Undergraduate Research: A Model For Preparing Students For Graduate SMET Education

P. RUBY MAWASHA
Wright State University

PAUL C. LAM
OKECHUKWU UGWEJE
TIRUMALAI SRIVATSAN
University of Akron

ABSTRACT

The development and training of competitive **S**cience, **M**ath, **E**ngineering, and **T**echnology (**SMET**) students in the new millennium must focus on an undergraduate curriculum that can provide a strong balance of technical background, professional development, and research experience. An undergraduate curriculum that is geared towards a balanced science and engineering education and research is becoming increasingly difficult to establish due to the dynamic changes in technology. In this paper, we postulate that the development of successful science, math, and engineering research professionals is dependent on the influence of several variables, which include: career orientation, technical background, academic and social support, and research experience. The proposed model is based on the ongoing **SMET** undergraduate research experience at The University of Akron. The proposed model is not intended to serve as an elaborate theory, but as a general guide in training undergraduate students in **SMET** research.

INTRODUCTION

Science, **M**ath, **E**ngineering, and **T**echnology (**SMET**) research at the undergraduate level can be effectively utilized to both foster and promote the development and training of competitive scientists and engineers. Further, experience in research enables students to: (a) attain a higher level of competence in SMET education, (b) understand research and process methods, (c) make good judgements regarding technical matters, and (d) work side by side with faculty and graduate students to form collaborative research groups and work effectively in a team (Gates et. al., 1999; NSF, 1998). A recent survey has revealed the existence of a strong movement to include participation of all undergraduate students in research (National Science Foundation, 1998; U.S. Department of Education, 1986). Training undergraduate students is crucial because attrition from research related disciplines starts during their experience as undergraduates (Tinto et. al., 1997). Participation of the undergraduate students in research has been cited as an effective aid to those individuals who are uncertain about going to graduate school, while concurrently clarifying their intent to pursue graduate research career goals (May, 1991). It has also been recorded that students who participate in undergraduate research programs are more likely than non-participants to continue on with the engineering program to obtain graduate degrees (George, 1996). For students who have no intention of going to graduate school, the team research environment helps them to form their own network, boost their self-esteem, and develop the critical thinking skills that are necessary for success in their chosen professional career. In addition, it allows students to take advantage of open communications with faculty, graduate students and peers.

While a substantial body of literature exists concerning undergraduate research programs, educators must also pay attention to strategies for developing and training future engineering researchers (National Science Foundation, 1998; Bentley, 1994; Nayaranan, 1999). Strategies that have been previously adopted by educators in undergraduate research training and that help students prepare better applications for graduate school include: (a) the affinity group model (Gates et. al., 1999), (b) graduate mentoring (Bentley, 1994), (c) hands-on activities experience (Nayaranan, 1999), (d) Graduate Record Examination (GRE) preparation (Oakes et. al., 1999), (e) academic advising (Morley et. al., 1998), and (f) motivation (Orthlieb et. al., 1994).

Some undergraduate research initiatives focusing on SMET education are already underway at different institutions globally (Stadler & St. Omer, 1999; Mellikov, 1999; Wahby, 1999). Based on available documentation on undergraduate research programs, we postulate that the development of a successful undergraduate research program in SMET must focus on interactive influences of several variables, to include: (a) career orientation, (b) knowledge of science, math, engineering, and technology (SMET), (c) academic and social support, and (d) perception of student.

The purpose of this paper is to describe the undergraduate research experience in SMET at The University of Akron. The objectives of the undergraduate research initiative in SMET are to enhance academic performance and increase recruitment and retention of students in SMET education; to promote academic excellence and preparation of students entering research in the engineering fields; and to emphasize the value of contributing to scholarly research in SMET education and to the community at large. The study will also emphasize success by removing artificial barriers, rewarding performance, and providing an environment of support that fosters posi-

tive attitudes in undergraduate students committed to SMET research (Turner & Pratkanis, 1994).

PROGRAM DESCRIPTION

The undergraduate research program in SMET was initiated in 1995 by the College of Engineering faculty in collaboration with the **W**omen **i**n **E**ngineering **P**rogram (**WIEP**) and the **I**ncreasing **D**iversity in **E**ngineering **A**cademics (**IDEAs**) Program at The University of Akron. Co-sponsors include the U.S. Department of Education's McNair's Scholars Post Baccalaureate Program and the Ohio Space Grant Consortium Fellowship (OSGC), and the research programs encourage a large number of undergraduate students to pursue graduate research opportunities in SMET education. Of the twenty-three students participating in the program, seventy-five percent of these are majoring in engineering. Of the engineering majors around fifty percent of these opt to major in Mechanical Engineering with a specialization or interest in the subject area of materials science and engineering.

