.P., Benson B., Cook G., "Emerging Technology-Evaluation Methodology", IEEE Transactions on Engineering Management, Vol 40, No 2, May 1993, pp 114-123
A methodology for evaluating emerging technologies at a very early stage of their development has been proposed. The methodology consists of three gateways: Technology, Market and Management.

Saleh S., Wang C., "The Management of Innovation: Strategy, Structure, and Organizational Climate", IEEE Transactions on Engineering Management, Vol 40, No 1, February 1993, pp 14-21
The aim of this paper is to investigate some of the factors that differentiate innovative and less innovative companies. The study focuses on the differences in the managerial strategy, organizational structure, and organizational climate.

Warwick T., Bragaw L., "Value Assessment of Changing Technological Innovation", Proceedings of Mgmt of Tech IV, 1994, Ed's Khalil and Bayraktar, IIE, pp 163-172
The paper focuses on the value assesment of five technological innovation styles by ranking their relative performance, cost and value. The tech. Innovation styles evaluated are: Build and bust, Measure and refine, Break the line, Blast and create, Satisfy and attract.