Roger N. Nagel

Senior Fellow for Creative Programs in the P.C. Rosin Engineering College

Harvey Wagner Professor in the Computer Science and Engineering Department &

Senior Fellow, Enterprise Systems Center

Lehigh University

Education

University Of Maryland, College Park, MD
Ph.D. 1976, Computer Science :Computer Detection of Freehand Forgeries

Stevens Institute Of Technology, Hoboken, NJ
M. S 1969, Mathematics and Computer Science
B. S 1964, General Science and Engineering

Summary of qualifications

A strong and proven ability to convert visionary ideas into practical reality and to make complex ideas simple to understand. Trained as a computer scientist, and highly valued for the ability to stimulate new ideas and concepts in others. An accomplished facilitator, with extensive experience in building consensus in multicultural and interdisciplinary teams. An established track record of partnering successfully with senior executives and academics on major projects in a wide mix of industries including aerospace, automotive, computers, communications, e-commerce, education, electronics, food, manufacturing, textiles and many others.

A prolific contributor of innovative ideas and competitiveness concepts, with a track record as an accomplished thought leader, and advisor to senior executives. Cited by Business Week, Forbes, and Fortune magazines for visionary efforts and as the father of the virtual corporation concept. Served as the leader of the team, which developed the original ideas and concepts for agile manufacturing and global agility strategies. Co-author of the widely influential business book, “Agile Competitors and Virtual Organizations: Strategies for Enriching the Customer.” Introduced new ideas and pioneering insights into the dynamics of people and their relationships in defining and acting upon business challenges in the book “Cooperate To Compete: Building Agile Business Relationships.” Both books are widely acclaimed internationally and are available in more than five languages.

Currently the senior Fellow for Creative programs in the Engineering college, as well as the past CEO and Director Emeritus of the Iacocca Institute. Able to understand and build on a unique background of research, in manufacturing systems, information systems, e-commerce and global competition. An established network of extensive contacts and experience with business and Industry executives in Asia, Europe and the Americas. A broad based background based on a variety of previous positions as a senior executive in Industry, government and academia, over the last thirty years.

A popular consultant, keynote speaker and guest at executive gatherings and board meetings. Routinely asked to describe the future of manufacturing, global competition and the future of e-commerce and digitization strategies in the presence of ubiquitous information and network based competition. Actively works with industry and academic executive’s to formulate strategic options enabled by these technologies.

Professional Background

1. Appointed in June of 2003 as the Senior Fellow for Creative Programs in the P.C. Rosin College of Engineering. Responsibilities include facilitating the creation of new academic programs such

as a minor in engineering for non-engineers, and chairing various faculty committees.

2. Appointed in May of 2000 by the commerce department as the academic representative on the United States steering committee for intelligent Manufacturing Systems (IMS). In this capacity I am one of three senior US executives, one from Industry and one from government to represent the United States in collaboration with Australia, Canada, Europe, and Japan on cooperative research projects in IMS.

3. Appointed January 1, 1999 as a Senior Fellow in the Enterprise Systems Center, to serve as a source of innovation with students in the development of a Collaboratory a new concept for interactive learning between and amongst faculty and students. Also serve as an advisor to the executive director, developing strategic options for the Center. Beginning research to better understand the collaboratory principles fundamental to building value circle relationships in and across industry, academia, government and internationally. Examples include a recently developed partnership for excellence program in industry, and the exploration of potential collaboratory relationships with Chinese professors and industry in manufacturing collaboration between Chinese and American firms, professors and students.

4. Appointed In 1995 as CEO/Executive Director of the Iacocca Institute and as an executive officer of Lehigh University. Responsible for the internal operations of the Institute and to provide leadership and direction to the CEO's of four Lehigh University member corporations involved in economic development. A member of the board of directors of each corporation, worked with the Lehigh trustee oversight committee on corporate governance and oversight. As the CEO of the Iacocca Institute, reported to the President of Lehigh University and served as one of his advisors on revenue generation, economic development, industrial partnerships, the globalization of Lehigh University. Initiated programs to partner with industry on global competitiveness, executive education and leadership development. The Iacocca Institute provided assistance to and developed joint projects with more than one hundred small and medium sized firms each year to help increase their effectiveness and competitiveness.

