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Education

Ph.D.	Industrial and Operations Engineering, University of Michigan, Ann Arbor, Advisor: James C. Bean, 1995.
M.S.	Industrial Engineering, University of Oklahoma, 1991.
B.S.	Industrial Engineering, University of Oklahoma, 1988.

Professional Positions Held

6/2017-Present	Professor and Department Chair, Department of Industrial, Manufacturing, and Systems Engineering, Texas Tech University, Lubbock, TX
9/2001–6/2017	Associate Professor, Department of Industrial Engineering, University of Pittsburgh, Pittsburgh, PA
9/1995–8/2001	Assistant Professor, Department of Industrial Engineering, University of Pittsburgh, Pittsburgh, PA
9/1991-8/1995	Research Assistant, Department of Industrial and Operations Engineering, University of Michigan, Ann Arbor.
9/1989-8/1991	Research Assistant, Department of Industrial Engineering, University of Oklahoma.
5/1988-8/1989	Network Design Engineer, Southwestern Bell Telephone, Oklahoma City, OK.
5/1986-12/1987 (12 months)	Manufacturing Engineering Intern, Dana Corporation, Oklahoma City, OK.

Scholarship

Referred Publications

Journal Papers

1. Keshtzari, M, B. A. Norman, "Improving Patient Access in Oncology Clinics Using Simulation", *Journal of Industrial Engineering and Management*, Vol. 15 (3), (2022), 455-469, https://doi.org/10.3926/jiem.392

2. Svirkso, A., B. A. Norman, "Optimizing the Medication Distribution Process for Inpatient Units", *Journal of Medical Systems,* (2022), May 3;46(6):32. doi: 10.1007/s10916-022-01822-2.

3. Lim, Jung, B. A. Norman, & J. Rajgopal. "Redesign of Vaccine Distribution Networks", *International Transactions on Operations Research,* (2022), https://doi.org/10.1111/itor.12758

4. Hamzi A., Norman B.A., "An Economic Analysis of Using Scribes to Improve Hospitalists' Workload", *Journal of Hospital and Medical Management,* (2020), Vol.6 ,No. 2:253.

5. Svirsko, C.A., Norman, B. A. & Hostetler, S., "Standardizing pharmaceutical delivery to reduce pharmacy costs while simultaneously reducing missing doses", *IISE Transactions on Healthcare Systems Engineering*, (2020), 10:1, 33-46, DOI: 10.1080/24725579.2019.1671924

6. Svirsko, A.C., Norman, B.A., Rausch, D., & Woodring, J. "Using Mathematical Modeling to Improve the Emergency Department Nurse Scheduling Process", *Journal of Emergency Nursing,* Vol. 45 (4), July 2019, https://doi.org/10.1016/j.jen.2019.01.013

7. Esmaili, N., Norman, B.A., & Rajgopal, J. "Exact analysis of (R, s, S) inventory control systems with lost sales and zero lead time", *Naval Research Logistics*, 2019;1–10. https://doi.org/10.1002/nav.21833

8. Esmaili, N., B. A. Norman, J. Rajgopal, "Shelf-space optimization models in decentralized automated dispensing cabinets", *Operations Research for Health Care*, 2018. doi: 10.1016/j.orhc.2018.03.005

9. Mofrad, M., L. M. Maillart, B. A., Norman, J. Rajgopal, "Multi-dose vial administration with non-stationary demand and delayed service", *Operations Research for Health Care,* 2018. doi: 10.1016/j.orhc.2018.03.003.

10. Abraham, O. M. Myers, A. L. Brothers, J. Montgomery, B. A. Norman, T. Fabian, "Assessing need for pharmacist involvement to improve care coordination for patients on LAI antipsychotics transitioning from hospital to home: A work system approach", *Research in Social and Administrative Pharmacy, Sep - Oct;13(5), 2017, 1004-1013. doi: 10.1016/j.sapharm.2017.02.006.*

11. Lim, J., B. A. Norman, J. Rajgopal, "Process Redesign and Simplified Policies for More Effective Vaccine Inventory Management," *Engineering Management Journal,* Vol. 29, Issue 1, 2017, 17-25.

12. Mofrad, M.H., G. Garcia, L.M. Maillart, B.A. Norman, J. Rajgopal, "Customizing Immunization Clinic Operations To Minimize Open Vial Waste", *Socio-Economic Planning Sciences*, Vol. 54, June, 2016, 1-17.

13. Lim, J., E. Claypool, B. A. Norman, J. Rajgopal, "Outreach Planning Models for EPI Vaccination Programs in Low and Middle Income Countries," *Operations Research for Healthcare*, Vol. 9, 2016, 40-48.

14. Blackwell, C., J. Wasas, S. Flanagan, B. A. Norman, and J. M. Haight, "Grocery Shelf Stocking Tool: Analysis of Productivity and Human Factors, *International Journal of Productivity and Performance Management*, Vol. 65, No. 4, 2016, 554-570.

15. Norman, B. A., J. Rajgopal, J. Lim, K. Gorham, L. Haidari, S. T. Brown, B. Y., Lee, "Modular Vaccine Packaging Increases Packing Efficiency", *Vaccine*, Vol. 33, No. 27, June 17, 2015, 3135-3141.

16. Claypool, E., Norman, B. A., & Needy, K. L., "Design for supply chain: An analysis of key risk factors", *Industrial Engineering & Management*, Vol. 4, No. 2, May 2015, doi:10.4172/2169-0316.1000156.

17. Portnoy, A., S. Ozawa, S. Grewal, B. A. Norman, J. Rajgopal, K. M. Gorham, S. T. Brown, B. Y. Lee, "Costs of vaccine programs across 94 low- and middle-income countries", *Vaccine*, Vol. 33, Supplement 1, May 7, 2015, A99-A108.

18. Chen, S-I., B. A. Norman, J. Rajgopal, and B. Y. Lee, "Passive Cold Devices for Vaccine Supply Chains," Annals of Operations Research, Vol. 230, No. 1, 2015, 87-105.

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20. Norman, B.A., B. Bidanda, "Operating Room Turnaround Time Analysis – A Case Study," *Journal of Collaborative Enterprise*, Vol.4, No.1/2, 2014, 101 – 114.

