

NIGERIAN NATIONAL ORDER OF MERIT NOMINATION FOR PROFESSOR
BARTHOLOMEW OKECHUKWU NNAJI, Ph.D.

Attachment #3:

**Curriculum Vitae of
Professor Bart O. Nnaji**

Office Address

School of Engineering
1048 Benedum Hall, University of Pittsburgh Pittsburgh, PA 15261
Phone: (412) 624-9857; Fax: (412) 624-2910

Citizenship

Nigerian, born in Umuode autonomous community of Nkanu East LGA, Enugu State.

Education:

Ph.D.---Industrial Engineering and Operations Research, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, May, 1983.

Major Area: Manufacturing Engineering and Operations Research. Dissertation: Computer-Aided Design of Robots.

M.S. ---Industrial Engineering and Operations Research, Virginia Polytechnic Institute and State University, January, 1982.

Major Area: Manufacturing Engineering and Operations Research.

B.S. ---Physics (graduated 1st in his class and with distinction) St. John's University, New York, May 1980.

Major Area: Applied physics (Graduated in 2 years 9 months).

Post-doctoral Certificate courses -MIT, Artificial Intelligence Laboratory, 1985. Course: Robot Manipulators, Computer Vision, and Automated Manufacturing. Secondary School (W.A.E.C.) Certificate - St. Patrick's Secondary School, Emene, Enugu State 1975.

•Key Professional Positions:

- William Kepler White ford Distinguished Professor, School of Engineering, University of Pittsburgh (July 2002 - present).
- Alcoa Foundation Distinguished Professor, School of Engineering, University of Pittsburgh (July 1996 - 2002). --
- Founder and Director, United States National Science Foundation Industry / University Cooperative Research e-Design Center for IT Enabled Design and Realization System for Mechanically Engineered Products and Systems (June 2003 - present).
- Chairman, Geometric Power-Reattach Consortium, (the first indigenous private sector power generating company in Nigeria), (2000 - present).
- Federal Minister of Science and Technology, Federal Republic of Nigeria (A national cabinet position) (August 1993 - November 1993).

• Professor of Robotics and Computer-integrated Manufacturing,
Department of Mechanical and Industrial

Engineering, University of Massachusetts (1983 - August 31, 1997).

• Director, Automation and Robotics Laboratory, University of
Massachusetts at Amherst (1984 - 1997).
• Editor-in-chief, International Journal of Design and Manufacturing
(August 1990- December 1995).
• Senior Editor, IIE Transactions on Design and Manufacturing (1996 -
2002)

•) Editor, SME Transactions on Robotics Research (1990-1995).

Research Interest

E-Design and Realization, Robotics & Robotics Assembly, CAD/CAM,

CIM,

Artificial Intelligence, Production, Operations Research and Manufacturing Systems.

Teaching Experience:

William Kepler White ford Distinguished Professor --- School of Engineering, University
of Pittsburgh (July 2002 - present)

ALCOA Foundation Distinguished Professor in Manufacturing Engineering and
Professor of Industrial Engineering with tenure School of Engineering, University of
Pittsburgh (July 1996 -
June 2002)

Professor with tenure -- Department of Mechanical and Industrial Engineering and
member, Graduate Faculty for Manufacturing Engineering Program, University of
Massachusetts (1995 - August 31, 1997)

Professor with tenure --- Department of Industrial Engineering and Operations Research
and member, Graduate Faculty for Manufacturing Engineering Program University of
Massachusetts (1983 - 1995)

Affiliated Professor -- Department of Computer and Information Services, University of
Massachusetts (July, 1989 - present)

Professor-Extraordinary -- Faculty of Engineering, Enugu State University of Science
and Technology, Enugu, Nigeria (1992 - present)

Faculty Member --- National Technological University, teaching Robotics and Computer
Integrated Manufacturing courses on TV being broadcast to various companies and
organizations in USA and Puerto Rico (1987-present)

**NIGERIAN NIGERIAN NATIONAL ORDER OF MERIT NOMINATION FOR
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New Courses Developed & Taught:

1. Automation in Manufacturing and Product Design (MS. and Ph.D. Course)
2. Advanced Topics in Manufacturing (MS. and Ph.D. Course)

3. Advanced Production Planning and Control (required MS. and Ph.D. Course).
4. Automation and Mechanization (MS. and Ph.D. level Course).
5. Industrial Robots Design, Selection Implementation (Senior and Postgraduate Course.)
6. Computer integrated Manufacturing-CIM (MS. and Ph.D. level Courses).
7. Computer Applications in Manufacturing (A 3-credit Video course for practicing engineers in US and Germany) with Professors U. Remold and A. Storr.
8. Design and Manufacturing Automation (MS. and Ph.D. level Course).
9. Computer Aided Design (junior level course)

Other Courses Taught:

1. Manufacturing Control (MS. and Ph.D. level Courses).
2. Production Planning and Control (Undergraduate Final year Course).
3. Senior Capstone Design (Undergraduate Final Year Design Course).

Other Teaching Experience

Graduate Teaching Assistant Department of Industrial Engineering and Operations Research. Virginia Polytechnic Institute and State University (1981. 1982. 1983)
 Courses Assisted: Materials Handling (Spring 1981). Systems Analysis of Global Growth (Spring 1981), Methods engineering (winter 1982), Materials Handling and Plant Layout (Spring 1982). Introduction to Industrial Engineering (Fall 1982), Plant Design and Layout

- Co-principal Investigator with M. Miller (PI): Academy of Applied Science Internship Supervisor, Research and Engineering Apprenticeship Program (REAP), 1993, 8, 0000.00 (funded).
- Co-Principal Investigator with M Miller (PI): Academy of Applied Science Internship Supervisor, Research and Engineering Apprenticeship Program (REAP), 1992, 8, 0000.00 (funded).
- Co-Principal Investigator with M Miller (PI): Academy of Applied Science Internship Supervisor, Research and Engineering Apprenticeship Program (REAP), 1991, 8, 0000.00 (funded).
- Co-Principal Investigator with M Miller (PI): Academy of Applied Science Internship Supervisor, Research and Engineering Apprenticeship Program (REAP), 1990, 8, 0000.00 (funded).
- Co-Principal Investigator with M Miller (PI): Academy of Applied Science Internship Supervisor, Research and Engineering Apprenticeship Program (REAP), 1988, 8, 0000.00 (funded).
- Co-Principal Investigator with M Miller (PI): Academy of Applied Science Internship Supervisor, Research and Engineering Apprenticeship Program (REAP), 1987, 8, 0000.00 (funded).
- Co-Principal Investigator with M. Miller (PI): Academy of Applied Science Internship Supervisor, Research and Engineering Apprenticeship Program (REAP), 1986, 8, 0000.00 (funded).