In order to gain entry into the undergraduate SMET research program, students must be entering their sophomore, junior, or senior year in the College of Engineering. Also, students must have demonstrated either an interest in or have the potential to enjoy and succeed in the SMET area. The Director of the IDEAs program, the Associate Dean of Engineering for Undergraduate Programs, and faculty of the College of Engineering at The University of Akron select students that exemplify the potential to succeed in the SMET research discipline.

A candidate who wishes to participate in the undergraduate SMET research program must demonstrate self-confidence, enthusiasm, and good problem solving skills. Furthermore, the student must demonstrate knowledge and completion of relevant basic courses in SMET. Success in SMET areas must be distinctly revealed both through grades and an overall participation in academic activities. While these indicators may not be sufficient to provide the depth and capabilities of an individual student, they certainly serve as indicators that a student participant is likely to succeed.

Table 1: Linkages Between Model Constructs and Program Components

Constructs	Related Program Variables
A. Career Orientation	1. Commitment to SMET research as a career 2. Opportunity to pursue research career in SMET 3. Reasons to pursue research in SMET education
B. Technical Background	1. Achievement in SMET competency 2. Self-efficacy in SMET disciplines 3. Growth in SMET courses completed
C. Academic and Social Support	1. Role models – peers and graduate students 2. Counseling and tutoring 3. Faculty mentors 4. Cooperative learning community
D. Research Experience	1. Research in SMET 2. Ability to read and write research manuscripts and technical reports 3. Prepare grant writing and present technical work 4. Attending technical conference

Most of the recruits for the SMET program are junior and senior level college students and they are matched with faculty mentors to participate in the research projects during their undergraduate career. The students must sign a contract, which from a psychological perspective has the effect of formalizing the students' commitment to SMET as a profession and to the ideals and goals of the program (Rousseau, 1995). The contract also has a performance clause that allows the student to earn an incentive tuition scholarship of up to $3,000 per academic year. The four primary components of the model, which are identified as workshop factors for success, are discussed in greater detail in the following section. The components and related program variables are summarized in Table 1.

PROGRAM COMPONENTS

Orientation

Some form of orientation is necessary to facilitate the assimilation of new students in a research group (Gates et. al., 1999; Oakes et. al., 1999). Orientation is an effective cooperative model for building affinity groups to enable and encourage student success in learning (Orthlieb et. al., 1994). The first week of the orientation period allows them to explore opportunities that are available in the profession of SMET research. In addition, the orientation period allows them to go through a self-assessment period that facilitates determining their commitment to pursuing education, training and research in SMET.

Upon orientation and meeting with the

Table 2: Career Workshops

Workshops	Adjoined Topics
A. Career in Research	1. Identify high tech. careers 2. Awareness of wage equity 3. Familiarity with work environment 4. Sensitivity to diversity
B. Graduate School Preparation	1. Graduate entrance requirements (GRE preparation) 2. How to apply to a university or college 3. Visit to university and department of interest 4. Meeting with current graduate students, alumni and faculty of the university of interest
C. Financial Aid and Scholarship	1. Identifying assistantships and fellowships 2. Understanding the differences between research and teaching assistantships 3. Learning about summer research opportunities

faculty members, each student will choose a research project. Details of the research project will be clearly spelled out by the faculty mentor, and the student must agree to work with graduate research associates and the faculty mentors. To address issues pertaining to a lack of knowledge in SMET research, the students will be required to participate in a career workshop (Table 2) that would feature topics that focus on: (a) careers in research, (b) preparation for graduate school, and (c) financial aid and scholarship opportunities.

Research Activities

After the students have chosen the research projects, each student is required to define and propose the activities and associated time schedule to complete their tasks. The appropriate time schedule coupled with well-defined goals would motivate students to focus and maintain balance between research and coursework. The research in SMET will focus on topics such as:

a) Thermal behavior of cross-flow heat exchangers during transients.
b) Study of fatigue deformation characteristics of high strength aluminum alloys.
c) Dynamic model and analysis of a centrifugal blood pump and induction motor.
d) Understanding the stress, strain, and mechanical response of automotive suspension system.
e) Transient behavior of seated human body during input from caudophalad acceleration.
f) An examination of microstructure and hardness of nanostructured cemented carbides: influence of processing parameters.
g) An examination of microstructure and hardness of nanostructured materials: Boron Carbide and Cobalt
h) An examination of microstructure and hardness of fine-grained and nanostructured materials: Copper and Molybdenum.
i) The microstructure and hardness of Silicon Carbide synthesized by plasma pressure compaction.
j) Phytoremediation: Sunflowers and non-eatable lifesavers.
k) An exploration of Wavelet theory in image processing.
l) Understanding Peizo smart materials.