   Guided the Institute, as it became a gathering place for executives from across the world to formulate and share ideas. Signed cooperative agreements with partnering institutes in Europe, Asia and Latin America. Led the Institute in developing and enhancing the Iacocca Scholars program, bringing executives to campus for seminars, workshops, and in creating the Crossroads of Knowledge program. Focused on making a real and positive impact on students, using hands on experienced based learning approach to cause students at all levels from undergraduate to executives to invent solutions that will work. Motivated by the thrill of interactions with these students and the opportunity to learn from them. Enjoy being a Socratic teacher and mentor.

   Interacted regularly with Lee Iacocca chairman of the Iacocca Institute advisory board, and fifteen other CEO's in reviewing Institute goals and programs and in setting strategy for the Institute. By 1998 the Institute grew its annual contracts and grant revenue to twenty five million dollars.

5. As CEO of the Institute, led the team that created and implemented the Global Village for Future leaders of Business and Industry, in 1997. The global village is an innovative summer program designed to build 21st century global business leaders through goal directed experienced based learning. The state of the art program focuses on three areas: (1) Interdisciplinary, multicultural team building skills; (2) Leadership and Entrepreneurial skills; and (3) the development of an understanding of global business concepts as they differ from those of the late 20th century. In the first pilot year, 1997 52 Iacocca Interns were selected to participate representing 26 countries. All

of the participants in the pilot program, which serves as an experiment in 21st century learning techniques, said they valued it highly and more than 90 percent said it "changed their lives". So did most of the over one hundred global business executives who participated in the program. The executives were asked to share their ideas and concepts for leadership and success, as part of the hands on experience sharing in the program. Personal relationships, helping others and sharing are core elements of the unique global village experience. In 1998, the second pilot year of the Global Village 56 participants attended from 26 countries with even better results. The global village experience goals, objectives and detailed results analysis are documented in a special report of the Iacocca Institute.

6. From 1988-1995 was actively involved in the Iacocca Institute concept starting in 1988 as an active member of the team, which recruited Lee Iacocca and co-authored the proposal to create the Iacocca Institute as a national resource on global competitiveness for Industry and for the students and faculty at Lehigh. In 1989, served, as the Operations Director years and then in 1993 became the Deputy Director of the Iacocca Institute. As deputy director, led the Institute team that produced the "21st Century Manufacturing Enterprise Strategy," with more than thirty thousand copies in circulation.

7. Co-author of three successful books. The two business books "Agile Competitors and Virtual Organizations: Strategies for Enriching the Customer," and "Cooperate To Compete: Building Agile Business Relationships." have been widely accepted. These two books are available in multiple languages, have won awards, and are used as the source of global competitiveness strategies. The third book on Robotics is still today a successful textbook almost ten years after its first publication.

8. Frequently present and share key ideas with senior executives in a broad variety of fields. This ongoing professional activity is undertaken to maintain and share an understanding of the key issues facing industry in the transition to 21st century competition. Each interaction is unique and different part of a formal or informal gathering of executives. Some sessions involve active consulting, plant visits or workshops, while others are invited lecturers or presentations with interactive Q/A sessions. Typically twenty or more sessions have occurred in each of the last ten years. For example in 1998-99 such sessions took place at or involved executives involved with the Emory University Executive program, Northern Ireland Electric company, Delphi interiors, Alpha Laval worldwide manufacturing, the Process Equipment Manufactures Association, Association of Textile Machinery, the Danish Manufacturing Association, the Logistics Forum, the Human Resources Forum, Nutratech, Procure, GMA, the Tool Town Foundation, the Window & Door Association, the Laboratory Products Association, the Professional Builders Association, Euroventure, Armstrong World industries, General Motors, the Smithsonian Museum Information Technology Awards program, Team Pennsylvania, PenDOT, the Agility Forum, and the Discovery Center..

9. Cited by BusineessWeek in an International cover story as one of three "fathers" of the Virtual Corporation concept, have been invited to go around the world advising government and industrial leaders on the effective use of this innovative organizational mechanism. Served as an advisor to President Clinton's New Economic Council, as well as Government ministers and industrial leaders in Asia, Europe, Latin America and the United States.

10. Extended the work on the effective use of the virtual organization concepts, by focusing on the way to get organizations prepared to use the concept. In a pilot program funded by the US government for two million dollars over three years, was a key member of the facilitating staff, and an advisor to the nineteen CEO's whose companies participated in the Agile WEB of

Pennsylvania. This group of companies worked for three years to be able to work quickly and easily together when the opportunity arises. The pilot program identified new techniques for building trust, sharing information and establishing a common set of values, ethics and expectations between companies who want to work together.

