Cross-Cultural Service Learning for Responsible Engineering Graduates

David Vader, Carl A. Erikson, John W. Eby
Messiah College, Grantham, PA

Engineering programs everywhere are developing mission statements and outcome assessment plans. Messiah College aims to graduate engineers who are "technically competent and broadly educated, prepared for interdisciplinary work in the global workplace." Moreover, we want to influence our students so that their professional character and conduct are "consistent with Christian faith commitments." The familiar process of gaining and learning to use new information achieves many of our goals for would-be engineers. But how do we grow beyond merely doing good engineering and learn to do good with our engineering?

The paper first explores the need for responsible engineering. Is technique the principal responsibility of engineers, the material working out of objectives defined and supplied by others? Or are engineers also responsible, in view of our special knowledge, to create and use technologies in ways that preserve, honor and advance prevailing social, political economic values? The paper then examines the educational objectives of Messiah College vis-à-vis the college mission and responsible engineering. It considers the influence of the appropriate technology movement in shaping our purpose and the role of service-learning in shaping our program. The paper concludes with the case study of an international service-learning project of Messiah College Engineering.

I. Responsible Engineering

Persons outside of the profession, and sometimes engineers themselves, do not understand the nature of engineering work very well. Ron Howard's film about the troubled Apollo 13 moon shot depicts the response of engineers to crises. In one scene, the astronauts' lives are in jeopardy as carbon dioxide accumulates in a disabled spacecraft. Ground crew engineers working under severe time constraints, and using only those supplies available to the astronauts, must make square filtration canisters work in round receptacles. Confined to an office, someone pours the available material resources onto a table. As time passes, disaster seems to be inevitable, when the engineers emerge victorious. Amazingly, they have crafted a solution from, among other things, duct tape, plastic bags, and pieces of the flight plan document. This is engineering at its unambiguous best. When needs, goals, time constraints, and available resources are unambiguous, engineers can solve problems.

Rarely, however, are the scope and boundary of an engineer's work so well defined. In the United States, the Accreditation Board for Engineering and Technology (ABET) describes engineering as devising components, systems and processes to meet needs. This is the process of applying mathematics and science "to convert resources optimally to meet a stated

objective."[1] Even this abstract definition of engineering points to needs, resources, and optimums: how much more subjective is actual engineering practice? Subjective ideals not only motivate an engineer's work, they alter the culture from which those ideals arise. Cultural activities shape our work, and our work is itself shaping cultural activity: planting and harvesting crops, conducting business, starting and raising families, communicating with other human beings.[2]

Critics and advocates agree that modern technology is pervasive. Complex equipment, owned by large and interconnected institutions, manufactures even the most basic stuff of modern life: food, clothing, and shelter. Before the Industrial Revolution, artisans in scattered shops used locally produced natural fibers for textiles and clothing. Centralized manufacturers of today's synthetic, petroleum-based fibers depend on international oil fields and distribution systems, pipelines, tankers, roads and trucks, for raw material. Equipment for weaving these fibers requires low cost, readily available steel and other refined metals, as well as plastics and ceramics. Also needed are reliable sources of water, electric power, and telecommunications. These are the hidden realities behind our convenience culture, on which even something as simple as purchasing an article of clothing is dependent. Disrupting a single strand in this web of technology can affect the basics of everyday life.

Considering the pervasive and complex relationships between technology and turn of the century culture, it is astonishing that there is so little public discourse on the nature of our commitments to guide the development of technologies. Some of us are technological somnambulists.[3] Engineers have unique opportunities, because of their technical literacy and awareness of developing technology, to foster and contribute to technical discourse. Value questions, however, are often discouraged within the profession and by employers. Engineering addresses empirical issues: Which material will meet technical objectives? What process is most efficient? How can we create new inventions?[4] The surprisingly narrow focus on know-how may stem from supposed neutrality of technology.

By distinguishing between means and ends, for example, we can almost believe that technology is neutral. According to this view, people make judgments concerning the worth of a technology's end use, but the means to achieve that end is only a technical matter. Attaching value only to externally defined goals is presumed beyond the control and responsibility of the engineer. Further contributing to the illusion that technology is neutral is a common but simplistic understanding of technology as tools. Once made, according to this argument, people use tools on various occasions for specific purposes that can be either good or evil. This view neglects the ways in which technology provides structure for and reshapes the meaning of human activity.[5] Printing, for example, reshaped religion, automobiles restructured communities, and automation redefined work.