Faculty mentors expect students to deliver concrete results in their research projects. Deliverables may be in the form of oral presentations in technical conferences, abstracts, posters, literature reviews, or participation in writing archival journal papers. For example, a recently concluded undergraduate research "On the microstructure and hardness of silicon carbide synthesized by plasma pressure compaction" (Ravi, et. al., 2000) resulted in a publication in the Journal of Alloys and Compounds with student as the co-author. Another paper, with student as the first author, titled "Design of a Robotic Fish Using Shape Memory Alloy (SMA) Wires," (Penney, et. al., 2001) was published in the American Society of Mechanical Engineers design proceeding. Other papers have been presented as posters or orally at various student conferences, including The American Society of Mechanical Engineers OLD Guard competition and Ohio Space Grant Consortium Student Research Symposium sponsored by the Ohio Aerospace Institute.

Academic and Social Support

Students participating in the SMET program work side by side with the faculty and graduate students, and they meet every week with program coordinators to (a) discuss their research projects, (b) discuss their social and academic problems, and (c) augment the focus of their goals. The support structure for student participants includes the: (1) IDEAs Director, (2) WIEP Director, (3) College of Engineering faculty and administrators, (4) graduate assistants and peers, and (5) faculty mentors. The role of program coordinators (Associate Dean of Undergraduate Studies, Assistant to the Dean of Diversity Programs, McNair coordinator, Director of Women in Engineering, and selected faculty members) is complicated and multidimensional in nature. The key responsibilities of the coordinators involve overall administration of the program coupled with supervision and management of the individual research projects. The program coordinators are expected to offer a set of skills and abilities including valuing diversity, so as to serve as "champions of change", while concurrently promoting a broad knowledge pertaining to research in SMET. To be effective, the coordinators must also show well-developed skills in multicultural career and personal counseling. The coordinators who need to develop particular mentoring and diversity expertise, specifically faculty members, will be asked to participate in workshops offered to develop these skills. Experts from outside professional establishments are invited to run the workshop. All the SMET scholars are expected to attend all professional academic workshops and all GRE preparation classes, and meet with faculty mentors and Program Director on a weekly base.

By working together, the coordinators with the recommendation of the board of directors arrange: (a) all the research activities for the participants, (b) academic workshops to reinforce excellence in students' academic progress, and (c) tutoring to help the students in those areas where they reveal deficiencies. Also, the coordinators develop an overall assessment and evaluation procedure for the program, while concurrently maintaining a database that includes individual records of the participating students. The coordinators also play a critical role both as a liaison and as an advocate to program sponsors.

Effectiveness of the Program

In designing the undergraduate research program in SMET, emphasis was placed on the effectiveness of the program in involving undergraduate students in research. The program contributes to the goal of involving undergraduate students in careers leading to research disciplines, and it serves as a recruitment base for graduate programs and experts in research and development for industry. Also, the program is an outreach program to educate the engineering community on materials science and engineering.

During hands-on research activities in SMET, students gained academic experience by working side by side with graduate students and mentors. They formed collaborative research groups and learned the value of working in teams, and research survival skills. Working in teams was a common theme across all of the various research activities and helped the students to help themselves through the development of peer support and

study networks (Wahby, 2000). Study groups offer many benefits including: (1) an emphasis on self-support and self-help, (2) networking, and (3) the development of communication links (Sessa, 1992, Walker et. al., 1992). It has also been suggested that the creation of a cooperative environment and concurrent use of group-centered approaches may be more compatible with existing value systems of learning (Bowman, 1993; Sue et. al., 1990).

PROGRAM EVALUATION

The University of Akron's undergraduate research program in SMET has increased the retention of those students intending to pursue a career in research. Students have accepted the research learning experience with positive attitudes. The program objectives have resulted in significant student outcomes in the form of: (a) oral technical presentations, (b) abstracts, (c) posters, and (d) archival journal papers.