11. Selected in 1992 the commerce Department to be a member and then Chairman of a United States Technical Committee negotiating the feasibility of sharing Intelligent Manufacturing Systems (IMS) across the world. Represented our country for three years in the IMS feasibility negotiations with delegations from Europe, Japan, Canada and Australia. Responsible for organizing and conducting real experiments with real and valued results which involved shared manufacturing expertise across at least two continents. More than fifty firms participated in seven test cases involving all five regions. The feasibility program was deemed to be a success by all of the governments involved and a formal follow program was launched.

12. In 1991 selected by DOD executives to be the leader/ facilitator of a team of Industrial executives who created the "21st Century Enterprise Strategy". The United States Government commissioned this visionary report for the Congress of the United States. Its goal to show the path that would allow American based global manufacturing to return to a position of leadership on the competitiveness stage. The report introduced the concepts of agile competitors and virtual organizations and is accepted around the world as a key enabler of the competitiveness transition we are now experiencing, More than thirty thousand copies of the report are in circulation. As a result of this work was invited to testify before congress on multiple occasions and to advise government leaders on the rapid spread and deployment of the Agility vision. Lehigh received a twenty million dollar grant over five years to create a small organization led by industry, which would advise the government and assist industry in the deployment of agility strategies. As of 1999 Agility is a strategic objective of major corporations around the world. Agility research is ongoing in major universities across the globe. For example in an April 1999 gathering of European and American leaders in global manufacturing involving University and industry leaders. The heads of the European and American delegation requested an update of his view of the original "21st Century Manufacturing Report". More than half of the speakers attending this important meeting talked of the need for agility more experience in using virtual organizations

13. Honored In 1987Lehigh with an Endowed Chair, selected to receive a lifetime appointment as the Harvey Wagner Professor of manufacturing Systems Engineering. The chair appointment was made in recognition of accomplishments as a member of the National Academy of Sciences Manufacturing Studies Board, the leadership role in creating the award winning Manufacturing Systems Engineering program.

14. From 1982 until 1989 served as advisor to more than twenty-five MS students and four Ph.D. students. Also led a variety of faculty teams and conducted collaborative research projects with industry. Was the principle investigator on more than ten million dollars in contracts and grants, and led the faculty team implementing the interdisciplinary Manufacturing Systems Engineering (MSE) Program. This innovative program involved faculty from seven departments in two colleges. The program was initially funded by an award from IBM of two million dollars and won an award in 1985 for the best faculty team implementing and teaching computer integrated manufacturing. Also served as the founding director of the Institute for Robotics, and the Intelligent Systems Laboratory, and served as the director of the Center for Design and Manufacturing innovation (CDMI).

15. 1981 was a founding member of the Robotics International Society and chairman of the research

group.

16. Was selected in 1980 meeting at the National Academy of Sciences, to be the leader of the United States team, which developed the IGES standard for the exchange of CAD/CAM data. In this role with two colleagues from Boeing and GE was responsible for building consensus amongst forty companies in three months. Provided technical expertise, leadership and facilitating skills. The IGES organization that we started in 1980 continued to facilitate collaboration across industrial firms for more than a decade. . The IGES organization then evolved into the IGES/PDES organization and finally adopted the role as American home for the international work on STEP. This pioneering work was recognized by several professional societies who presented a variety of awards over the next fifteen years. These awards include the "Jacquard Award" and a special ceremony at Autofact, and others.

17. Was a key leader and member of the scientific team developing the Factory Hierarchical Control system in the Robotics group at the national Bureau of Standards (NBS) now NIST. The work on Hierarchical control systems along with James Albus and Tony Barbera and Gordon Vanderbrug has been the basis of hundreds of computer based control systems for automation over the last twenty years. The research directions started in 1979 and 1980 at the NBS were continued for most of the next fifteen years. Serves as a technical advisor and consultant to the Manufacturing Engineering Laboratory and many of its division chiefs still today in 1999.

18. Was a Senior Staff Fellow at NIH beginning in 1995. Developed a patent on an imaging invention of that time and pioneered some of the early software for CAT scanner analysis. Invented 3D visual simulation techniques for medical applications in the National Institute of Dental Health. This technique was later used in NIST as a means of visualizing small changes in the molecular measuring machine project.