- Co-Principal Investigator with M Miller (PI): Academy of Applied Science Internship Supervisor, Research and Engineering Apprenticeship Program (REAP), 1985, 8, 0000.00 (funded).
- Co-Principal Investigator with J. Marcus (PI): Academy of Applied Science Internship Supervisor, Research and Engineering Apprenticeship Program (REAP), 1984, 8, 0000.00 (funded).

Academic and Public Service Awards and Honors: Recipient:

- Baker Distinguished Researcher Award (the highest research award given by the Institute of Industrial Engineers) presented May, 2001
- ARCO Petrochemicals Excellence Award pres ARCO Petrochemicals Excellence Award presented at Dorchester Hotel London April 27, 2001.

NIGERIAN NATIONAL ORDER OF MERIT NOMINATION FOR PROFESSOR BARTHOLOMEW OKECHUKWU NNAJI, Ph.D.

- Officer of the Order of Niger, Nigeria's National Honor awarded by the Nigerian President (November 16, 2000)
- Commander of the Order of Niger, Nigeria's National Honor by the Nigerian Head of State (published in national gazette January, 1999)
- Honorary Doctor of Science, the University of Nigeria, Nsukka, awarded April 17, 1999
- Distinguished Scientist Award, World Bank-IMF Africa Group, Washington D.C. (October 25, 1998)
- Fellow, Society of Manufacturing Engineers (inducted November 1998)
- Honorary Doctor of Technology, Enugu State University of Science and Technology (conferred May 9, 1998)
- Honorary Doctor of Science, Federal University of Technology, Yola (conferred November 29, 1997)
- Fellow of the Nigerian Academy of Sciences (inducted July 1997)
- Distinguished Public Service Award by the Nigerian Eagle Society of USA (awarded October 25, 1997)
- Fellow, International Institute of Industrial Engineers (inducted May 1997)
- 1996 Zik Lecture Laureate (this lecture was given at the Nigerian Institute of International Affairs, Lagos on March 21, 1996)
- Elected, member of the New York Academy of Sciences (1996)
- The United States Secretary of State's Open Forum 1995 Distinguished Public Service Award
- Invited to give the United States -Secretary of State's Distinguished Lecture at the Secretary's Open Forum on September 1, 1996
- Invited by the White House to attend a Forum on The Role of Science and Technology in National Security and Global Stability, March 29-30, 1995
- Winner of the 1994 M Eugene Merchant Best Textbook Award (given by the International Society of Manufacturing Engineers) for the book, Computer

Integrated Manufacturing and Engineering, Addison Wesley, which Professor Nnaji co-authored with Remold, U., and Storr, A

- Inducted in St. John's University Sports Hall of Fame, October 1994 (for performance in track and field sports- long and triple jumps)
- Appointed the Federal Minister of Science and Technology for Nigeria in 1993
- Fellow of the International Society for Productivity Enhancement (1994)

- 1992 United Technology Corporation Outstanding Teaching Award
- Nominated for the American Association for the Advancement of Science (AAAS) for a outstanding scientist award (1991) by the African Academy of Arts, Science and Technologies
- 1991 Outstanding Young Engineer Award given by the Institute of Industrial Engineers (Academic)
- 1991 African Immigrant Achievement Award (in USA) in Science
- Proclamations of Congratulations by the Massachusetts Senate, Massachusetts House of Representatives, and the City Council of Boston for the 1991 African Immigrant Achievement Award in Science
- Fellow, African Academy of Arts and Science, and Technologies
- The Onwa I of Nkanuland: A High-Chieftaincy of Achievement conferred by the people of Nkanu (over one million people). Only two other persons have ever held the equivalent title.
- Offered the following Distinguished Professorships: the Samuel Pritchard Professor of Engineering at Virginia Tech (1993); and the Southwestern Professor of Engineering (and Director of the School of Industrial Engineering) at the University of Oklahoma (1993)
- 1988 Society of Manufacturing Engineering Outstanding Young Manufacturing Engineer Award
- 1988 Outstanding Young Faculty Scholar Award, College of Engineering, University of Massachusetts
- Society of Manufacturing Engineering Faculty Development Travel Fellowship Sponsored by TRW Foundation, 1988

NIGERIAN NATIONAL ORDER OF MERIT NOMINATION FOR PROFESSOR BARTHOLOMEW OKECHUKWU NNAJI) Ph.D.

- St. John's University 1980 PRESIDENT'S award for Academic Excellence (awarded to the top University Graduate).
- St. John's University 1980 Dean's Golden Key Award for Scholastic excellence in The field of Physics (awarded to top Physics graduate).
 - ALPHA PI MU - Industrial Engineering Honor Society (since 1981)

Note:

Support documents on the Certificates, Awards & Honors, and other public interest activities are enclosed in a bound volume.

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Attachment #4:

BIBLIOGRAPHY & OTHER RELEVANT DOCUMENTS

(Representative relevant documents enclosed herewith are indicated)

Publications:

Editorship

(• Editor-in-Chief: International Journal of Design and Manufacturing (the research journal of concurrent engineering) published by Chapman-Hall Publishers (August 1990 - 1995). (Volume 4, Number 2 June 1994 enclosed)

- Series Editor, Design and Manufacturing book series for Chapman-Hall Publishers, England (September 1990 - December 1995).(Volume 29, Number 4 April 1997 enclosed)

- Senior Editor, IIE Transactions on Design and Manufacturing (January 1996-present).

- Member of Editorial Board, IIE Transactions on Design and Manufacturing (December 1992 - present)

- Member of Editorial Board, Journal of Medicine and Virtual Reality (1994 present).

- Member of Editorial Board, Journal of Design and Manufacturing Automation (2000 - present).

- Guest Editor, Special Issue of IIE Transactions on Design and Manufacturing, "e-Product Design and Realization", to be published 2001.