Many of the student participants developed a positive attitude towards research, a can-do attitude, and personal self-esteem. For the senior students, the program prepares them for pursuing research in graduate school or a career in research and development. The program has an immediate impact on students as they enter the upper class academic year. The program's orientation workshop aids in re-engineering the academic environment to create learning situations that empower students and concurrently enhance their opportunities for success in a research environment. The program provides academic advising to select students so as to ensure that they will be involved in a research project that conforms to their interests. In addition, the program creates a partnership with the College of Engineering, industry, and technical community in a joint effort to increase participation in research activities. The program serves to cultivate well-prepared students that can succeed in their research activities, while also addressing other professional issues that will be very much needed during their career in the engineering community.

Based on the data (23 students) obtained for the past five years, 100% of the participants from our program graduated from college, 70% of the participants entered or applied to graduate school, and 39% are pursuing careers in industry. Table 3 summarizes the status of SMET students after graduation. 73 % of the SMET students majored in engineering and 27 % of the students are in the areas of applied or life science. As indicated from Table 3, six SMET students have received the master degree in engineering, two are pursuing the master degree in engineering, and one student is in medical school. Of the nine SMET students entered in the workforce, two students are pursuing the Master in Business Administration degree, one applied for graduate school in Sociology, and another student applied for graduate school in physical therapy. For the six graduating seniors, four of the students have applied for graduate, medical and law schools. Comparing to The University of Akron data of 608 students with similar profiles, the graduation rate was 93%, less than 50% of the students attended graduate school, and over 60% of the students entered in the workforce.

Table 3: Status of SMET students

Student	Undergraduate Major	Status
S1	Mechanical Engineering	Medical School[2]
S2	Chemical Engineering	MS-Chemical Engineering[2]
S3	Mechanical Engineering	MS – Biomedical Engineering[1]
S4	Mechanical Engineering	MS – Biomedical Engineering[1]
S5	Mechanical Engineering	MS – Mechanical Engineering[1]
S6	Mechanical Engineering	MS – Mechanical Engineering[2]
S7	Mechanical Engineering	MBA[2,4]
S8	Engineering	MS – Mechanical[1]
S9	Civil Engineering	MS – Civil Engineering[1]
S10	Mechanical Engineering	Mechanical Engineering[4]
S11	Mechanical Engineering	MBA[2,4]
S12	Mechanical Engineering	Law School[3,5]
S13	Biology	Medical School[3,5]
S14	Chemistry	Chemistry/Medical School[3,5]
S15	Biology	Biology[3]
S16	Exercise Physiology	Exercise Physiology[3,4]
S17	Mechanical Engineering	Mechanical Engineering[4]
S18	Electrical Engineering	Electrical Engineering[4]
S19	Mechanical Engineering	Mechanical Engineering[4,5]
S20	Mechanical Engineering	Mechanical Engineering[3,5]
S21	Biology	Biology[3,5]
S22	Mechanical-Polymer	Mechanical-Polymer[4]
S23	Anthropology	Sociology [3,4]

[1] Graduated [2] Attending graduate school [3] Applied to graduate school
[4] Industry [5] Graduating Senior

Based on these observations and judgments, and the comments (Examples: "I find the intent of the program to be very helpful for reinforcing my career goal and influence me to apply for graduate school." "It gives me some valuable information concerning graduate research projects." "Interacting with students one-on-one in the lab is a very rewarding experience, and it helps to illustrate difficult concepts.") provided by the participating students and mentors regarding their experiences in the field of research and training, it appears that the overall program had an effect of: (1) improving the research skills of students; (2) enhancing and promoting teamwork, cooperative learning, positive competition, and peer support; and (3) creating a learning environment and community committed to striving for excellence in scientific endeavors. The authors are in the process of collecting additional data to replicate this program with broader and larger samples.

DISCUSSION

From the students' exit interviews and mentors' comments, aspects of the program that need improvement have been identified. The first problem identified relates to scheduling and maintenance of peer networks. Networking among the

participants was stressed during the orientation workshops. Optimally, one would like to have groups of peers networking throughout their research program so as to ease the anxieties through college. This is difficult to accomplish primarily because of the following reasons: (a) the students come from different backgrounds, (b) they take different colleges courses although academic advisors were notified to do their best to cluster students into the same classes, and (c) they may have time conflicts that require alternative schedules. Thus, it is not always possible to maintain a continual network of the program participants.