21. Brown, S.T., B. Schreiber, B.E. Cakouros, A.R. Wateska, H.M. Dicko, D.L. Connor, P. Jaillard, M. Mvundura, B.A. Norman, C. Levin, J. Rajgopal, M. Avella, C. Lebrun, E. Claypool, P. Paula, B. Y. Lee, "The benefits of redesigning Benin's vaccine supply chain," *Vaccine,* Vol. 32, No. 32, 7 July 2014, 4097-4103.

22. Chen, S., B. A. Norman, J. Rajgopal, T.M. Assi, B.Y. Lee, S. T. Brown, "A Planning Model for the WHO-EPI Vaccine Distribution Network in Developing Countries," *IIE Transactions*, Vol. 46, No. 8, August 2014, 853-865.

23. Mofrad, M.H., L.M. Maillart, B.A. Norman, J. Rajgopal, "Dynamically Optimizing the Administration of Vaccines from Multi-Dose Vials," *IIE Transactions,* Vol. 46, No. 7, July 2014, 623-635

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25. Chen, S., B. A. Norman, J. Rajgopal, B. Y. Lee, "Passive Cold Devices For Vaccine Supply Chains," *Annals of Operations Research,* Dec. 2013, DOI 10.1007/s10479-013-1502-5.

26. Haidari L.A., D.L. Connor, A.R. Wateska, S. T. Brown, L.E. Mueller, B. A. Norman, M. M. Schmitz, P. Paul, J. Rajgopal, J.S. Welling, J. Leonard, E.G. Claypool, Y. Weng, S. Chen, B.Y. Lee. (2013), "Only adding stationary storage to vaccine supply chains may create and worsen transport bottlenecks", *Journal of Public Health Management and Practice*, Vol. 19, Suppl. 2, Sep-Oct 2013, S65-7.

27. Assi T.M., S.T. Brown, S. Kone, B.A. Norman, A. Djibo, D. L. Connor, A. R. Wateska, J. Rajgopal, R. B. Slayton, B.Y. Lee., "Removing the regional level from the Niger vaccine supply chain", *Vaccine,* Vol. 31, No. 26, 10 June 2013, 2828-2834.

28. Norman, B. A., S. Nourollahi, S. Chen, S. T. Brown, E. G. Claypool, D. L. Connor, M. M. Schmitz, J. Rajgopal, A. R. Wateska, B. Y. Lee, "An Economic Model of Passive Cold Storage Devices for Vaccines," *Vaccine,* Vol. 31, No. 45, 22 May 2013, 5232-8.

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measles vaccine vial size on Niger's vaccine supply chain: a computational model," *BMC Public Health.* 1471-2458, 2011, Vol. 11, No. 1, 425.

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36. Lee, B. Y., Assi, T. M., Rajgopal, J., Norman, B. A., Chen, S. I., Brown, S. T., Slayton, R. R., Kone, S., Hailu, K,, Welling, J. S., Connor, D. L., Wateska, A. R., Jana, A., Wiringa, A. E., Van Panhuis, W. G., Burke, D. S. "Impact of Introducing the Pneumococcal and Rotavirus Vaccines into the Routine Immunization Program in Niger" *American Journal of Public Health.* Vol. 102**,** 2 February 2012, 269-276.

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41. Lee, B. Y., B. A. Norman, T. M. Assi, S. Chen, R. R. Bailey, J. Rajgopal, S.T. Brown, A. E. Wiranga, and D. S. Burke, "Single versus multi-dose vaccine vials: An economic computational model," *Vaccine,* Vol. 28, No. 32, 5292-5300, 19 July 2010**.**

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44. Osman, A, B. A. Norman, and R. Ries, "Life cycle optimization of building energy systems," *Engineering Optimization*, Vol. 40, 157 – 178, 2008.

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46. Tharmmaphornphilas, W. and B. A. Norman, "A Methodology to Create Robust Job Rotation Schedules," *Annals of Operations Research*, 155, 339-360, 2007.

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50. Norman, B. A. and A. E. Smith, "A Continuous Approach To Considering Uncertainty In Facility Design," *Computers and Operations Research,* Vol. 33, 1760-1775, 2006.

51. Bidanda, B., P. Ariyawongrat, K. L. Needy, B. A. Norman, and W. Tharmmaphornphilas, "Human Related Issues In Manufacturing Cell Design, Implementation, And Operation: A Review & Survey," *Computers and Industrial Engineering*, Vol. 48, 507–523, 2005.

52. Kulturel, S., B. A. Norman, D. W. Coit and A. E. Smith, "Exploiting Tabu Search Memory In Constrained Problems," *INFORMS Journal on Computing,* Vol. 16, No. 3, 241-254, 2004.

53. Kulturel-Konak, S., A. E. Smith, and B. A. Norman, "Layout Optimization Considering Production Uncertainty and Routing Flexibility," *International Journal of Production Research*, Vol. 42, No. 21, 4475-4493, 2004.

54. Ozturk, U. A., M. Mazumdar, and B. A. Norman, "A Solution to the Stochastic Unit Commitment Problem Using Chance Constrained Programming," *IEEE Transactions on Power Systems,* Vol. 19, No. 3, 1589-1598, 2004.

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60. Kim, K., B. A. Norman, and B. O. Nnaji, "Heuristics For Single-Pass Welding Task Sequencing," *International Journal of Production Research*, Vol. 40, No. 12, 2769-2788, 2002.

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66. Norman, B. A., A. E. Smith, E. Yildirim and W. Tharmmaphornphilas, "An Evolutionary Approach to Incorporating Intradepartmental Flow into Facilities Design," *Advances in Engineering Software*, Vol. 32, No. 6, 443-453, 2001.

67. Carnahan, B. J., M. S. Redfern, and B. A. Norman, "Incorporating Physical Demand Criteria Into Assembly Line Balancing," *IIE Transactions,* Vol. 33, No. 10, 875-887, 2001.

68. Norman, B. A. and J. C. Bean, "Scheduling operations on parallel machine tools," *IIE Transactions*, Vol. 32, No. 5, 449-459, 2000.

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Book Chapters

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2. Esmaili, N., B. A. Norman, and J. Rajgopal. "A Heuristic Approach for Integrated Storage and Shelf-Space Allocation." *In Enhancing Synergies in a Collaborative Environment*, Pablo Cortes, Elvira Maeso, Alejandro Escudero-Santana (eds.), Springer International Publishing, 2015, 11-18.