Books

Representative samples

- Nnaji B.O. Computer-Aided Design, Selection and Evaluation of Robots, Elsevier Science Publishers, the Netherlands, 1986. (Enclosed)

- Nnaji B. O. Theory of Automatic Robot Assembly and Programming Chapman Hall (January 1994). (Enclosed)

- Remold, U, Nnaji, B.O. And Storr, A. Computer Integrated Manufacturing and Engineering, Addison Wesley (March, 1994) [this book won the M. Eugene Merchant best book award (given by the Society of Manufacturing Engineers)]. (English & German Editions, Enclosed)

- Nnaji, B.O., and Liu, B.C., "Computer Aided Design Techniques for Development of Automated Product Assembly Systems in Manufacturing Systems,"

book chapter in Operational Methods in Computer Aided Designs Vol III 2001, Edited by Cornelius Leondes and published by CRC Publishers. (Enclosed)

NIGERIAN NATIONAL ORDER OF MERIT NOMINATION FOR PROFESSOR BARTHOLOMEW OKECHUKWU NNAJI, Ph.D.

Others (not enclosed)

- Nnaji B.O. (Editor) SME Transactions on Robotics Research, Society of manufacturing Engineers Publication, 1992.
- Nnaji B. 0. (Editor) SME Transactions on Robotics Research, Society of manufacturing Engineers Publication, 1994.
- Nnaji B. 0. (Editor) SME Transactions on Robotics Research, Society of Manufacturing Engineers Publication, 1990.
- Nnaji B. 0. e-Design of Mechanically Engineered Products and Systems McGraw-Hill (in preparation).

Refereed Journal Papers

1. Nnaji B.O., and Davis, RP., "A Summary of Robot Components and Their Characteristics," Journal of Material Flow, Vol. 2, 2 (1985), pp. 245-261.(Enclosed)
2. Nnaji B.O., and Davis RP. "Robot Components Coding System," Journal of Manufacturing Flow, Vol. 4, No.3, (1987), pp. 131-138. (Enclosed)
3. Nnaji B.O., "CAD-based Schema for Assembly Planning Reasoner," Chapter in Expert Systems: Strategies and Solutions in Manufacturing Design and Planning, (edited by A Kusiak), SME Publications, 1988. (Enclosed)
4. Nnaji B.O., "Evaluation Methodology for Performance & System Economics of Robotics Devices," International Journal of Computers and Industrial Engineering, Vol. 14, No.1, pp. 27-39, 1988. (Enclosed)
5. Nnaji B.O., Chu, J. and Akrep, M., "A Schema for CAD-based Robotic Assembly Task Planning for CSG-based Objects, Journal of Manufacturing Systems, Vol. 7, No.2 pp. 131-145, 1988. (Enclosed)
6. Nnaji B.O., and Davis, RP. "Multi-Stage Multi-Product Lot size Sequencing of Operation," Journal of Mathematical Modeling, Vol. 12, December, pp. 593-600, 1988. (Enclosed)
7. Nnaji B.O., and Yannacoulou, Mary, "A Utility Theory Based Robot Evaluation for Electronic Assembly Applications," International Journal of Computers & Industrial Engineering, Vol. 14, No.4, pp. 477-493, 1988. (Enclosed)

- .8. Nnaji B. O. Lyu, P. and Alladin, S., "A Framework for a Rule-based Expert Fixturing System for Face Milling Planar Surfaces on a CAD System. Using Flexible Fixtures," with Journal of Manufacturing System, Vol. 7, No.3, pp. 193-207, 1988. (Enclosed)
9. Nnaji B. O. And Asano, D., "Evaluation of Trajectories for Different Classes of Robots," Journal of Robotics and Computer Integrated Manufacturing, Vol. 6, No. 1, pp. 25-35, 1989. (Enclosed)
10. Nnaji B. O. And Kang T., "Interpretation of CAD Models through Neutral Geometric Knowledge," Journal of Artificial Intelligence for Design, Analysis and Manufacturing, Vol. 4, No.1, pp. 15-45, 1990. (Enclosed)

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11. Nnaji B. O. And Chu J, "RALPH Static Planner: CAD-based Robotic Assembly Task Planning for CSG-based Objects," International Journal of Intelligence Systems, Vol. 5, No.2, pp. 153-181, 1990. (Enclosed)
12. Nnaji B. O. And Lyu, P., "Rules for an Expert Fixturing System For Face Milling Planner Surfaces on a CAD System Using Flexible Fixtures," International Journal of Intelligent Manufacturing, Vol. I, pp. 31-48, 1990. (Enclosed)
13. Nnaji B. O. and Alladin, S., "E-CAFFS: An Expert Computer-Aided Flexible . Fixturing System," International Journal of Computers and Industrial Engineering, Vol. 18, No.3, pp. 267-311, 1990. (Enclosed)
14. Nnaji B. O. "RALPH: An Automatic Robot Assembly Programmer - An Overview," SME Transactions on Robotics Research, Vol. 1, pp. 5-11 to 5-23, 1990. (Enclosed)
15. Liu, B.C. and Nnaji B. O. "Design with Spatial Relationships," Journal of Manufacturing Systems, Vol. 10, No.6. (Enclosed)
16. Nnaji B. O. Kang, T., Yeh S., and Chen, J.P., "Feature Reasoning for Sheet Metal Components," International Journal of Production Research, Vol. 29. No.9, pp. 1867-1896, 1991. (Enclosed)
17. Remold, u., and Nnaji, B.O., "The Role of Manufacturing Models for the Information Technology of the Factory of the Nineties," a keynote paper for International Journal of Design and Manufacturing, Vol. 1, No.2, pp. 67-87, 1991. (Enclosed)
18. Kang, T.S., and Nnaji B. O. "Feature Representation and Classification for Automatic Process Planning," Journal of Manufacturing Systems. Vol. '12, No.2. 1993. (Enclosed)
19. Jagtap, P., and Nnaji B. O. "Precedence Plan Generation with Spatial Relationships in Assembly," SME Transactions on Robotics Research, Vol. 2, pp. 4-29 to 4-59, 1992. (Enclosed)
20. Nnaji, B.O., Jagtap, P.B., Sandarac, J., and Yeh, S.C., "Automatic Precedence and Spanning Vector for Generation for Assembly Planning," Journal of Design and Manufacturing, Vol. 2, No.4, pp. 211-224, 1992. (Enclosed)
21. Rist, A, Lin, E., and Nnaji, B.O., "RALPH: Application for Surface Mount Assembly," International Journal of Flexible Manufacturing, Vol. 5, pp. 27-52, 1993. (Enclosed)