The second problem involved deficiencies in the educational backgrounds of a few of the students. Thus, a future goal is to develop early intervention workshops and programs that reach out to students as soon as they enter college in an attempt to increase their interest in SMET and to improve their academic background. A program that has been used to increase interest in engineering is The University of Akron's Pre-Engineering Program. The Pre-Engineering Program is aimed at students in high school and is a partnership among professional engineers, high schools, and the engineering faculty. Its objectives include: (a) to promote engineering and science literacy, (b) to emphasize cooperative learning, (c) to foster curiosity and creativity, and (d) to provide opportunities to develop problem-solving skills and to practice measuring skills. This is achieved through the implementation of design teams, which simulate engineering roles in real life.

A third and more difficult problem involves students who have significant life problems. The problems may be emotional, social or economic in nature, and may present obstacles to the success of the student. For example, a student may lack social or familial support, or his/her current living arrangement may be one in which the family or community environment is a negative factor. In such cases, either a university counselor or one of the mentors associated with the program may have to spend a significant portion of his/her time offering nonacademic counseling in terms of offering a sympathetic ear and a comforting voice.

CONCLUSIONS

The undergraduate research program in SMET provides undergraduate students with a peer support network, a collaborative learning environment, hands-on research activities, and a model to inspire and maintain their commitment to high academic and career standards in research. Overall, the program appears to have been successful in meeting its goals of motivating, increasing awareness, providing a positive attitude, increasing student participation in research disciplines, and improving the performance and retention of undergraduate students in engineering. Data from this study indicated that student participants' graduation rate and percentage of students applying to graduate schools are slightly higher than other University of Akron students with similar profiles.

The undergraduate research program in SMET can be used as a model for developing activities for research programs and for developing career interventions in other areas where researchers have been traditionally underrepresented. It is anticipated that with the availability of funds coupled with the enthusiasm shown by administration, a two to three fold increase in current enrollment is expected in the next four to five years. The program's progress and impact should be a sufficient incentive for other institutions to build such a support, research, and counseling program for undergraduate students.

REFERENCES

Bentley, W. Undergraduate Researchers Within a Biochemical Engineering Research Program: Factors Influencing Quality and Learning Experience. 1994 *ASEE Annual Conference Proceedings*, Vol. 1, 1461-1464, 1994.

Bowman, S. L. (1993). Career intervention strategies for ethnic minorities. Career Development Quarterly, 42, 15-25.

Department of Education. (1998, September). Infusing equity in systemic reform: An implementation scheme. Washington DC: American Council on Education.

Gates, A.Q., Teller, P.J., Bernat, B., Delgado, N., and Della-Piana, C.K., "Expanding Participation in Undergraduate Research Using Affinity Group Model ". *Journal of Engineering Education*, 88, 353-359, 1999.

Gates, A., Patricia J. Teller, Andrew Bernat, Sergio Cabrera, and Connie Kubo Della-Piana, "A Cooperative Model for Orienting Students to Research Groups". *Proceeding, 1999 Frontiers in Education Conference*, November 1999.

George, M.D., "Shaping the Future for Undergraduate Education in Science, Mathematics, Engineering, and Technology". National Science Foundation: Directorate for Human Resources, 1996.

Landis, R. B. (1995). Studying engineering: A road map to a rewarding career. Burbank, CA: Discovery Publishing.

May, G.S., "A SUPBERB Experience". National Society of Black Engineers, March 1991.

Mellikov, E., "SMET Education in Estonia". *Proceeding, 2000 Spring Materials Research Society*, April 2000.

Morley, R., Havick, J., and May, S.G., An Evaluation of the Georgia Tech Summer Undergraduate Program of Research in Electrical Engineering for Minorities. *Journal of Engineering Education*, Vol. 87, No. 3, 321-325, 1998.

Nayaranan, R. M. Use of Object Based Undergraduate Research Project Experience as a Graduate Student Recruitment Tool. *Journal of Engineering Education*, Vol. 88, no. 3, 361-365, 1999.

Oakes, W.C., McComb, S.A., Mulkay, E.L., Berger, E.J., Blevins, L.G., Stamber, K., and Jones, J.D., "Equipping Undergraduate for the Graduate School Process". *Journal of Engineering Education*, Vol. 88, No. 3, 353-359, 1999.

Orthlieb Frederick L., and Fewster, Jonathan B. Undergraduate Laboratory Research As a Primary Mode of Education and not Just for Majors. 1994

ASEE Annual Conference Proceedings, Vol. 1, 1465-1468, 1994.

Penney, N., Barr, T., and Song, G., "Design of a Robotic Fish Using Shape Memory Alloy (SMA) Wires," Proceeding of the American Society of Mechanical Engineers Winter Annual meeting, 11/2001.