3. Hawrylak, P. J., A. Ogirala, B. A. Norman, J. Rajgopal, and M. H. Mickle. "Enabling Real-Time Management and Visibility with RFID." In *Management Engineering for Effective Healthcare Delivery: Principles and Applications,* ed. Alexander Kolker, and Pierce Story, IGI Global, 2012, 172-190.

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5. Wang, L., B. A. Norman and J. Rajgopal, "Maximizing Read Accuracy by Optimally Locating RFID Interrogators," *RFID Handbook: Applications, Technology, Security, and Privacy*, CRC Press, Taylor and Francis Group, Boca Raton, FL, 2008.

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8. A. E. Smith and B. A. Norman, "Design of Production Facilities using Evolutionary Computing," *Evolutionary Optimization,* (R. Sarker, M. Mohammadian and X. Yao, editors), Kluwer Academic Publishers, USA, 2002, 309-327.

9. "A. E. Smith and B. A. Norman, Evolutionary design of facilities considering production uncertainty," *Evolutionary Design and Manufacture: Selected Papers from ACDM 2000* (I. C. Parmee, editor), Springer-Verlag, London, 2000, 175-186.

Refereed Conference Proceedings

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2. A. Svirsko, B. A. Norman, and S. Hostetler, "Improving Inpatient Pharmaceutical Delivery to Enhance Patient Safety," *Proceedings of the 2017 Industrial and Systems Engineering Conference,* May, 2017, Pittsburgh, PA, CD-ROM.

3. Esmaili, N., B.A. Norman, J. Rajgopal. "Joint Inventory Control System and Shelf Space Allocation Optimization in Healthcare," *Proceedings of the 2015 Industrial and Systems Engineering Research Conference*, May, 2015, Nashville, TN, CD-ROM.

4. R. M. Clark, B. A. Norman and M. Besterfield-Sacre, "Preliminary Experiences with "Flipping" a Facility Layout/Material Handling Course," *23rd Industrial Engineering Research Conference,* May, 2014, Montreal, Quebec, CD Rom Format.

5. R. G. Ingalls, M. Carnejo, C. Methapartara, P. Sittivijan, K. L. Needy, B. A. Norman, B. Hunsaker, E. Claypool, N. Gokhan, and S. M. Mason, "Integrating Design for Supply Chain Research into a Graduate Supply Chain Modeling Course – A Collaborative Approach," *2008 American Society for Engineering Education Annual Conference Proceedings*, Pittsburgh, PA, CD Rom Format.

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19. Osman, A., R. Ries and B. A. Norman, "Life cycle assessment model: optimization of cogeneration systems in buildings," *14th Industrial Engineering Research Conference*, May, 2005, Atlanta, GA, CD Rom Format.

20. Kim, K. Y., B. A. Norman, B. O. Nnaji, D. G. Manley, and Y. M. Zhang, "An Integration Framework for Virtual Assembly Analysis and Welding Task Sequencing," *International Conference on e-Design*, May, 2005, Atlanta GA, CD Rom Format.

21. Tharmmaphornphilas, Wipawee and B. A. Norman, "Job rotation plans for reducing low back injuries with real-time information," *13th Industrial Engineering Research Conference*, May, 2004, Houston, TX, CD Rom Format.

22. Norman, B. A., Besterfield-Sacre, M., Bidanda, B., Needy, K. L., & Rajgopal, J. "A conceptual model for integrating and synthesizing the industrial engineering curriculum," *2004 American Society for Engineering Education Annual Conference Proceedings*, Salt Lake City, UT, CD Rom Format .

23. Wang, M. E. and B. A. Norman, "Zoning and Backbone Extraction for Preemptive Traffic Network Design," *12th Industrial Engineering Research Conference*, May, 2003, Portland, OR, CD Rom Format .

24. Wang, M. E. and B. A. Norman, "Preemptive Traffic Network Design," *12th Industrial Engineering Research Conference*, May, 2003, Portland, OR, CD Rom Format.

25. Ozturk, U. A., M. Mazumdar, and B. A. Norman, "The Effect of Considering the Correlation Structure of Hourly Demands on Unit Commitment Solutions," *12th Industrial Engineering Research Conference*, May, 2003, Portland, OR, CD Rom Format.

26. Tharmmaphornphilas, Wipawee and B. A. Norman, "A mathematical Analysis of Job Rotation Interval Lengths," *The Fourth Asia-Pacific Conference on Industrial Engineering and Management Systems*, Taipei, Taiwan, 2002, CD Rom Format.

27. Alagoz, O., B. A. Norman and A. E. Smith "Designing aisle networks to facilitate material flow," *Progress in Material Handling Research 2002* (Russell Meller, Michael K. Ogle, Brett A. Peters, G. Don Taylor and John Usher, editors), The Material Handling Institute, Charlotte, NC, 2002, 11-25.

28. Needy, K. L., B. A. Norman, B. Bidanda, W. Tharmmaphornphilas, P. Ariyawongrat, and R. C. Warner, "Human capital assessment in lean manufacturing," *American Society for Engineering Management Proceedings,* Huntsville, AL, 2001, 233-239.

29. Smith, A. E., G. Ozdemir, B. A. Norman, "Explicitly incorporating multiple material handling systems within block layout design," *Progress in Material Handling Research 2000*, (R.J. Graves, L. F. McGinnis, M.K. Ogle, B. A. Peters, R. E. Ward, and M.R. Wilhelm, editors), The Material Handling Institute, Charlotte, NC, 2000, 330-339.

30. Tharmmaphornphilas, W. and B. A. Norman, "A Heuristic Search Algorithm for Stochastic Job Rotation Scheduling," *9th Industrial Engineering Research Conference*, May 21-23, 2000, Cleveland, OH, CD Rom format.

31. Norman, B. A., W. Tharmmaphornphilas, K. L. Needy, B. Bidanda and R. C. Warner, "Assigning Workers to Tasks Considering Technical and Human Skills," *9th Industrial Engineering Research Conference*, May 21-23, 2000, Cleveland, OH, CD Rom format.

32. Al-Rumaih, A., D. Tipper, Y. Liu, and B. A. Norman, "Spare Capacity Planning for Survivable Mesh Networks," *Lecture Notes in Computer Science 1815, Proceedings IFIP-TC6 Networking 2000*, Paris, France, May, 2000, 957-968

33. Carnahan, B. J., M. S. Redfern, and B. A. Norman, "A Genetic Algorithm for Designing Job Rotation Schedules Considering Ergonomic Constraints," *Proceedings of the Congress on Evolutionary Computation*, Washington, D.C., July 1999, Published by IEEE Inc., 1093-1098.