22. Nnaji, B.O., and Liu, H., and Remold, H, "A Product Modeler for Discrete Components," International Journal of Production Research, Vol. 31. No.9, pp. 2017-2044, 1993. (Enclosed)
23. Yeh, S., Kamran, M., and Nnaji, B.O., "CAD-based Automatic Object Recognition," Journal of Design and Manufacturing, VoJ3, No.1 pp. 57-73 1993. (Enclosed)
24. Nwodo, T., and Nnaji, B.O., "Sensor-tuned Featured Reasoning in Automatic Robot Planning," SME Transactions on Robotics Research 1994. (Enclosed)
25. Schloen, J., and Nnaji, B.O., "Advanced Manipulation Skills for Autonomous Assembly," Journal of Design and Manufacturing, Vol.5, No.4, pp. 251-261, 1995. (Enclosed)

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26. Prinz, M., Liu, H.S., Nnaji, B.O., and Leuth T., "From CAD-based Kinematics Modeling to Automatic Robot Programming," International Journal of Robotics and Computer Integrated Manufacturing, Vol. 12, No.1, pp. 99-109,1996. (Enclosed)
 27. Deverajan, M., and Nnaji, B.O., "Profile Offsetting for Feature Extraction Tool Mapping in Sheet Metal," International Journal of Production Research, Vol. 35, No.6, pp. 1593-1607, 1997. (Enclosed)
 28. Liu, T. L. and Nnaji, B.O., A Framework for Design Advisory System for Mechanical assemblies. (Enclosed)
 29. Ashiagbor Apefa, Liu, H.S., and Nnaji, B.O., "Tolerance Control and Programming for Automated Assembly," International Journal of Production Research, Vol. 36, No.1, pp. 75-93, 1998. (Enclosed)
 30. Nwodoh, T., Nnaji, B.O., Lach, E., and Popplestone, R.J., "3-D Model Acquisition for Automated Burn Debridement," International Journal of Robotics and Computer Integrated Manufacturing, V 01.13, No.4, pp.309-318, 1997. (Enclosed)
 31. Kim, D.W., Choi, J-S, and Nnaji, B.O., "Robot Arc Welding Operations Planning with a Rotating / Tilting Positional," International Journal of Production Research, Vol. 36, No.4. Pp.957-979, 1998. (Enclosed)
 32. Wang, Y, and Nnaji, B.O., "Functionality Based Modular Design for Mechanical Product Customization Over the Internet," Journal of Design and Manufacturing Automation, Vol. 1, No.1 & 2, pp. 107-121 (2001). (Enclosed)
 33. Rist, AK., Lin, E.Y, Nnaji, B.O. RALPH Application for Surface Mount Assembly International Journal of Flexible Manufacturing Systems (in press) (Enclosed)
 34. Jagtap, P.B., and Nnaji, B.O., Automated Precedence Plan Generation with Spatial Relationships in assembly (Enclosed)
 35. Kang, T.S. and Nnaji, B.O., CAD in Automatic Machine programming (Enclosed). SME Technical Paper
 36. Nnaji, B.O, Lougheed, R.M., Dyer, G.L., Engelhard, K.G. and Woodruff, G. Transferring Robotic Research to Industry, An SME Technical Paper series, SME Publications, MSR91-10 1991 (Enclosed).
- Conference Readings

37. B.O. Nnaji and Kamran, M. On the Kinematics Behavior of Robots While Executing General Robot Level Commands (An SME World Conference on Robotics, 1989 Gaithersburg, Maryland) (Enclosed) .
38. Nnaji, B.O., RALPH: An Automatic Robot assembly Language programmer: An Overview (An SME World Conference on Robotics, 1989 Gaithersburg, Maryland) (Enclosed)
39. Haberer, S., Radhakrishnan, R., Nnaji, B.O. A Collision Report Approach Using Numerical Potential fields in the C-Space of general Robot Manipulators (4th World Conference on Robotics Research, Pittsburgh, 1991), (Enclosed)

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40. Vishnu, AK. and Nnaji, B.O., "Analysis of Subassembly Stability for Automated Assembly," 1991 World Conference on Robotics Research, Carnegie Mellon University, September 17-19,1991. (Enclosed)
41. Nnaji B.O., and Vishnu, AK. "a Generalized Shape Descriptor from Wire Frame Models on A CAD/CAM System," Journal of Manufacturing Systems, Vol. 5, No.4. 1986.(Enclosed)
- 42 .Dubey, A and Nnaji, B.O., Task-Oriented and Feature-Based Grasp Planning Robotics & Computer-Integrated Manufacturing, Vol. 9, No.6, 471 (1992) (Enclosed) :
43. Nnaji, B.O., and Kamran, M., "On the Kinematics Behavior of Robots while Executing Robot Level Commands," 1989 World Conference on Robotics Research / Vision, Maryland, May 7-11, 1989 (invited). (Enclosed)
- 44.23) Nnaji, B.O., "a framework for CAD-based Geometric Reasoning for Robot Assembly Language," Int. J. Prod. Res. Vol. 26, No, 5, 735, 1988 (Enclosed)
45. Yeh, S., Kamran, M., and Nnaji, B.O., "Unfolding of Sheet Metal Parts: a Graph-based Approach," International Journal of Production Research, Vol. 33, No, 3, pp.729-740, 1995 (Enclosed)
46. Nnaji, B.O., "Collision Avoidance for Dual-Arm SCARA Robot System," Transaction of the Second World Conference on Robotics Research, Scottsdale, Arizona, U.S.A., August, 1986 MS86-770-17. (Enclosed)
- Other Refereed Papers (not enclosed)
- Nnaji B.O., "A Framework for CAD-based Geometric Reasoning For Robotics Assembly Planning," The International Journal of Production Research, Special Issue on Artificial Intelligence Applications in Manufacturing, Vol. 26, No.5, pp. 735-764, 1988.
 - Nnaji B.O., and Liu, H., "Feature Reasoning for Automatic Robotic Assembly," International Journal of Production Research, Vol. 28, No.3, pp. 517-540, 1990.
 - Nnaji B. O. And Kamran, M., "Kinematics Behavior of Robots while Executing Robot Level Command," SME Transactions on Robotics Research, Vol. 1, pp. 7-17 to 7-33, 1990.
 - Vishnu, A, and Nnaji, B.O. "Analysis of Subassembly Stability for Automated Assembly," International Journal of Robotics and Computer Integrated Manufacturing, Vo1.9, No.6, pp.447-470, 1992.