Ravi, B. G., Omatoye, O. A., Srivatsan, T. S., Petraroli, M., and Sudarshan, T. S., "The Microstructure and Hardness of Silicon Carbide Synthesized by Plasma Pressure Compaction" Journal of Alloys and Compounds, Vol. 299, 2000, pp. 292-296.

Rousseau, D. M. Psychological contracts in organizations: Understanding written and unwritten agreements. Thousand Oaks, CA: Sage, 1995.

Sessa, V. T. (1992). Managing diversity at the Xerox corporation: Balanced workforce goals and caucus groups. In S. E. Jackson, (Ed.), Diversity in the workplace: Human resource initiatives (pp. 37-64). New York, NY: Guilford.

Stadler, B.J., and St. Omer, I.L. "Undergraduate Research Initiative: Providing Active Research Experiences". *Proceeding, 2000 Spring Materials Research Society*, April 2000.

Sue, D. W., & Sue, F (1990). Counseling the culturally different: Theory and practice. New York, NY: Wiley.

Tinto, V., Love, A.G., and Russo, P., Leaving College: Rethinking the Courses and Curses of Student Attrition (2nd Ed.). The University of Chicago Press, Chicago, Illinois 1993.

Turner, M. E., & Pratkanis, A. R. (1994). Affirmative action as help: A review of recipient reactions to preferential selection and affirmative action. Basic and Applied Social Psychology, 15, 43_69.

Wahby, W.S., "Collective Undergraduate Research: A Teaching/Learning Tool for MSE Students". *Proceeding, 2000 Spring Materials Research Society*, April 2000.

Walker, B. A., & Hanson, W C. (1992). Valuing differences at Digital Equipment Corporation. In S. E. Jackson, (Ed,). Diversity in the workplace: Human resource initiative, (p. 119-137). New York, NY: Guilford.

Dr. P Ruby Mawasha received his BS degree in Mechanical Engineering from The City College of the City University of New York. He holds MS and PhD degrees in Mechanical Engineering from The University of Akron. Currently, Dr. Mawasha is the Assistant Dean of Engineering and Computer Science at Wright State University (WSU). Dr. Mawasha is also an Adjunct Faculty in the Department of Mechanical Engineering at WSU. He is involved in several professional societies including the American Society of Mechanical Engineers and American Society for Engineering Education. Dr. Mawasha has received numerous honors including Omicron Delta Kappa (Leadership), Pi Tau Sigma (Mechanical Engineering), Pi Mu Epsilon (Mathematics), and Tau Beta Pi (Engineering). His research interests include thermo-fluids sciences, bioengineering, applied mathematics, and engineering education.

Dr. Paul C. Lam is Professor and Associate Dean of Undergraduate Studies, Diversity Programs and Co-op Education Director in engineering at The University of Akron. Research interests include structural dynamics, fatigue and fracture evaluation of material behavior, pre-engineering math/science/technology programs, and minority engineering retention models. He received his BS degree in 1969 at Purdue University, MS degree in 1970 at University of Illinois, and PhD in 1978 at The University of Akron. Dr. Lam is an ASME Fellow and the recipient of numerous outstanding teacher awards.

Dr. Okechukwu Ugweje obtained his BS and MS degrees in Electrical Engineering from Southern Illinois University in 1984 and 1986, respectively, and his PhD degree in Electrical Engineering from Florida Atlantic University in 1997. He is currently an Assistant Professor in the Department of Electrical Engineering at The University of Akron. Before joining Akron, he was employed by Siemens Network Telecom, Boca Raton Florida, as a telecommunication engineer. Dr. Ugweje is a member of Tau Beta Pi, Eta Kappa Nu and several IEEE societies. His research interests include communication systems, wireless technologies, and Asynchronous Transfer Mode.

Dr. T. S. Srivatsan is Professor of Mechanical Engineering at The University of Akron. He received his MS (1981) and PhD (1984) degrees in Mechanical Engineering from Georgia Institute of Technology, specializing in fields synergizing all aspects related to processing, characterization and mechanical behavior of engineering and engineered materials. He has authored/edited twenty-six [26] books in areas cross-pollinating mechanical design; processing and fabrication of advanced materials; deformation, fatigue and fracture of ordered intermetallic materials; machining of composites; failure analysis; and technology of rapid solidification processing of materials. He also serves as the editor of the international journal on Materials and Manufacturing Processes. Dr. Srivatsan is an ASME Fellow.