34. Norman, B. A., A. E. Smith and R. A. Arapoglu, "Integrated facility design using an evolutionary approach with a subordinate network algorithm," *Parallel Problem Solving from Nature (PPSN V)* (A. E. Eiben, T. Baeck, M. Schoenauer and H.-P. Schwefel, editors), Lecture Notes in Computer Science 1498, Springer-Verlag, Berlin, Germany, 1998, 937-946.

35. Carnahan B.J., Redfern M.S., Norman B., "Genetic Algorithms Applied to Problems in Job Rotation," *Advances in Occupational Ergonomics and Safety: Proceedings of the XIIIth Annual International Occupational Ergonomics and Safety Conference*, Kumar S. (ed.) IOS Press, Amsterdam, 1998, 43-46.

36. Norman, B. A. and A. E. Smith, "Considering Risk Trade-offs in Unequal Area Block Layout Design," *6th Industrial Engineering Research Conference*, May 17-18, 1997, Miami Beach, FL, 826-831.

37. Norman, B. A. and J. C. Bean, "Operation Sequencing and Tool Assignment for Multiple Spindle CNC Machines," *1997 IEEE International Conference on Evolutionary Computation*, April 13-16, 1997, Indianapolis, IN, 425-429.

38. Norman, B. A. and A. E. Smith, "Random Keys Genetic Algorithm With Adaptive Penalty Function For Optimization Of Constrained Facility Layout Problems," *1997 IEEE International Conference on Evolutionary Computation*, April 13-16, 1997, Indianapolis, IN, 407-411.

Non-refereed Publications Conference Proceedings

1. Norman, B. A. and A. E. Smith, "Comprehensive redesign of industrial facilities," *Proceedings of the 2003 NSF Design and Manufacturing Research Conference*, Birmingham, AL, January 2003, CD Rom format.

2. Needy, K. L., B. A. Norman, B. Bidanda, "Workforce Development in Lean Manufacturing," *Proceedings of the 9th Annual APICS E & R Foundation Summer Academic/Practitioner Workshop*, Wilmerding Pennsylvania, 2002, 81-85.

3. Norman, B. A. and A. E. Smith, "Comprehensive redesign of industrial facilities," *Proceedings of the 2002 NSF Design and Manufacturing Research Conference*, San Juan, Puerto Rico, January 2002, CD Rom format.

4. Norman, B. A. and A. E. Smith, "Comprehensive redesign of industrial facilities," *Proceedings of the 2001 NSF Design and Manufacturing Research Conference*, Tampa, FL, January 2001, CD Rom format.

5. Norman, B. A. and A. E. Smith, "Comprehensive redesign of industrial facilities," *Proceedings of the 2000 NSF Design and Manufacturing Research Conference*, Vancouver, BC, January 2000, CD Rom format.

6. Needy, K. L., B. A. Norman, and B. Bidanda, "Worker Assignment for Cellular Manufacturing Considering Human Issues," *Proceedings of the 2000 NSF Design and Manufacturing Research Conference*, Vancouver, BC, January 2000, CD Rom format.

7. Ozdemir, G., A. E. Smith, and B. A. Norman "Incorporating heterogeneous distance metrics within block layout design," *Proceedings of the Second Asia-Pacific Conference on Industrial Engineering and Management Systems*, Kanazawa, Japan, 1999, 213-216. Also published in *Proceedings of the 1999 Second Japan-USA Joint Workshop on Intelligent Manufacturing Systems* (M. Gen. T. Yokota, A. E. Smith, G. A. Suer, R. W. Wolff and G. Yamazaki, editors), Kanazawa, Japan, October 1999, 49-52.

8. Arapoglu, R. A., B. A. Norman and A. E. Smith, "A genetic algorithm approach to input/output station location in facilities design," *Proceedings of the Second Japan-Australia Joint Workshop on Intelligent and Evolutionary Systems*, Kyoto, Japan, November 1998, 155-170.

9. A. E. Smith and B. A. Norman, "Research in intelligent manufacturing systems at the University of Pittsburgh," *Proceedings of 1998 The First Japan-USA Joint Workshops on Intelligent Manufacturing Systems*, Ashikaga, Japan, November 1998, Addendum.

10. Chakravarthy, K. and B. A. Norman, "Sequencing Jobs and Allocating Buffers in a Flowshop Environment," *7th Industrial Engineering Research Conference*, May 9-10, 1998, Banff, Alberta, Canada, CD Rom format.

11. Carnahan, B. J., B. A. Norman, and M. S. Redfern, "Assembly Line Balancing Considering Both Production and Worker Constraints," *7th Industrial Engineering Research Conference*, May 9-10, 1998, Banff, Alberta, Canada, CD Rom format.

12. Norman, B. A., A. E. Smith, and R. A. Arapoglu, "An Efficient Algorithm for Using a Perimeter Distance Metric in Unequal Area Facility Layout," *7th Industrial Engineering Research Conference*, May 9-10, 1998, Banff, Alberta, Canada, CD Rom format.

13. Bean, J. C., A. B. Hadj-Alouane, and B. Norman, "Rescheduling Disrupted Production Systems," *Proceedings of the 1994 NSF Design and Manufacturing Grantees Conference*, 1994, 237-238.

14. Leemis, L. M. and B. A. Norman, "Software for the Analysis of Survival Data," *Proceedings of the 23rd Annual Midwest Section Meeting, American Society of Engineering Education*, April 1988, Section IIIB, 9-20.

Invited Presentations

Author or co-author on over 100 technical and conference presentations and invited seminars.

Externally Funded Research

1. "Surgical and Outpatient Services Process Improvement" B. A. Norman, $139,511, 2016-2017, Children's Hospital of Pittsburgh. This funding supports faculty, a graduate student and undergraduate students to assess surgical services and outpatient resource allocation at Children's Hospital of Pittsburgh.

2. "University of Pittsburgh Clinical & Translational Science Institute" PI Steven Reis (University of Pittsburgh Medical School), B.A. Norman sub-award, $578,809, 2016-2021, NIH/NCATS (National Center for Advancing Translational Sciences). This funding supports faculty, a graduate student, and undergraduate students to assess and improve operations within the Clinical and Translational Science Institute.