- Dubey, A., and Nnaji, B.O., "Task Oriented and Feature-based Grasp Planning," *International Journal of Robotics and Computer Integrated Manufacturing*, Vol. 9, No.6, pp. 471-484, 1992.
- Millette F. v., Prinz, M., and Nnaji B. O., "A Collision Repelling Approach using Numerical Potential Fields in the Configuration Space of General Manipulators," *SME Transactions on Robotics Research*, Vol. 2, pp. 4-61 to 4-89.

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NIGERIAN NATIONAL ORDER OF MERIT NOMINATION FOR PROFESSOR BARTHOLOMEIV OKECHUKIVU NNAJI, Ph.D.

- Nnaji, B.O., Sandarac, J. and Yeh, S.C" "Spanning Vector for assembly directions and the application," *Computer Aided Design* (accepted).
- Kang, T.S., and Nnaji, B.O., "CAD-based Feature Reasoning for Automated Machine Programming," Chapter in *Design and Implementation of the Intelligent Manufacturing Systems*, M. Jamshidi and Hamid Parsei (editors).
- Nnaji, B.O., "Technological Advancement in Post-Colonial Africa," a chapter in a book , on *Post-Colonial African Achievements*, (edited by Ebere Onwudiwe) sponsored by the US Department of Education, published by Stanford University Press).
- (S. Yeh, Kamran, M., and Nnaji, B.O., "A Design Advisor for Sheet Metal Components. Fabrication," *IIE Transaction on Design and Manufacturing*, Vol. 28, pp. 1-10, 1996.
- Rhadakrisnan, R, Amsalu, A., Kamran, M. and Nnaji, B.O., "Design Rule Checker for Sheet Metal Components Using Medial Axis Transformation and Geometric Reasoning", *Journal of Manufacturing Systems*, Vol. 15. No.3, 1996.
- Aguwa, Celestine C., and Nnaji, B.O., "Spatial Kinematics Modeling and Analysis of Spherical and Cylindrical joints and Applications in Automated Assembly Systems," *The International Journal of Flexible Manufacturing Systems* (accepted).
- Liu, T.L., and Nnaji, B.O., "Realization and Management of Product Design Constraints in CAD Modeling," *Computer Aided Design* (accepted).
- Adickes, M.D., Billo, RE., Norman, B.A., Banarjee, S., Nnaji, B.O., and Rajgopal, 1., "Optimization of Indoor Wireless Communication Network Layouts," *IIE Transactions*, Vol. 34, September 2002, pp. 823-836 (Winner of IIE Transactions Best Paper Award for Feature Applications for 2002-2003).
- Liu, T.L., and Nnaji, B.O., "A Framework for Constraint-Based Design Advisor for Sheet Metal Assemblies," *International Journal of Production Research* (in review).
- Kim, D.W., Liu, T.L., Nnaji, B.O. and Kim, KY, "Spatial Relationships for CAD Modeling of Sheet Metal Weld Assemblies," *Journal of Manufacturing Systems* (in review).
- Nnaji, B.O., Gupta D., and Kim, KY, "Welding Distortion Minimization for an Aluminum Alloy Extruded Beam Structure Using a 2D Model," *ASME Journal of Manufacturing Science and Engineering* (in press).
- Nnaji, B.O., Wang, Y, Kim, K-Y., and Muogboh, O.S., "PEGASUS: A Service Oriented Product Engineering System over the Internet," *International Journal of Robotics and Computer Integrated Manufacturing* (in review).

- Wang, Y, and Nnaji, B.O., ~'Constraint-Enabled Distributed Design Data Model for Mechanical Products," Special Issue on Product Data and Representation, Part II of Journal of Computer Aided Design (in review).
- Kim, KY, Kim, D.W., and Nnaji, B.O. "Robot Arc Welding Task Sequencing Using Genetic Algorithms," IIE Transactions on Design and Manufacturing Vol. 34, No.10. (2002).
- Kim, KY, Wang, Y, Muogboh, O.S., and Nnaji, B.O., "Design Formalism for Collaborative Assembly Design," Special Issue of Computer-Aided Design on Distributed CAD (accepted June 2003).

NIGERIAN NATIONAL ORDER OF MERIT PROFESSOR BARTHOLOMEW OKECHUKIVU NNAJI, Ph.D.

Kim, K.Y., Norman, B., and Nnaji, B.O. "Heuristics for single-pass welding task sequencing," International Journal of Production Research, Vol. 40, No. 12, 2002.

- Kim, D. W., Choi, J. S., and Nnaji. B. O., "Robot Arc Welding Operations Planning with a Rotating Tilting Positional, II Int. Jr. of Production Research, Vol. 36, No.4, 1998.

Proceedings (Note Enclosed)

- Aguwa, C.C., Bidanda, B., and Nnaji, B.O., "A Manufacturing Modernization Model for Developing Countries: A Nigerian Perspective," Proceedings of the 5th Africa-USA Conference on Manufacturing Technology, Abuja, Nigeria, July 10-14, 2000.
- Muogboh, O. Nnaji, B.O., Kidder, J., "3-D Image Acquisition and Modeling of Human Foot for Automated Design and Manufacture of Orthotic Devices," Proceedings of the 5th Africa-USA Conference on Manufacturing Technology, Abuja, Nigeria, July 10-14, 2000.
- Maitra, A., Nnaji, B.O., and Bidanda, B., "A Framework for Task-Level Programming in Automated Storage retrieval Systems," Proceedings of the IERC Conference, Cleveland, OH May 22-24, 2000.
- Celestine C. Aguwa, and Bart O. Nnaji, "Promod-S: Poster Presentation", 1999 NSF Design & Manufacturing Grantees Conference, 1/5-8/99, Long Beach, CA.
- Nnaji, B.O., "Trends in Design Automation", Proceedings of the Automation and Design Conference, Vancouver, Canada, August 1999.
- Kim, D-W, Liu, T.L., Nnaji, B.O., and Kim, K-Y, "Sheet Metal Weld Assemblies Modeling with Spatial Relationships," Proceedings of the 2nd International Conference on Engineering Design and Automation, Maui, Hawaii August 9-12, 1998.
- Terpenney, J.P., Nnaji, B.O., and Bohn, J.H., "Blending Top-Down and Bottom-Up Approaches Conceptual Design; Institute of Industrial Engineers Research Conference, Banff, Alberta, Canada, May 8-ro, 1998.
- Nnaji B.O., and Liu, T., "Constraint Based Modeling for Mechanical Assemblies," NSF Design and Manufacturing Grantees, Monterrey, Mexico, January 5-8, 1998.
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- Nnaji, B.O., "Computer-Aided Parametric Design of a Manufacturing Facility," with Wenglong Eng, Proceedings of CAD/CAM Robotics and Automation International Conference, Tucson, Arizona, February, 1985, pp. 465-469.
- Nnaji, B.O., "Automation Shape Interpreter of Computer-Aided Models for Manufacturing" with Ashok Vishnu, Artificial Intelligence in Engineering Symposium, George Washington University, October 21-23, 1985 (invited).
Keynote and Plenary Addresses Delivered at Professional Meetings
- Nnaji, B.O., "The Internet Leapfrog Effect: Leveling the Playing Field - Developing and Developed Worlds", Sagan National Colloquium 2000, Ohio Wesleyan University, October 10, 2000 (colloquium speaker)
- Nnaji, B.O., "The Effect of the Internet & Information Technology in Africa and Other Developing Countries," Center for African Studies Conference on the Internet and National Cultures: Problems and Prospects, at the Ohio State University. June 1-3, 2000 (Keynote speaker)
- Nnaji, B.D., "Nigerian Economic Development and the Role of Nigerians in America," Carnegie Endowment for International Peace / Nigerian Peoples Forum Joint Conference, at the Carnegie Endowment for International Peace. December 1, 1999 (organizer and Plenary speaker)
- Nnaji, B.O., "Advances in Computer Aided Design and Manufacturing: Systems," Technical Conference 3833, Intelligent Systems in Design and Manufacturing II, SPIE, September 21, 1999 (keynote speaker)