Engineering practice and scholarship deal almost exclusively with the issues of forming and using technology.[6] The stated problem, historically defined and externally supplied, determines character of most technological thought and activity.[7] Engineers are good at solving problems. They could do more to help define them.

II. Mission of Messiah College

Messiah College is a Christian college of the liberal and applied arts and sciences. We are a church-related college of higher education with a vision for positively influencing communities and institutions through our graduates. Our mission is to educate men and women toward maturity of intellect, character and Christian faith in preparation for lives of service, leadership, and reconciliation in church and society.

The Engineering Department aims to advance the College mission through our educational objectives and our program. The first educational objective of the Engineering Department is to graduate technically competent engineers who are valuable to the companies and other organizations they serve. Believing that good engineering is more than an engine for the creation of material wealth, Messiah also aims to graduate engineers who are prepared to work with technology beneficially in a particular social, political and economic setting. A second educational objective is therefore to graduate engineers who are broadly educated, prepared for interdisciplinary work in the global workplace. Our graduates are familiar with contemporary issues and the historical context of those issues.

Finally our mission argues that engineering is an inherently value-laden activity. Engineers describe their work as the efficient or even optimum use of resources to meet needs. Messiah engineers seek to benefit or positively influence our world. Only from within the framework of moral philosophy, however, is it possible to recognize and agree upon needs, benefits, positive influences and optimum solutions. Many historical and contemporary voices have shaped various philosophies and perspectives. Messiah College is committed to Christian understandings and expressions of what is right.[8] Consequently a third educational objective of Messiah College is to graduate students whose character and conduct are consistent with their Christian faith commitments. Messiah College engineering faculty and staff aim to accomplish their mission "through engineering instruction and experiences, an education in the liberal arts tradition and mentoring relationships with students." These methods must ultimately be expressed in specific initiatives and a particular curriculum. "Appropriate Engineering" and "Service-Learning" are two ideas that have informed Messiah's program.

III. Appropriate Engineering

Appropriate Engineering is a holistic approach to engineering design that incorporates social, political, cultural, environmental, economic and human empowerment issues as central, along with technical considerations, to the process. For example, many rural inhabitants in much of Africa have low incomes and cannot afford to buy batteries for their portable radios. However, hand-cranked radios, which use a mainspring to drive a little dynamo, are highly functional and desired because of their low cost. These radios allow a small village to "zip back into the Information Age with a twist of the wrist."[9]

Many Appropriate Engineering principles have evolved from the work of British economist E. F. Schumacher in the late 1960's and early 1970's on what he called Intermediate Technology. His concepts helped start a movement throughout the world which was designated by the term

Appropriate Technology. Appropriate Technologies are "local, self-help, self-reliant technologies that local people themselves choose, which they can understand, maintain, and repair. They are generally simple, capital saving, labor enhancing, and culturally acceptable. Ecologically, appropriate technologies are environmentally sustainable, as much as possible using renewable energy, and limiting atmospheric, chemical, and solid waste pollution."[10]

Many people associate Appropriate Technology with low or intermediate technology. Developed nations, however, also comprise "local people" who may choose larger scale, more advanced and more capital intensive technologies. The mission of Messiah College is service oriented; we are very pleased that some of our alumni are working in the 2/3 world. Many Messiah engineers, however, are serving in US corporations. Appropriate Engineering seeks to advantage a local setting, developing or industrial, labor or capital oriented. It honors and enhances what is just about that setting and seeks to correct that which is wrong. Appropriate Engineering recognizes technology's potential for good and harm, and aims to do more good than harm.

Because Appropriate Engineering is a distinctive of our Engineering Department, opportunities to encourage, promote, develop, and implement its principles are pursued with our engineering students, the Messiah College community, and the worldwide community. Appropriate Engineering provides a broad and interdisciplinary view of the engineering design process and profession so as to foster an ethical and service oriented mind set as well as technical and commercial considerations. Three general ways that we strive to accomplish this distinctive are:

1. Provide cross-cultural learning and service opportunities for students and faculty through an elective course on Appropriate Engineering, projects in courses like Introduction to Engineering and Senior Project, and service-learning teams. Student-faculty project teams work throughout the academic year, while implementation teams work onsite over the summer and during our January-term.