19. During the years from 1969-1976 served as an Instructor in the Computer Science Department, at the University of Maryland, a Consultant to Earth Satellite Corporation was a principle in a software development business. Also worked as a full time Ph.D. student. Earned a Ph.D. in Computer Science in January of 1976. Had research support while at the University from a former employer and various federal agencies, with a research focus on computer animation, Image processing and Artificial Intelligence.

20. 1968 was one of three key professionals on the team at MAGI which created the three dimensional modeling package used by private and commercial CAD/CAM systems like CADAM Solids over the next 25 years

21. 1966 was responsible for developing and writing systems software for the Apollo Mission Simulators. In this capacity led a team of five systems programmers in creating shared memory code for multiple machines and supporting the simulation programs used by NASA for Astronaut training.

National Academy & Government Service

Appointed by the Commerce Department office of the Deputy Secretary for Science and Technology as Chairman of the United States Technical Committee on Intelligent Manufacturing Systems, 1992 for three-year term.

National Research Council Commission on Physical Sciences, Mathematics & Resources Panel for Manufacturing Engineering - appointed September 1989 and renewed September 1993 to conduct annual peer review of the National Institute of Science & Technology's (NIST) Center for Manufacturing Engineering.

Served as a senior member of the National Research Council's (NRC) Manufacturing Studies Board (MSB) from 1982 through June 1991.

Appointed to be a member of the MSB Committee on Global Manufacturing: Comparative Cost Factors & Structures a sub committee of the NRC Commission on Engineering & Technical Services, 1989.

Appointed to be a member MSB sub Committee on Graduated Mobilization Response, November 1989

Panel on Alternative Concepts in Manufacturing, Committee on Research Directions & Needs in U.S. Manufacturing of the Manufacturing Studies Board (MSB) & Commission on Engineering & Technical Services, National Research Council (NRC), 1989.

Asked by the National Research Council Office of Japan Affairs to help organize the "U.S. Committee for the Bilateral Exchange on Approaches to Robotics in the U.S. & Japan", 1989.

Appointed as member of the Advanced Manufacturing Technologies Group of the Science & Technology Committee of the Committee on Strategic Technologies for the Army (STAR), 1989.

National Research Council delegate in the Bilateral Exchange on Approaches to Robotics In The U.S. and Japan, September 1989.

National Research Council Committee member at the Conference on Japan-U.S. Manufacturing Research Exchange, 1988.

Member of Robotics-Automation Group, Navy-21 Study, Naval Studies Board, September 1987.

Selected to be Chairman of the MSB committee working on "A Framework for Understanding the Ingredients of an Intelligent Knowledge-Based Manufacturing System," (sub committee of MSB), September 1986.

Member of the National Research Council 's Air Force Studies Board, Committee on Advanced Robotics for Air Force Operations, appointed for two-year term, with equivalent rank of two star General May 1986.

Appointed to be a member of the Committee to Review Army Robotics & Artificial Intelligence (sub committee of MSB), October 1982 and January 1986.

Appointed as a member of the Commission on Engineering and Technical Systems, Panel on Manufacturing Systems Research, November 1984 - 1985.

Professional Job History

1982 – Present Lehigh University Bethlehem, PA.

Wager Professor & Senior Fellow

1980 – 1982 International Harvester Hinsdale, IL.
Manager of Automation Technology in Corporate Science & Technology Laboratories

1978 – 1980 National Bureau of Standards (NBS)Gaithersburg, MD.
Group Head CAD/CAM Integration in Center for manufacturing Engineering

1975 - 1978 National Institutes of Health Bethesda, MD.
Senior Staff Fellow in National Institute of Dental Research

1969 - 1976 University of Maryland College Park, MD.
Instructor and Faculty Research Associate in Computer Science & Artificial Intelligence

1965 - 1969 Mathematical Applications Group Inc (MAGI) White Plains, NY
Systems Analyst in small Science based entrepreneurial firm

1964 - 1965xx Link Computation Center Pleasantville, NY

Project Leader responsible for creating systems software for Apollo Mission simulators

Patents and publications

Devia, N. and Nagel, R.: "Value-focused Borderless Collaboratories: The next Agility Development" (in Preparation for submission to the Fourth Annual Virtual Company Conference May 17-18, 2000. Charleston West Virginia.)