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Laureate of the 1996 Zik Lecture Series in Nation Building at the Nigerian Institute of International Affairs. Topic: Issues in African Development, March 21, 1996

- Nnaji, B.O., "Laureate of the United States Secretary of State's Distinguished Lecture at the Secretary's Open Forum. Topic: The Policy Implications of Emerging Technologies:
Assessing the Critical Challenges of the Twenty-first Century, September 1, 1995
- Nnaji, B.O., "Industrialization and Democracy," A keynote address to begin at March "Toward Lasting Democracy Symposium Worcester State College, USA, March 25, 1995
- Nnaji, B.O., "Influence of Technology in Development of Africa and the Diaspora," An address given to The United States Congressional Black Caucus Science and Technology Brain trust, Cannon House Office Building, Washington D.C., September 16, 1994
- Nnaji, B.O., "Progress in Technology," An address given at the Conference on Post Colonial African Achievements, (sponsored by the United States Department of

Education, Proceedings book to be published 'by Stanford University Press) Central State University Ohio, October 27-28, 1994

- Nnaji, B.O., "Geometric Reasoning and Applications in Design Manufacturers," (the Caterpillar Distinguished Lecture) University of Iowa, USA, May 5, 1994
- Nnaji, B.O., "Simultaneous Engineering," (a plenary address) 1992 National Industrial Engineering Congress of Mexico at Universidad de las Americas, Puebla Mexico, February 27-29, 1992
- Nnaji, B.O., "Automation and Robotics in Factories of the Future," National Society of Black Engineers National Conference," Sheraton Center, New York City, March 27, 1992
- Nnaji, B.O., "Attitudes, Performance and Success in Engineering Education," 1991 Regional Conference of National Society of Black Engineers," University of Massachusetts, Amherst, November, 1991
- Nnaji, B.O., "Theory of Automatic Robot Programming," Special Public (Plenary) Lecture at the Fourth International Conference on CAD, CAM, Robotics and Factories of the Future, Indian Institute of Technology, New Delhi, Dec. 19-22, 1989
- Nnaji, B.O., "RALPH: An Automatic Robot Assembly Programmer -- An Overview," 1989 World Conference on Robotics Research / Vision, Maryland, May 7-11, 1989
- Nnaji, B.O., "Automatic Programming of Machines," 1989 SME International Conference, Detroit, Michigan, May 2, 1989

NIGERIAN NATIONAL ORDER OF MERIT NOMINATION FOR PROFESSOR BARTHOLOMEW OKECHUKWU NNAJI, PhD.

- Nnaji, B.O., "Technological Development and Transfer in West Africa - The Prospect," 1989 Education Symposium, Glass borough State College, Glass borough, New Jersey, April 18, 1989
- Nnaji, B.D., "Attitudes in Engineering Education," 1988 Regional Conference of National Society of Black Engineers," University of Massachusetts, Amherst, February, 1988
- Nnaji, B.D., "Robotic Safety and the Future Machines," Safety Council of Western Massachusetts, May 18, 1988.

Attachment #1:

DETAIL OF PROF. BART.O.NNAJI CONTRIBUTIONS ON WHICH HIS NOMINATION IS BASED

#1(a): INVENTIONS

Invention of the concept of e-Design

E-Design involves conceptualizing, designing and realizing a product using tools that allow for interoperability of remote and heterogeneous systems, collaboration among remote supply chain and multidisciplinary enterprise product design team stakeholders, and v~ testing and validation of a product in a secure Internet based information

infrastructure. E-Design allows for lean data exchange, instantaneous remote constraint imposition, remote service provider invocation, and active customer participation through Direct preference imposition.

The concept of e-design has resulted in the United States government establishing a center of excellence that will pursue research and development in the concept of e-design. This center is named the United States National Science Foundation Center for e-Design and Realization of Engineered Products and Systems. It is operating as a multi-campus center at the University of Pittsburgh~ University of Massachusetts at Amherst, Carnegie Mellon University and the University of Central Florida. It currently has the following

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Government agencies and industries as paying members of the center: Alcoa, Ford Motor Company, IBM, United States Air Force Research Laboratory, United States Army, Ansys, General Electric Aircraft Engine, BAE Systems, Lockheed Martin, Pratt & Whitney, Parametric Technology Corporation, Respironics, Raytheon, and Engineous Software Inc. The center has about 35 professors and approximately 100 graduate students working on research and development the center was established in 2003 and should generate annually about US\$ 2 million in research funds. The center addresses problems that prevent industry designers of complex products such as aircrafts, automobiles, robots, etc. from being able to collaborate in design from remote locations around the world and which prevent their data from talking to each other. The work going on at the center will reduce the time from conception to production of a car from 48 months to 12 months. It will significantly reduce time and cost in product design and manufacture and will allow for products to be tested using the computer instead of by building real life prototypes. Professor Bart Nnaji is the Director (Chief Executive Officer) of the Center.