3. "Engineering Access to Primary Care" B. A. Norman and J. Rajgopal, $94,053, 2016-2017, Veteran's Administration. This funding supports faculty, a graduate student and undergraduate students to analyze patient access for primary care outpatient services, create simulation and modeling tools to support capacity planning and process analysis and process redesign for appointment scheduling.

4. "Pediatric Process Improvement" B. A. Norman, $94,479, 2015-2016, Children's Hospital of Pittsburgh. This funding supports faculty, a graduate student and undergraduate students to reduce length of stay in the emergency department and to reengineer the patient transfer process at Children's Hospital of Pittsburgh.

5. “Engineering Access to Care Project” B. A. Norman and J. Rajgopal, $210,658, 2015-2016, Veteran’s Administration. This funding supports faculty, a graduate student and undergraduate students to analyze patient access for outpatient services, evaluate access metrics, and create tools to support capacity planning and other access related functions.

6. “Surgical Operations Review” B. A. Norman and J. Rajgopal, $160,000, 2014-2015, Veteran’s Administration. This funding supports faculty, a graduate student and undergraduate students to analyze patient flow at outpatient surgical clinics with particular emphasis on improving patient access.

7. “HERMES Graphical User Interface Development,” B. A. Norman and J. Rajgopal sub-contract from Johns Hopkins-PI B. Y. Lee, Sub Contract portion $132,000, 2014, Bill and Melinda Gates Foundation. This funding supports staff and faculty to develop the graphical user interface for the HERMES vaccine supply chain analysis tool and modeling of the Bihar and Kerala states in India.

8. “Prosthetics Inventory Management Analysis” J. Rajgopal and B. A. Norman, $150,000, 2013-2014, Veteran’s Administration. This funding supported faculty, a graduate student and undergraduate students to analyze prosthetics inventory management including setting inventory levels, creating costing models to compare stocking versus shipping items to veterans, evaluating alternative storage solutions, and designing material storage areas.

9. “Assessing Technologies for Patient Intake”, B. A. Norman, $31,372, 2013-2015, Department of Internal Medicine, University of Pittsburgh. This funding supported faculty and undergraduate students to conduct a root cause analysis to determine why patients are not using the MyUPMC portal and to evaluate the process and productivity effects of using tablet computers for patient intake.

10. “Development of Staffing Methodologies and Tools for Sterile Processing Services” B. A. Norman and B. Bidanda, $160,000, 2013-2014, Veteran’s Administration. This funding supported faculty, a graduate student and multiple undergraduate students to create a workload model and a staffing model for Sterile Processing Services.

11. “Flipping IE 1055: Facility Layout and Material Handling”, B.A. Norman, $15,000, 2013-2014, EERC, Swanson School of Engineering. This funding supported faculty time to flip the IE 1055 course for the Spring 2014 semester.

12. “HERMES Graphical User Interface Development and India Analysis,” B. A. Norman and J. Rajgopal sub-contract under Internal Medicine-PI B. Y. Lee, Sub Contract portion $152,640, 2013, Bill and Melinda Gates Foundation. This funding supports staff and faculty to develop the graphical user interface for the HERMES vaccine supply chain analysis tool and to conduct analysis of the Indian supply chain.

13. “An Analysis of Tablet Computers for Patient Intake”, B. A. Norman, $23,000, 2012-2013, Department of Internal Medicine, University of Pittsburgh. This funding supported faculty and undergraduate students to analyze how using tablet computers affects the patient intake process and staff time needed for processing patient surveys.

14. "Staffing Analysis of the CTRC", B. A. Norman, $15,000, 2012-2013, Department of Internal Medicine, University of Pittsburgh. This funding supported faculty time for an evaluation of staffing methods and processes at the CTRC.

15. "Reusable Medical Equipment – Process Design & Costing Analysis" B. A. Norman and B. Bidanda, $339, 936, 2012-2013, Veteran's Administration. This funding supported faculty, a graduate student and multiple undergraduate students to analyze staffing, centralized versus decentralized operations, quality assurance methodologies, and the development of a cost model for endoscope reprocessing.

16. "Prosthetics Inventory Management Analysis" B. A. Norman and R. Rajgopal, $80,064, 2012-2013, Veteran's Administration. This funding supported faculty and undergraduate students to analyze prosthetics inventory management including setting inventory levels, developing replenishment methodologies, and designing material storage areas.

17. "Vaccine Modeling Initiative – Supplemental Award," B. A. Norman and J. Rajgopal sub-contract under GSPH-PI D. Burke, Sub Contract portion $200,000, 2012-2013, Bill and Melinda Gates Foundation. This funding supported faculty and graduate students to develop vaccine supply chain models and analyze vaccine logistics systems and operations.

18. "Markov Decision Process Models for Optimizing Vaccine Administration," L. Maillart, B. Lee, B. A. Norman, J. Rajgopal, $336,957, 2011-2014, National Science Foundation. This funding is supporting a graduate student to develop and evaluate models related to vaccine administration. There is also a supplemental REU award to support undergraduates to work on the research.

19. "Analysis of UPMC Operating Room Turnaround Time," B. Bidanda and B. A. Norman, $20,000, 2011, University of Pittsburgh Medical Center. This funding supported faculty time and undergraduate students to determine the key factors that delay operating room turnaround. Extensive process observations were conducted which led to process recommendations including redefining roles and responsibilities, changing resource allocations, revising surgical pick lists, and improved scheduling practices.

20. "Reusable Medical Equipment – Process & Facility Redesign," B. A. Norman and B. Bidanda, $330,806, 2010-2012, Veteran's Administration. This funding supported a graduate student and multiple undergraduate students to conduct a comprehensive process evaluation of endoscope reprocessing.

21. "Vaccine Modeling Initiative," B. A. Norman and J. Rajgopal sub-contract under GSPH-PI D. Burke, Sub Contract portion $104,383, 2009-2012, Bill and Melinda Gates Foundation. This funding supported a graduate student to develop vaccine supply chain models.

22. "Collaborative Research: A TIE Research Program on E-Design for Design for Supply Chain," K. L. Needy, B. Hunsaker, B. A. Norman, $50,000, 2009-2011, National Science Foundation. This funding supported a graduate student to develop and evaluate models related to supply chains and product design to evaluate the value of considering supply chain impacts during product design.