2. Address nontechnical issues in engineering practice. We work with other academic departments within Messiah College on mutual projects and ideas. Ethics case studies help us identify and address these issues in class.

3. Foster a service ethic among engineering graduates and within our profession. On-campus student clubs like Habitat for Humanity and Earthkeepers assist this effort. We make Appropriate Engineering presentations to alumni, at professional society meetings, in churches and to para-church organizations. We also cooperate with worldwide agencies like the Society for International Ministries (SIM) and the Mennonite Central Committee (MCC) on special projects.

IV. Service-Learning

The idea of Appropriate Engineering helps Messiah engineers recognize good engineering; service-learning helps us discover how to do good with engineering. Technology is what philosophers call an instrument value.[11] It is not valuable itself, but because it enables one to

achieve something else that is valuable while creating and using technology may indeed, as Samuel Florman suggests,[12] provide existential pleasures for the engineer. An engineer discovers the inherent value in her work only when engineering is practiced as a kind of service. "Service-learning is a method and philosophy of experiential learning through which participants in community service meet community needs while developing their abilities for critical thinking and group problem-solving, their commitment and values and the skills needed for effective citizenship. The core elements of service-learning are (1) service activities that help meet community needs that the community finds important and (2) structured educational components that challenge participants to think critically about and learn from their experiences."[13]

In response to a growing concern about education in America, the Carnegie Foundation for the Advancement of Teaching launched a study of what they sensed was a foundational issue, the meaning of scholarship. In 1990, Dr. Ernest Boyer, President of the Foundation, wrote a highly acclaimed report, *Scholarship Reconsidered*.[14] Boyer reclaimed as common ground the scholarship that underlies what has too frequently been a divisive polarity in the academy, the interaction between teaching, research and community service. He identified four kinds of scholarship - the scholarship of discovery; the scholarship of integration; the scholarship of application; and the scholarship of teaching. The report emphasized the connections between the disciplines and between the disciplines and general education. It privileged what historically had been a central concern of the academy but had been neglected in recent years - the application of knowledge in responsible ways to consequential societal problems through service. "Service is routinely praised," he says, "but accorded little attention - even in programs where it is most appropriate."

Boyer observes that less than a century ago the words *reality*, *practicality* and *service* were used by the nations most distinguished academic leaders to describe higher education's mission. He has articulated a vision for a New American College that "celebrates teaching and selectively supports research, while also taking special pride in its capacity to connect thought to action, theory to practice." He quotes Woodrow Wilson several years prior to his becoming president of Princeton University, "It is not learning but the spirit of service that will give a college a place in the annals of the nation."[15]

Empirical studies show that participation in community service leads to personal, moral and civic development. One controlled experiment showed that students who participated in service-learning showed increases in a sense of civic responsibility, increase in international understanding and decrease in racial prejudice.[16] Undergraduate ethics students who engaged in community service work as part of a course requirement scored higher on a test of moral reasoning than students who did not. By the end of the class 51 percent of the experimental group used principled moral reasoning while only 13 percent of the control group did. The service-learning students participated more in class discussions, showed increased sensitivity to social issues and increased understanding of persons different from themselves.[17] Other studies show that participation in service-learning increases student self-confidence, self reliance, sense of self-worth, tolerance and leadership skills. Participation in community service contributes to

students' becoming responsible citizens, developing career competencies, and to self-empowerment.[18,19,20,21]

V. Cross-Cultural Engineering

There are particular reasons for students to be required to cross social, economic and cultural boundaries in service-learning. Messiah College encourages every engineering graduate to embrace the idea of Responsible Engineering. Immersed in a native culture, however, we are often unaware of the social, economic, political and environmental overtones of our engineering. Working in situations significantly different from their own will give students opportunity to develop skills of cross-cultural relationships and to reflect on their own experience and culture from the vantage point of another. These experiences also enable students to identify and relate to the other in our own culture.