Invention of technologies that enabled robotic assembly

Prof. Nail's work on robot programming has led to the development of RALPH (Robot Assembly Language Planning Hierarchy)'; RALPH is a rule-based expert system which generates a robot's servo commands from a task level• command, using dynamic

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Geometric information captured through sensors, intermitting the real-time data with static information from a modeled knowledge database. Reasoning about this information according to the given task command. and then generating the sequence of servo commands necessary for the assembly to the robot with the knowledge of the robot's kinematics structure and other attributes of the assembly operation. His work in RALPH is part of his effort to develop a more general Product Assembly Modeling (PAM) system which employs geometric reasoning in automatic planning of parts assembly in an industrial setting. Professor Nnaji is considered the foremost authority in the world in automatic robot and machine programming. His work in this area has resulted in many books and international journal papers. One of his books (entitled Computer Integrated Manufacturing and Engineering published by Addison-Wesley) co-authored with U. Remold and A Stoor. And having English and German editions, won the world prize as best manufacturing book in 1994. His work in this area also led to the creation of his first company. Geometric Machines Corporation which was founded in 1990 and was sold in 1994 to a larger company in the United States.

#1 (b): INOVATIONS

Built first indigenously owned independent power station in Nigeria

The joint venture of Geometric Power & Rematch is the pioneer power provider in Nigeria from the indigenous private sector. Geometric Power & Rematch is a consortium of two private companies. Geometric Power Limited and Rematch International Limited. Nigeria. Geometric Power Limited. Nigeria is affiliated with Geometric Power, Inc. of the United States. The two companies formed a consortium in April 2000 to build the 15 Megawatt Abuja Emergency Power Station which is the first power generating station built by the company in Nigeria. This power station which came on stream on November 7, 2001 and was officially commissioned in a ceremony by the Vice President of Nigeria, Alhaji Atiku Abubakar, on December 21, 2001. This power station has been operating on demand (24 hours per day, 7 days a week) since the commissioning. The company has therefore proven that it is possible to build and sustain a privately owned electric power company in Nigeria. Professor Nnaji serves as the Chairman of Geometric Power and Chairman of the joint venture with Rematch.

Building the first precision auto parts manufacturing plant in Sub Saharan Africa
Professor Nnaji is in the final stage of establishing the first precision automobile parts manufacturing plant in Sub-Saharan Africa. This plant will make engine parts. The joint venture is with a South Korean firm and the financiers are international banks. This has been a seven year quest on the part of Professor Nnaji to develop this plant in Nigeria. It is intended to break the technology barrier in precision manufacturing in Nigeria and in Sub-Saharan Africa. This company will provide numerous jobs in Nigeria.

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#1(c): OTHER MAJOR CONTRIBUTIONS TO KNOWLEDGE

Founded the Africa USA International Conference on Manufacturing Technology

Professor Nnaji conceived and worked with his Nigerian colleagues in the United States to establish this conference. It was Professor Nnaji who wrote the proposal to the United States National Science Foundation and convinced the international societies such as the Society of Manufacturing Engineers and the Institute of Industrial Engineers as well as many universities around the world to establish the conference. The 5th and 6th Africa USA International Conferences were held in Abuja in 2000 and 2002 respectively. The 7th Africa USA International Conference will hold in Port Harcourt in July 2004. Professor Nnaji has also shown leadership by transferring the management of the conference to his colleagues who have honored him by gracefully naming him as Founding General Chairman of the conference.

Founding Editor of the International Journal of Design and Manufacturing

In the early nineties. Professor Nnaji worked with the English publishing firm of Chapman Hall and with distinguished design scientists and engineers around the world to establish the first international journal of design and manufacturing. This journal chronicled the work of the early work in the tight coupling of design and manufacturing and integration of issues pertaining to them. The concept which the journal advocated helped to revolutionize the way industries automated their companies using tools such as robots, computer networks, and similar technologies. The journal was eventually folded

into the Institute of Industrial Engineers Transactions on Design and Manufacturing of which Professor Nnaji was its first Editor of the design department of the journal.

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ATTACHMENT #2:

GRANDS FOR NOMINATION OF PROF. BARTHOLOMEW ATTACHMENT #2:

GRANDS FOR NOMINATION OF PROF. BARTHOLOMEW O. NNAJI,

B.S. (St. John's Univ., USA), M.S., Ph.D. (Virginia Polytech & State Univ.) (Hon.)

D.Sc. (Univ. of Nigeria, ESUT, Enugu & FUT, Yola), OON, CON, FAS.

Bartholomew O. Nnaji, born in Umuode autonomous community of Nkanu East L.G.A of Enugu State, had his Secondary School education at St Patrick's Secondary School, Emene, Enugu State in early 19708. On graduation, he was recruited as an Athlete for a brief service in the then Anambra / Eastern State Sports Council nom where, through hard work, he proceeded in 1977 to St 10hn's University, New York, U.S.A He received his B.S. in Physics from St 10hn's University in 1980 with distinction, his MS. and Ph.D. in Industrial Engineering from Virginia Polytechnic and State University in 1983. He also obtained a certificate of Postdoctoral studies in Robotics from Massachusetts Institute of Technology (MIT) in 1985.

He joined the Department of Industrial Engineering and Operations Research of the University of Massachusetts at Amherst in 1983, where his progress was meteoric. In 1984, he founded the Automation and Robotics Laboratory at the University of Massachusetts and became its director. He rose to the rank of full professor of Mechanical and Industrial Engineering and in 1991 became Distinguished Professor of Computer Integrated Manufacturing and Robotics. In 1992 and 1993 he organized the 1st and 2nd Africa-USA International Conference in Manufacturing Technology in Lagos which, no doubt, led to his appointment as Hon. Federal Minister of Science & Technology in 1993, in which capacity he restarted the FMST abolished in 1992 and prepared the policy framework for inter alia the establishment of "Technology Business Incubators" as a mechanism for industrialization in Nigeria. In July 1996, he was appointed the ALCOA Foundation Professor in Manufacturing Engineering and Distinguished Professor of Industrial Engineering at the University of Pittsburgh. He is currently the William Kepler White ford Professor of Industrial Engineering. He is also the Director of the United States National Science Foundation Center for e-Design and Realization of Engineered Products and Systems.