23. "Diabetes Prevention and Treatment Program for Western Pennsylvania," B. A. Norman (sub contract from Barnes (PI) USAMRAA W81XWH-04-2-0030), $46,508, 2008-2009. This funding supported faculty and undergraduate time to conduct process analysis comparing

synchronous and asynchronous communication between patients and healthcare providers.

24. "An evaluation of RFID Interoperability," B. A. Norman and J. Rajgopal, $10,496, 2007-2008, TEGO. This funding supported a graduate student to develop a tool to evaluate RFID interoperability.

25. "Manufacturing Product Costing Project at Bombardier" Bryan A. Norman, Kim LaScola Needy, Michael R. Lovell, $13,000, 2007. This funding supported one student to conduct a manufacturing product cost analysis.

26. "An Ultra Low-power, Gen 2 Compatible Active RFID Tag", Alex K. Jones, Marlin H. Mickle, J. T. Cain, Jayant Rajgopal, and Bryan A. Norman (Co-PI), $39,800, 2006-2007. In this project we developed a prototype ISO 18000-6C RFID compatible RFID tag sing an active front-end. Normally this tag is a passive device requiring a reader to provide power for it to execute. This active prototype can be used for testing and a variety of other purposes.

27. "Optimizing Antenna/Reader Placement for Arbitrary Orientations of Passive RFID Tags," Jayant Rajgopal, Bryan A. Norman, Marlin H. Mickle, J. T. Cain, and Alex K. Jones, $39,800, 2006-2007. This funding supported a graduate student to develop models and methodologies for locating RFID transceiver antennas in order to maximize the probability of reading tags.

28. "Cell Spar Optimization Analysis," Bryan A. Norman, Michael Lovell, Kyoung-Yun Kim, Source: Technip, $7,500, 2004. This funding supported a project through the Swanson Center to improve Technip's ability to produce cell spars (used to produce offshore oil platforms) more effectively. Overall, four possible areas of improvement were analyzed: (1) materials handling and flow, (2) scheduling of materials handling and resource utilization, (3) facilities planning and layout, and (4) process improvement, particularly at the welding stations.

29. "A Conceptual Model for Engineering Curriculum Integration and Synthesis, with an Application to Industrial Engineering," Bryan A. Norman, Mary Besterfield-Sacre, Kim LaScola Needy, Jayant Rajgopal, and Bopaya Bidanda, Source: National Science Foundation , $100,000, 2003 – 2004. This grant is a planning grant to support efforts to redesign the undergraduate curriculum of the Industrial Engineering program at the University of Pittsburgh. This redesign effort focuses on more closely integrating the courses in the curriculum in addition to incorporating globalization ideas into different courses where appropriate. Additionally, a new course that emphasizes synthesis of ideas by solving unstructured problems based on case studies has been developed.

30. "Collaborative Research: Worker Cross Training and Assignment Considering Learning & Forgetting Effects," Bryan A. Norman and David A. Nembhard (Pennsylvania State University), Source: National Science Foundation, $176,900 (University of Pittsburgh Portion), 2002 – 2005. This research focuses on exploring the need to consider worker task learning and forgetting effects in developing worker assignment strategies. Worker learning and forgetting characteristics can be modeled mathematically. This information can be incorporated into worker assignment models and system simulations to determine the interactions between different worker assignments and system productive efficiency. In particular, factors such as absenteeism, turnover, and product life cycle can be considered. This work has a broad range of application since worker assignment issues arise in many settings.

31. **"**A Simulation Model for the PCB Manufacturing Facility at Medrad," Bryan A. Norman and Jayant Rajgopal, Source: Medrad, Inc., $12,000, Summer 2000. The purpose of this project is to develop a simulation model of Medrad's PCB Manufacturing lines in order to evaluate capacity for changing product demands. We are also investigating process improvements.

32. "Comprehensive Redesign of Industrial Facilities," Bryan A. Norman and Alice E. Smith (Auburn University), Source: National Science Foundation, $317,562, 1999 – 2002. This grant relates to facility layout design with particular emphasis on the redesign of existing facilities. There are four primary objectives for this research. The first is to identify the main differences between greenfield design (new designs) and redesign of existing facilities. The second objective is to develop methods for designing the block and detailed layout simultaneously rather than in two sequential steps. A third objective of this research concerns modeling product demand uncertainty. A fourth objective is to develop aisle networks and material flow strategies during the block layout design process. There was a supplemental REU award for an additional $10,000.

33. "Worker Assignment for Cellular Manufacturing Considering Human Issues," Kim L. Needy, Bryan A. Norman, and Bopaya Bidanda, Source: National Science Foundation, $99,965, 1999 – 2000. This grant concerns skills assessment and worker assignment in manufacturing cells. The goal of this project is to investigate and quantify the effect of human skills on manufacturing cell performance. Then, to use this information to determine the worker assignments that maximize cell productivity. Rolls-Royce's Indianapolis operations is serving as an industrial partner in this project and has provided a good working environment within which to gather data and test hypotheses.

34. "Joint Research on Intelligent Manufacturing Techniques," Mitsuo Gen (Ashikaga Institute of Technology, Japan), Alice E. Smith (Auburn University), Bryan A. Norman and Gursel A. Suer (Ohio University), Source: Monbusho (Japanese Ministry of Education, Science and Culture) International Scientific Research Program, 6,900,000 yen (Appx. $57,500) with supplemental funds from the University Center for International Studies, University of Pittsburgh, $760, and the Japanese science and Technology Management Program, University of Pittsburgh, $5000, 1998-2000. This grant is a travel grant to support joint research in intelligent manufacturing.

35. "An Intelligent System for Hot Rolling Process Control," Bryan A. Norman and Richard E. Billo (Oregon State University), Source: Ben Franklin Technology Center of Western Pennsylvania, $148,333, 1997-1998. This project focused on process control for a hot rolling process in a local steel mill. The goal of the project was to design an intelligent system to monitor and control the process in order to minimize cracking and warping of steel alloys and titanium.

36. "A Comprehensive Scheduling and Forecasting System for KnowledgeSoft," Bryan A. Norman, Source: KnowledgeSoft Inc., $12,086, 1997. The purpose of this project was to develop an algorithm for scheduling instructors for corporate training courses. The objective was to maximize revenue while satisfying customer service requirements.