Nagel, R. and Devia, N: "Agile Manufacturing" Proceedings of the 5th International Conference on Manufacturing Technology; Beijing, China. Nov. (1999).

Nagel, R. and Devia, N: "The Dawning of Relationship Based Competition" The Quality Yearbookp.61-68J.W. Cortada and J. A. Woods Eds. (1997).

K. Preiss, Goldman, S. L. and R. N. Nagel (1996) Cooperate to Compete: Building Agile Business Relationships New York, NY: Van Nostrand Reinhold.

Nagel, R. and Devia, N: "Agile Web Inc.'s Core Competencies." Publication-ready paper Submitted as part of the Iacocca Institute's Final Report to Ben Franklin Technology Center. December (1996).

Nagel, R. and Devia, N: "How to Determine the Core Competencies of an Agile Web"Publication-ready paper submitted as part of the Iacocca Institute's Final Report to Ben Franklin Technology Center. December, (1996).

Devia, N. and Nagel, R "An Agility Quick Test for Assessing Agility Performance of a Manufacturing Organization." Proceedings Fifth National Agility Conference; Boston, Massachusetts, March 5-7, (1996)

Devia, N. and Nagel, R. "Initial Experience with the Development of Agility Measures and Audits in Manufacturing Operations," Proceedings, Agility Forum Conference, Volume I, Atlanta, Georgia, March (1995)."

Goldman, S. L., R. N. Nagel and K. Preiss (1995). Agile Competitors and Virtual Organizations: Strategies for Enriching the Customer, New York, NY: Van Nostrand Reinhold.

Goldman, Steven L., and Roger N. Nagel. 1993. "Management, Technology, and Agility: The Emergence of a New Era in Manufacturing," Interscience Enterprises Ltd. 8(1/2): 18-37.

Goldman, S. and Nagel, R.: Management, Technology, and Agility in "Competitiveness and American Society (Research in Technology Studies, Vol. 7)" Steven L. Goldman (Editor), Hardcover February 1993, Lehigh University Press; ISBN: 0934223289

Nagel, R.: "What Industry Must Do". Electronics Magazine, April 1992.

Nagel, R., Dove, R.: "21st Century Manufacturing Enterprise Strategy" (Volumes 1 & 2), November 1991.

Raban, S., Nagel, R.: "Constraint-Based Control of Flexible Flow Lines". International Journal of Production Research, 1991.

Preiss, K., Nagel, R., and Krenz, K.: "Design & Manufacturing in an Information-Limited Environment", Journal of Design & Manufacturing, September 1991.

Krenz, K., Preiss, K., and Nagel, R.: "University Industry Partnership in Designing & Developing a Modern Automated Electronics Factory", Annals of the CIRP, Proceedings of the 40th General Assembly, Berlin, Germany, September 1, 1990.

Nagel, Roger N.: "Shortening Product Development Times", Fortune Magazine, and March 1990.

Krenz, K. A. and Nagel, R. N.: "Critical Performance Measures for FMPS Design and Management", Proceedings of the 21st CIRP Manufacturing Systems Seminar, Stockholm, Sweden, June, 1989.

Contributing Author: Advanced Robotics for Air Force Operations - Robotics: Leverage for the Future. Committee on Advanced Robotics for Air Force Operations-AIr Force Studies Board, National Research Council, Washington, DC, 1989.

Hawker, J. & Nagel, R.: "World Models in Intelligent Control Systems". International Trends in Advanced Manufacturing Technology: Autonomous Robots, IFS Publications, and Bedford, England, 1989.

Nagel, R. N.: "Manufacturing Systems Engineering and the Factory of the Future", U. S. Congressional Record, June 27, 1988.

Hawker, J. S. and Nagel, R. N.: "World Models in Intelligent Control Systems", IEEE

Intelligent Control Symposium, Philadelphia, Pennsylvania, January 1987.

Nagel, R. N., Garrigan, S. R.: "Robots, Anthropomorphic," Encyclopedia of Artificial Intelligence, Volume 2, John Wiley & Sons, Inc., 1987. Pp. 944-956.

Hawker J. S., Nagel, R. N.: "Integration of a Dual Arm Control System," Robotics Research Conference: The Next Five Years and Beyond, August 1986.