Messiah is experimenting with cross-cultural service-learning projects as a means of influencing graduates toward more responsible engineering. Goals for these projects are to: (1) Create interdisciplinary learning and service opportunities for Messiah students and faculty. (2) Develop new ways of integrating faith and practice. (3) Foster a service ethic among Messiah students and faculty. (4) Witness the relevance of faith to practice by dissemination via academic, professional, and other public forums. (5) Meet physical and spiritual needs through culturally appropriate solutions and Christian testimony. During January 1996, two engineering students and three college staff members[22] visited Society for International Ministries (SIM) missions in West Africa to discover ways of working with SIM to create service and learning opportunities for Messiah students. Following this investigative trip, SIM invited a student-led design team to develop a photovoltaic electric power plant for a medical clinic in the village of Mahadaga, Burkina Faso.

Burkina Faso in West Africa is a landlocked area of the Sahel about the size of Colorado. The region is prone to drought and famine. Subsistence agriculture dominates the economy, which is also supported by agricultural processing, light manufacturing, textiles and uranium mining. Annual per capita income in 1992 was $290. Anecdotal reports indicate that this may have doubled by 1998. Infant mortality is 123 per 1000 births and life expectancy is 48 years. There is one physician in Burkina Faso for every 27,000 people, compared to one for every 400 to 600 Americans. Nearly 50 percent of the Burkinabe population is under age 15, while only 4 percent are over age 65.[23] In terms of material wealth, Burkina Faso is one of the poorest countries in the world.

Electric power needs in Mahadaga are modest by American standards, but provide pumping for drinkable water and lighting for the clinic. The clinic staff, predominately African assisted by four expatriate women, provides basic health care in the region. Obstetric care is a particularly important service of the clinic. More than 100 "difficult" births take place at the clinic every month, while many more babies are delivered in the bush. Infant mortality is less than 1%, while the national average is about 12%. For many years a diesel generator has been used to fill a water tower and provide electric lighting between the 6:00 and 9:00 P.M.. A few residences are equipped with a single photovoltaic panel and battery storage for lighting after 9:00 P.M..

Deliveries and minor surgery after 9:00 P.M. have been conducted with the assistance of flashlights. Fuel is expensive and shortages are common. This and the increasing cost and frequency of repairs motivated the clinic staff to seek alternatives to the generator.

We chose the Mahadaga solar project as a first cross-cultural service learning activity precisely because the technical requirements were interesting but straightforward. Project management, working on teams, funding, system testing and installation were additional challenges that students face infrequently in the classroom. Classroom experiences in these areas, moreover, can hardly avoid being somewhat contrived. Working for a real client, SIM in this case, provided many of the students with their first genuine opportunity to fail. Ninety percent earns an "A" in many courses; our system would either work or not. Students raised money to pay for travel expenses. A donor to the Society for International Ministries provided funds for the cost of the solar panels, batteries and wiring, so we were working with money belonging to another organization. The added requirements of international and intercultural communication, shipping, customs, and travel logistics made our activity a very robust learning opportunity.

In the spring of 1996, faculty advisor Dr. David Vader helped Messiah students organize their engineering design team under the direction of three student leaders. Two senior engineering students were appointed mechanical and electrical design leaders. A sophomore was the administrative leader. As many as seventeen other students, spanning the freshmen through senior years and contributing at various levels, organized under these leaders. The students recognized that a photovoltaic power plant was the customer's proposed solution to the problem of unreliable and costly electric power. They determined, however, that solar power was indeed the most appropriate technology. Fuel and maintenance for generators are scarce in the region, while sunlight is abundant. The students chose multilayer thin film collector technology with polycarbonate covers instead of more efficient polycrystalline or single crystal photovoltaics. This option was more cost effective and resistant to vandalism. The team also determined that replacing an existing AC well pump with a DC pump would reduce capital and operating costs of the project. This strategy eliminated the cost and inefficiency of inverting power for the AC pump. Students worked closely with the clinic staff to plan, direct and implement the project.

After fourteen months of learning and system design, we submitted our system proposal to SIM and formed an implementation team to install the system in Mahadaga. Only two members of the design team served on the implementation team. This new team was seven students and one alumnus, our mechanical engineering technician, an engineer from the Harrisburg, PA area, and the faculty advisor. We prepared for intercultural learning by reading and discussing selected fiction and nonfiction on the region and culture. The team also received lectures provided by Messiah faculty, SIM staff, and local people in Burkina Faso. Each student kept two composition book journals, one for personal reflection and the other for technical record keeping. Four students chose to write a paper that focuses on a theme, insight or problem coming out of their cross-cultural experience. The implementation team worked for ten months to take the design from paper to reality. In January 1998 the team traveled to Mahadaga, Burkina Faso and installed the system.