37. "Heuristic Optimization Design Strategies for Effective Resource Allocation," Bryan A. Norman, Source: Central Research Development Fund University of Pittsburgh, $13,912, 1997-1998. This grant was seed money to initiate my research into personnel scheduling.

38. "Modernizing Manufacturing Engineering Education at the University of Pittsburgh," Bryan A. Norman and Bopaya Bidanda, Source: SME Education Foundation, $41,195, 1997. This grant represents in-kind donations from industry of software and equipment related to manufacturing systems.

Contributions to Teaching

Courses Taught

During my last five years at the University of Pittsburgh I taught the courses listed below.

Course #	Course Name	Course Level	Dates Taught	Evaluation	# Students
IE 1054	Productivity Analysis	Undergrad. – Soph.	Fall 12	4.39	73
IE 1055/ IE 2025	Facility Layout and Material Handling	Undergrad. - Jr , Sr. or Grad	Spring 12 Spring 13 Spring 14 Spring 15 Spring 16	4.31 4.35 4.72 4.36 4.23	58 81 69 78 84
IE 1090	Senior Project	Undergrad	 Spring 11 Spring 12 Spring 14 Spring 15	 4.61 4.57 4.50 4.71	 24 21 34 31
IE 1101/ IE 2101	Facility Logistics	Undergrad. - Sr or Grad	Fall 13	4.50	19
IE 1106/ 2106	Operations Improvement in Healthcare	Undergrad. - Sr or Grad	Fall 15	4.89	18
IE 1180/ 2180	Operations Analysis	Undergrad. - Sr or Grad	Fall 14	4.60	20
Overall Average Evaluation (Weighted by number of students)				4.46	

Note that teaching evaluations are on a 1.0-5.0 scale. Swanson School of Engineering average is 3.9.

I have taught the following courses at Texas Tech.

Course #	Work Design For Production Operations	Course Level	Dates Taught	Evaluation	# Students
IE 2401	Work Design For Production Operations	Undergrad.	Spring 22	4.2	48
IE 4351	Facility Planning and Design	Undergrad. - Grad	Fall 21	4.4	51
IE 4351	Facility Planning and Design	Undergrad. - Grad	Spring 21	4.3	74
IE 3328	Manufacturing Systems Control	Undergrad	Spring 20	4.1	46
IE 4333	Senior Project	Undergrad	Fall 19	4.1	34
IE 3328	Manufacturing Systems Control	Undergrad	Fall 2019	3.9	19
IE 4333	Senior Project	Undergrad	Spring 19	4.2	37
IE 4333	Senior Project	Undergrad	Fall 18	4.2	42
IE 4351	Facility Planning and Design	Undergrad.	Spring 18	4.2	33
IE 4333	Senior Project	Undergrad	Spring 18	4.2	42
Overall Average Evaluation (Weighted by number of students)				4.1	

Note that teaching evaluations are on a 1.0-5.0 scale. Whitacre College of Engineering average is 4.0.

Courses Developed

I have developed or fully revised several courses over the years, including:
IE 1055/2025: Facility Layout and Material Handling
IE 1101/2101: Facility Logistics
IE 1106/2106: Operations Improvement in Healthcare
IE 1180/2180: Operations Analysis
IE 3082: Mathematical Models of Scheduling
IE 3087: Network Optimization
IE 3091: Heuristic Optimization

Contributions to non-classroom teaching

- IE 1090: Senior Design Projects. I typically teach this course during the spring term and have taught it eight times total and four of the last five years. I find the sponsors and arrange 85% of the projects in the terms I teach the course and about 50% of the projects in the terms I do not teach the course.
- Curriculum redesign. I have been actively engaged in efforts to redesign the undergraduate curriculum with an emphasis on integrating the curriculum, rather than having silos of different subjects in the curriculum. I was the PI on an NSF grant that supported this effort.
- Health Systems Concentration. I have worked with Dr. Karen Bursic and others to promote and implement the health systems concentration within the undergraduate program. I am also the coordinator for the joint Masters Healthcare Systems Certificate with the School of Public Health. Additionally, I have taken over teaching IE 1106: Operations Improvement in Healthcare and am leading the Healthcare Systems Seminar that is required for students from industrial engineering and public health that pursue the Healthcare Systems Certificate.

Graduate Students

Ph.D. Dissertations Supervised

1. Rifat Aykut Arapoglu, Ph.D., 2000, “Simultaneous Layout Design in Facility Layout”, Department of Industrial Engineering, Osmangazi University, Turkey.
2. Wipawee Tharmmaphornphilas, Ph.D., 2001, “A Robust Job Rotation Schedule to Minimize Worker Injuries,” Assistant Professor, Faculty of Engineering, Chulalongkorn University, Bangkok, Thailand.
3. Ugur Aytun Ozturk, Ph.D., 2003, “The Stochastic Unit Commitment Problem: a Chance Constrained Programming Approach Considering Extreme Multivariate Tail Probabilities,” Associate Professor of Economics and Business, Soka University, Tokyo, Japan.
4. Natasa Vidic, Ph.D., 2007, “Developing Methods To Solve The Workforce Assignment Problem Considering Worker Heterogeneity And Learning And Forgetting,” Lecturer, University of Pittsburgh.
5. Lin Wang, Ph.D., 2009, “RFID in Supply Chains,” American Airlines, Dallas, TX.
6. Chen Li, Ph.D., 2010, A Facility Layout Design Methodology for Retail Environments”, Cytel, Singapore.
7. Erin Gross, Ph.D., 2011, “Assessing and Mitigating Risk in a Design for Supply Chain Problem”, Independent Consultant and Adjunct Faculty Member, University of Pittsburgh.
8. Sheng-I Chen, Ph.D., 2012, “Modeling The WHO-EPI Vaccine Supply Chain In Low And Middle Income Countries,” Department of Industrial Engineering and Management, National Chiao Tung University.