Groover, M. P., Weiss, M., Nagel, R.N., Odrey, N. G.: Industrial Robotics: Technology, Programming & Applications, McGraw-Hill Publishing Company, New York, 1986.

Nagel, R. N., Krenz, K. A., Shelly, M.: "Developing & Implementing Modernization/Integration Strategies for Manufacturing Companies," Annals of the CIRP, Vol. 35, pp. 313-
316, January 1986.

Odrey, N. G., Nagel, R. N.: "Critical Issues in Integrating Factory Automation Systems", CIM REVIEW, Auerbach Publishers, pp 29-37, Winter 1986

Hawker, J. S., Nagel, R. N., Odrey, N. G., Roberts, R.: "Multiple Robotics Manipulators", BYTE Magazine, pp. 203-219, January, 1986.

Nagel R. N., Garrigan, S. R.: "Robot Software: Current State of the Art, and Future Challenges," NATO AGARD Lecture Series No. 142: Artificial Intelligence and Robotics, London, England, pp. 4.1-4.9, September 1985.

Odrey, N. G., Nagel, R. N.: "Critical Integration Issues: Control Systems, Data Bases and Standard Interfaces." CAD/CAM: Management Strategies, 1(4.2.4) S17, Auerback Publishers, Inc., pp. 1-11,
June 1985.

Odrey, N. G., Nagel, R. N.: "A Progress Report on Robot Programming," CIM Review, pp. 23-26, Summer, 1985.

Odrey, N. G., Nagel, R, N.: "Outlook on Robotics," article for Data Processing Management by Auerback Publishers, June 1985.

Nagel, R. N.: "Robotics A State of The Art Review," IEEE Society Reprint pp. 566-577 from IEEE The 4th Jerusalem Conference on Information Technology (JCIT) -- Next Decade in Information Technology, May 21-25, 1984, Jerusalem, Israel. Conference co-sponsors are IEEE Computer Society and ACM.

Nagel, R. N., et.al: "Appendix: State of the Art and Predictions for Artificial Intelligence and Robotics," Applications of Robotics and Artificial Intelligence to Reduce Risk and Improve Effectiveness, A Study for the United States Army. A Report of the Committee on Army Robotics and Artificial Intelligence (NRC, Manufacturing Studies Board), Washington, D.C., pp. 42-89, 1983.

Nagel, R. N.: "Robots: Not Yet Smart Enough," IEEE Spectrum, pp. 78-83, May 1983.

Nagel, R. N., et. al.: "Connecting the PUMA Robot With The MIC Vision System and Other Sensors," Proceedings of Robot VI Conference, pp. 447-466, March 1982.

Albus, J.S., Barber, A. J., and Nagel, R. N.: "Theory and Practice of Hierarchical Control," Twenty-Third IEEE Computer Society International Conference, pp. 18-38, Sept. 1981.

Nagel, R. N. (Ed.): "Manufacturing Engineering for Tomorrow's Needs," Proceedings of SME Engineering Foundation Conference, August 1981.

Kelly, T. C., Wolf, R., Kennicott, P., and Nagel, R. N.: "A Technical Briefing on the Initial Graphics Exchange Specifications (IGES)," N.B.S. Report NBSIR 8-2297, July 1981.

Nagel, R. N.: "IGES - Initial Graphics Exchange Specification," Proc. of Autofac West Conference, Nov. 1980.

Wheatley, T. E., Albus, J. S., and Nagel, R. N.: "Robotic Support Project for the Air Force ICAM Program," Proc. of Robot V Conference, Detroit, October 1980.

Albus, J. S., Barbera, A. J., Fitzgerald, J. L., Nagel, R. N., VanderBrug, G. J., Wheatley, T. E.: "A Measurement and Control Model for Adaptive Robots," Proc. of the 10th International Symposium on Robotics, March 1980.

Webber, R. L., and Nagel, R. N.: "Pseudo Solid: Three Dimensional Enhancement of Two Dimensional Images," Journal of Clinical Engineering Vol. 5 #1, pp. 41-50, March 1980.

Wheatly, T. E., Albus, J. S., and Nagel, R. N. (Ed.): Proceedings of NBS/Air Force ICAM Workshop on Robot Interfaces, January 1980.

Nagel, R. N., Braithwaite, W. W., and Kennicott, P. R.: "Initial Graphics Exchange Specification," N.B.S. Report NBSIR 80-1978 (R), January 1980.