Students have reported the project on campus, to nearly 300 supporters and interested persons through a newsletter, to the South-Central Pennsylvania Chapter of the American Society of Materials and to the Pennsylvania Society of Professional Engineers. They hope to encourage other engineers to use their skills in service.

VI. Conclusion

The Mahadaga solar project was both successful and a predictor of the many additional requirements for the long term success of this initiative. SIM's Alan Dixon writes, "The solar plant is working well. Francoise told me the other day that it is 'merveilleux,' which is about as good as things get in Mahadaga." A baby was delivered and minor surgery performed the very night the system became operational. Twenty-four hours earlier clinic staff would have worked by flashlight. The system was a full week, however, late in coming on-line. The student's failure to become sufficiently motivated early in their work culminated in delays in the arrival of solar panels and batteries in Mahadaga. We completed the project only by leaving four of our members in Mahadaga for an extra week. Because parts were shipped only weeks before they were needed in Africa, SIM staff had little time to negotiate with customs officials in Burkina Faso. Customs was able to extract a $5000 import tax on our solar panels, half their value. Inadequate testing resulted our lacking a relay switch for the low-voltage disconnect.[24] We sent the part later, but suspect that the batteries were damaged. Lightning strikes have destroyed several sets of fuses.

These results are instructional for staff as well as students. Future projects will require more deliberate instruction in project management, working in teams, and system test. We are still wondering how to impart professionalism and the will to commit to self-imposed work schedules. The project is continually no more than a few semesters away from graduating its leaders. A priority assignment for every student leader is the mentoring of his or her replacement. Some members of the implementation team have moved onto other things. Others, however, are working with our friends in Mahadaga to maintain our system. Africa is home to many technology projects failed for lack of resources and know-how to sustain them. We are proposing a long-term relationship with SIM in Burkina Faso to insure that our work continues to benefit our customers. Two students will be in Mahadaga in the summer of 1999 to install improved lightning rods, investigate reports of low battery capacity, and to complete advance work for the next project. We hope to offer several students a stipend to join student-faculty summer design teams.

The vision and organization have now expanded to include nearly 40 students representing engineering, nursing, business, communication and other academic departments. New service-learning activities by interdisciplinary teams will help disabled people in Mahadaga gain self-sufficiency and independence.

While in Mahadaga, a nurse practitioner working with people disabled by polio and other causes asked the students for assistance. We hope to expand a small farming operation run by disabled children into a self-sustaining agricultural micro enterprise. Business students will help develop marketing and business plans. Engineering students will research and design human powered

pumps appropriate to that situation to draw water needed for irrigation. A particular challenge will be to develop a pump that can be operated by persons who do not have strength in their lower body. It is hoped that several designs can be found, each using a different muscle group thus allowing pumpers to do physical therapy at the same time they are pumping water. Disabled persons in Mahadaga, where there are no locally owned motorized vehicles, also need to gain mobility. A hand-powered tricycle is used by some. This device is functional, but prone to mechanical failure and repairs are difficult. A simple, inexpensive, easily repairable hand-powered tricycle that can be manufactured locally is needed. It is hoped that this too can develop into a self-supporting micro-enterprise.

Ernest Boyer, alumnus of Messiah College and past President of the Carnegie Foundation for the Advancement of Teaching, once said that the tragedy of life is not death, it is to die with commitments undefined, with convictions undeclared and with service unfilled. Messiah College professors, staff and students believe that international service-learning experiences can challenge us to define commitments, declare convictions and fulfill service. We have reported significant progress toward the creation of the program to offer these opportunities to interested persons in our community. Future work must include a longitudinal study to discover how the program has affected the attitudes and actions of participants.