Industry leaders and government agencies in the U.S. have committed financial and human resources in order to benefit from Professor Nnaji's cutting edge research.

Members of Professor Nnaji's research center include the Ford Motor Company, IBM, U.S. Department of Defense, Alcoa, General Electric Aircraft Engine, Lockheed Martin, BAE Systems, Parametric Technology Corporation (PTC), Raytheon, Ansys, Science Applications International Corporation, Pratt & Whitney and others. He is also the Founder and Chairman of Geometric Power Limited - the first indigenously owned and privately operated power supplier, operating the 15 Megawatt Abuja Emergency Power Station with annual revenue of N500' million. He was a member of Vision 2010

Committee in Nigeria from November 1996 to October 1997 and has served as consultant

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to United Nations Development Program and the United States Agency for International Development in using technology to develop and expand the economies of many Countries. I

Professor Nnaji has received numerous professional academic and public service awards. He received an Honorary Doctor of Science from the Federal University of Technology, Yola; Honorary Doctor of Technology from Enugu State University of Science and Technology; and Honorary Doctor of Science from the University of Nigeria, Nsukka. He received the St John's University President's Award for academic excellence (awarded to the top University graduate); St John's University Gold Key for scholastic excellence for graduating in first position among all Physics graduates; 1988 Outstanding Young Faculty Scholar Award by the College of Engineering of the University of Massachusetts at Amherst; 1988 Outstanding Young Manufacturing Engineer Award by , the Society of Manufacturing Engineers (SME) which is given to one engineer, under the age of 35, in the world judged to be the most outstanding in the field of manufacturing engineering; and the 1992 Outstanding Young Industrial Engineer Award by the International Institute for Industrial Engineers (IIIE) which is given to one engineer, under the age of 35(in the world judged to be the most outstanding in the field of industrial engineering. He is a Fellow of Nigerian Academy of Science (inducted July 1997); and a Fellow of the Institute of Industrial Engineers (inducted 1997), and Fellow of Society of Manufacturing Engineers (inducted 1998). He received congratulatory proclamations as winner of the 1991 African Immigrant Award in Science from the Massachusetts Senate, the Massachusetts House of Representatives, and the City Council of Boston. In 1992, he received the United Technologies Outstanding Teacher Award. He was honored with the U.S. Secretary of State's Distinguished Public Service Award in 1995. In March 1996, he was the Zik Lecture Laureate. In October 1998, he was awarded Distinguished Scientist Award by the World Bank - IMF Africa Group. On January 1, 2000, the former Head of State of Nigeria, General Abdulsalami Abubakar published on national gazette the award to Prof: Nnaji of the national honor: Commander of the Order of Niger (CON). On November 16, 2000 the Nigerian President awarded him the national honor - Officer of the Order of Niger (OON). In April 2001, he was presented the 2001 ARCO Excellence in Science & Technology in Engineering Award: In May, the 2001 Baker Distinguished Research Award, which is the highest research award given by the International Institute of Industrial Engineers, was awarded to him.

Professor Nnaji's contributions in engineering and engineering science are in three key areas: Computer-Aided Design (CAD), Robotics, and Computer-Aided Engineering. The confluence of his earlier research work in these three areas is the field which he founded called geometric reasoning. The principal assumption is that anything we use has a geometric configuration. Our interactions with objects are therefore based on our understanding of their geometric constructs. Thus, a robot is able to pick-up an object if it «understands" how the geometric configuration of its grippers can «assemble" with the

geometric configuration of the object. A machine tool is able to drill a hole on a metallic part because of spatial interaction of the tool with the part. One can place his hand on a table, and the spatial interaction of the hand •surface and the surface of the table can be mathematically realized, etc. Professor Nnaji's research aim has been to develop the
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Principles which define geometric entities, and how they interact in an engineering system. He also develops the machines and systems that use these fundamental principles. Many of Professor Nnaji's MS. and PhD. graduates currently work in top companies and universities around the world. The detail of Professor Nnaji's major contributions to Science, Technology and Economic Development which is part of the grounds for his nomination has been presented earlier in Attachment #1.

It is pertinent to state the method of accomplishment employed by Professor Nnaji. Support for research leading to the development of the ProMod-S and RALPH systems came from the US. National Science Foundation, North Atlantic Treaty Organization (NATO), US. Department of Defense, Digital Equipment Corporation (now part of Compaq), IBM, General Electric Company, and Mallinckrodt Inc. Professor Nnaji has served as the Principal Investigator for all of these grants worth over \$6 million. He was Co-Principal Investigator on research worth over \$29 million from various sources in government and industry. The e-Design Center currently has attracted major supporters from government and industry. A sampling of them include: the US. Department of Defense, US. National Science Foundation, US. National Institute of Standards & Technology, General Electric Company, Pratt & Whitney, Ford, Rolls Royce, Ansys, Alcoa, Respironics, Parametric Technologies, IBM, Raytheon, Lockheed Martin, SAIC, etc. At steady state, this center is expected to generate over US\$2 million annually in research support

Finally, the grounds for nomination of Professor Nnaji include the contributions to knowledge from his books, conferences and technical publications. He has published 5 books and over 100 technical articles which will be listed under the Bibliography in Attachment #4. His recent book with Professor Remold of the University of Karlsruhe, Germany and Professor Storr of the University of Stuttgart, Germany titled, "Computer Integrated Manufacturing and Engineering" won the 1994 M Eugene Merchant Best Book Award by the Society of Manufacturing Engineers. This book award is the Society of Manufacturing Engineer's world prize for a text book. Professor Nnaji is a senior member of the Institute of Industrial Engineers and the Society of Manufacturing Engineering. He is the founding Editor-in-Chief of the International Journal of Design and Manufacturing and also serves as the Editor of the SME Transactions on Robotics Research. The Journal Design and Manufacturing is the main journal for researchers in contemporary design and manufacturing techniques in the world, He also serves as the Editor for the Design Department of Institute of Industrial & Engineers Transactions on Design and Manufacturing. Professor Nnaji has served as the Chairman of the Fourth World Conference on Robotics Research organized by the Society of Manufacturing Engineers at Carnegie Mellon University (1991); and the Founder and General-Chairman

of Africa-USA International Conferences on Manufacturing Technology. He also served as the International Program Chairman on Fifth World Conference on Robotics Research that was held at MIT in 1994: He also served as Chair of the Sensors and Controls for Advanced Manufacturing Conferences organized by the International Society for Optical Engineering (1995, 1996, and 1997).

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