Nagel, R. N., et.al.: "Experiments in Part Acquisition Using Robot Vision," SME AUTOFAC 2, November 1979.

VanderBrug G. J., and Nagel, R. N.: "Image Pattern Recognition in Industrial Inspection," N.B.S. Report NBSIR 79-1764 September 1979.

Nagel, R. N.: "Robots on the Assembly Line," Silicon, Satellites and Robots: The Impacts of Technological Change on the Workplace pp. 14-17, AFL-CIO Conference, September 1979.

VanderBrug, G. J. and Nagel, R. N.: "Vision Systems for Manufacturing," Proceedings of IEEE Meeting on Decision and Control Denver, Colorado, June 1979.

Webber, R. L., and Nagel, R. N.: "Theoretical Factors Limiting Source Design," Proc. of Workshop of Rod Anode Sources in Dentistry, U. S. Dept. of Health, Education and Welfare, No. (NIH) 78-248, July 1978.

Webber, R. L., and Nagel, R. N.: "Image Preprocessing As An Aid to Visual

Interpretation," IADMFR Proceedings, Malmo, Sweden, June 1977.

Nagel, R. N. and Rosenfeld, A.: "Computer Detection of Freehand Forgeries," IEEE Transaction on Computers. pp. 895-904, September 1977.

Evans, Jr., J. M., Kirsch, R., and Nagel, R. N.: "Workshops on Standards for Image Pattern Recognition," N.B.S. Special Publication 500 - 8, June 1977.

Blum, H. and Nagel, R. N.: "Shape Description Using Weighted Symmetric Axis Features," Proc. of IEEE Conf. on Pattern Recognition and Image Processing pp. 203-215, June 1977.

Webber, R. L., Youmans, H., and Nagel, R. N.: "A Nonlinear Model for Predicting Radiographic Contrast," Oral Surg., Oral Med., Oral Path. 43:798-811, May 1977.

Nagel, R. N.: "Recent Advances in Forgery Detection," Proc. EIA Symposium on Image Processing and Pattern Recognition, May 1977.

Nagel, R. N., and Blum, H.: "A Symmetric Axis Basis for Object Recognition and Description," Proc. of IEEE Meeting on Decision and Control pp. 168-170, December 1976.

Nagel, R. N. and Rosenfeld, A.: "Computer Detection of Freehand Forgeries," University of Maryland Computer Science Center TR-457, May 1976.

Weszka, J. S., Nagel, R. N., and Rosenfeld, A.: "Threshold Selection Technique," IEEE Transactions on Computers C-23, pp. 1326-1332, December 1974.

Nagel, R. N. and Rosenfeld, A.: "Steps Toward Handwritten Signature Verification," Proc. of the First International Joint Conference on Pattern Recognition pp. 59-66, October 1973.

Weszka, J. S., Nagel, R. N., and Rosenfeld, A.: "A Technique for Facilitating Threshold Selection for Object Extraction," University of Maryland Computer Science Center TR-243, May 1973.

Nagel, R. N.: "Computer Screening of Handwritten Signatures," University of Maryland Computer Science Center TR-220, January, 1973.

Nagel, R. N. and Rosenfeld, A.: "Ordered Search Techniques in Template Matching," Proc. IEEE 60: 242-244, February 1972. Expanded version in University of Maryland Computer Science Center TR-166, August 1971.

Goldstein, R. and Nagel, R. N.: "3-D Visual Simulation," Simulation 16: 25-31, January 1971.

Nagel, R. N. and Rosenfeld, A.: "Digital Zooming," Proc. UAIDE 9th Annual Meeting, pp. 241-249, October 1970.

Nagel, R. N.: "Computer Animation Tutorial," Proc. UAIDE 9th Annual Meeting, pp. 399A-400, October 1970.

Abbamonte, M., Johnston, E. G., Lee, Y. H., Nagel, R. N., Rosenfeld, A., and Thurston, M.: "Edge and Curve Enhancement in Digital Pictures 2," University of Maryland Computer Science Center TR-70-103, January 1970.

J. Roy Davis, Roger Nagel, and Walter Guber, A Model Making and Display Technique for 3-D Pictures, Proceedings of the 7th Annual Meeting of UAIDE, San Francisco, Oct. 1968, pp. 47-72.