9. Jung Lim, 2016, “Improving the Design and Operation of WHO-EPI Vaccine Distribution Networks”, Korea Institute for Defense Analyses.
10. Nazanin Esmaili, 2016, “Optimizing Multi-Item Inventory Management Decisions in Healthcare Facilities”, Data Scientist Workplace Safety and Insurance Board, Toronto Ontario.
11. Hamdy Salman, 2019, “Work Flow Analysis, Scheduling, and Chance Constraint Models in Community Pharmacy Operations”, FedEx Ground.
12. Anna Svirsko, 2019, “Multiobjective and Robust Optimization in Pharmacy Delivery and Emergency Department Nurse Staffing”, Faculty member United States Naval Academy.
13. Maryam Keshtzari, 2020, “Improving Patient Access, Capacity Planning, and Chemotherapy Nurse Assignment in Oncology Clinics”, University of San Diego.
14. Ahmed Hamzi, 2020, “Economic Analysis and Resource Optimization for Scribes Working with Hospitalists, and Effectively Balancing Hospitalist Workloads”, Jazan University.

M.S. Theses Supervised

1. Karunakaran Chakravarthy, “Flowshop scheduling with work-in-process inventory constraints,” 1998.
2. Charles Shebanie, “An Integrated, Evolutionary Approach to Facility Layout and Detailed Design,” 2004.

Honors and Awards

IISE Fellow, 2021
Society for Health Systems Diplomate Award, 2015
Chancellor’s Distinguished Teaching Award 2013 (At most 5 of these awards are given each year across the entire University)
Swanson School of Engineering Outstanding Educator Award 2011
Faculty Honor Roll Award for Outstanding Industrial Engineering Teaching for 2002, 2004, 2007, 2010.
William Kepler Whiteford Faculty Fellow, 2001- 2005.
2004 Best Paper Award by the American Society for Engineering Education Industrial Engineering Division.
IIE Transactions 2003 Best Application Paper Award.
Finalist for the Merritt Williamson Best Paper Award at the American Society for Engineering Management 2001 Conference in Huntsville, AL
Selected as a faculty member who made a significant impact on students’ lives, Spring 1998.
Outstanding Graduate Student, Department of Industrial and Operations Engineering, University of Michigan, 1995.
ORSA Doctoral Colloquium Invitee, 1993.
National Science Foundation Fellow, 1990-1993.
Centennial Research Fellow, University of Oklahoma, 1989-1991.
Outstanding Senior, Department of Industrial Engr. University of Oklahoma, 1988.
National Merit Scholar, University of Oklahoma, 1982-1986.

Professional Service and Leadership Activities

Professional Activities

Member INFORMS, 1989-Present
- Chair of the Facility Logistics Special Interests Group within the Transportation Science and Logistics Division of INFORMS, (2011-2012)
- Vice-Chair of the Facility Logistics Special Interests Group within the Transportation Science and Logistics Division of INFORMS, (2009-2010)
- Tutorials co-Chair for the 2006 INFORMS meeting

Institute of Industrial Engineers, 1986-Present
- IE Body of Knowledge, Governing Board Member, 2019-2021.
- Industrial and Systems Engineering Research Conference, Program Committee, 2014-2016, Healthcare Modeling Track Co-Chair
- Institute of Industrial Engineers Scholarship Committee, 2009-2013
- Program co-Chair for the 2004 Industrial Engineering Research Conference
- Industrial Engineering Research Conference, Program Committee, 1998-2005, Facility Layout Track Co-Chair
- Co-editor for the Institute of Industrial Engineering Solutions 1998 Proceedings
- Liaison between the Pittsburgh Senior Chapter and the University of Pittsburgh Student Chapter and Student Chapter Advisor, 2003-2007
- Pittsburgh Chapter Programs Committee, 2000-2002
- Pittsburgh Chapter Membership Officer, 1997-2000

Member of the IEEE Task Force on Evolutionary Scheduling, 2004-2006

Multidisciplinary International Scheduling (MISTA) Conference, Program Committee, 2003-2007, 2011-2015

Evolutionary Computation Conference, Program Committee, 1999-2004

Associate Editor for INFORMS Journal on Computing, 2005-2006

Organized/co-organized over 20 sessions at INFORMS meetings

Organized/co-organized over 25 sessions at IERC and ISERC meetings

Member of the College Industry Council on Material Handling Education (CIC-MHE) (2002-2005). CIC-MHE is composed of educators and MHIA industry representatives who develop resources for Educators, Students and anyone desiring to learn more about material handling logistics and its applications.

Proposal reviewer for the National Science Foundation, Ben Franklin Technology Center of Western Pennsylvania, MHIA/CICMHE Research Proposal RFP

Referee for: Management Science, Operations Research, IIE Transactions, INFORMS Journal on Computing, European Journal of Operational Research, Production and Operations Management, Omega, Journal of Flexible Manufacturing, Computers and Operations Research, Vaccine, Engineering Design and Automation, and Knowledge and Information Systems Journal.

Book Reviews: Operations Research: Applications and Algorithms by Wayne Winston, Duxbury Press, Faculty Design by Stephan Konz and Steven Hanna.

University Service

University Level Service
Chancellors Distinguished Teaching Award Selection Committee, 2013-2015
Conflict of Interest Committee, 2009-2012

Swanson School of Engineering
Outstanding Educator Committee, 2012-2016, Chaired 2012
Academic Affairs Committee, 2014-2016
Served on the NTS Faculty Promotion Guidelines Committee, 2012-2013
Promotion and Tenure committee, 2009-2012
Worked with Jay Rajgopal to develop block schedules used by freshman engineering for registration in the summer of 2009
Awards committee, 2007-2008
Space planning committee, 2006-2008

Department of Industrial Engineering
Faculty Advisor for Students Consulting for Nonprofit Organizations, 2012-2015
I have served on the graduate committee, undergraduate committee, and multiple faculty search committees.
Provide academic advising for 20 undergraduate students and 5-10 Master's students each year.
Help register incoming IE students each year.
Help recruit IE students from the freshman class each year. Present a TSP demo and applications of IE presentation.
Served on the committee working to establish a joint program in supply chain management between CBA and IE.

Consulting Activities

I have engaged in several consulting activities over the years with local manufacturing companies and more recently with healthcare providers.

My work with Medrad regarding implementation of lean manufacturing (a process they labeled "Medflow") contributed to Medrad receiving several regional and national process excellence awards culminating in the 2003 Malcolm Baldrige National Quality Award.

My healthcare quality improvement work with St. Clair Hospital has helped them win the 2013 VHA Leadership Award for Supply Chain Management Excellence and the Hospital Association of PA's annual Achievement Award for Operational Excellence.