Bibliography

1. *Criteria For Accrediting Programs in Engineering In The United States* (New York, NY: Engineering Accreditation Commission Accreditation Board for Engineering and Technology, Inc., 1993).
2. Stephen V. Monsma *et al*., *Responsible Technology: A Christian Perspective* (Grand Rapids, MI: William B. Eerdmans Publishing Company, 1986), p. 19.
3. Langdon Winner, "Technologies as Forms of Life," in *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago: The University of Chicago Press, 1986), pp. 5-10.
4. Carl Mitcham and Robert Mackey, "Introduction: Technology as a Philosophical Problem," in Carl Mitcham and Robert Mackey, eds., *Philosophy and Technology Readings in the Philosophical Problems of Technology* (New York, NY: The Free Press, 1983), p. 1.
5. Langdon Winner, "Technologies as Forms of Life," pp. 5-6.
6. Langdon Winner, "Technologies as Forms of Life," p. 6.
7. I. C. Jarvie, "The Social Character of Technological Problems," in Carl Mitcham and Robert Mackey, eds., p. 52.
8. Monsma *et al.* Suggest these normative principles as a guide for responsible engineering: cultural appropriateness, access to information, social communication, stewardship, justice, caring and trust.
9. Donald F. McNeil, Jr., "This $40 Crank-Up Radio Lets Rural Africa Tune In", *New York Times*, February 16, 1996.
10. R. W. Stevens, ed., *Appropriate Technology: A Focus for the Nineties* (Intermediate Technology Group of North America, 1991), p. ix.
11. Kwame Gyekye, "Technology and Culture in a Developing Country," in Roger Fellows, ed., *Philosophy and Technology* (Cambridge, Great Britain: Cambridge University Press, 1995), p. 141.
12. Samuel C. Florman, *The Existential Pleasures of Engineering* (New York: St. Martin's Press, 1975).
13. S. Mintz and G. Liu, "Service-Learning: An Overview," in *National and Community Service: A Resource Guide* (Washington, DC: The Corporation for National and Community Service, 1993).
14. Ernest L. Boyer, *Scholarship Reconsidered: Priorities of the Professorate* (Princeton, NJ: The Carnegie Foundation for the Advancement of Teaching, 1990).
15. Ernest Boyer, "Creating the New American College," in *The Chronicle of Higher Education*, March 9, 1994, p. A48.

[16.] S. Myers-Lipton, *The Effects of Service Learning on College Students' Attitudes Toward Civic Responsibility, International Understanding and Racial Prejudice*, Unpublished Ph.D. Thesis (University of Colorado, 1994).
[17.] J. Boss, "The Effect of Community Service Work on the Moral Development of College Ethics Students," *Journal of Moral Education*, V. 23, N. 2 (1994), pp. 183-198.
[18.] S. Cohen and S. Sovet, "Human Service Education, Experiential Learning and Student Development," *College Student Journal*, V. 23, N. 2 (1989), pp. 117-122.
[19.] D. Conrad and D. Hedin, "The Impact of Experiential Education on Youth Development," in J. Kendall, ed., *Combining Service and Learning: A Resource Book for Community and Public Service*, V. 1 (Raleigh, NC: National Society for Internships and Experiential Education, 1990), pp. 119-129.
[20.] R. Coles, "Doing and Learning" in *The Call of Service: A Witness to Idealism* (New York: Houghton Mifflin Compnay, 1993), pp. 145-173.
[21.] H. N. Weaver and J. Martin, "Educational Value of International Experience," in S. Showalter, ed., *The Role of Service-Learning in International Education: Proceedings of a Wingspread Conference*, (Goshen, IN: Goshen College, 1989), pp. 59-81.
[22.] Members of this team included Dr. David Vader, Chair of the Engineering Department, Dr. John Eby, Director of the Agape Center for Service and Learning, and Cindy Blount, Director of Student Outreach.
[23.] *World Population Data Sheet: 1994* (Washington, DC: Population Reference Bureau, Inc., 1994).
[24.] That we were only missing one minor component was actually a positive result. We carried every tool and part, down to the last scrap of wire, to the installation site. The nearest commercial center was three hundred kilometers distant.

DAVID VADER
David Vader is an Associate Professor and Chair of the Engineering Department at Messiah College. He was recently named the Clarence Hottel Chair of Engineering, a two-year appointment that will enable him to continue his work in service-learning. He is co-author of several patents and papers on heat dissipation for electronic packages. Dr. Vader earned a B.S. degree in Mechanical Engineering from Texas A&M University in 1982. He earned graduate degrees in Mechanical Engineering from Purdue University, the M.S. in 1985 and Ph.D. in 1988.

CARL A. ERIKSON
Carl Erikson is currently Assistant Professor of Engineering at Messiah College. Mr. Erikson obtained his BSEE degree from Rutgers University in 1969 and his MSEE degree from Purdue University in 1971. He has authored many articles on microelectronic processing and components. He has given numerous presentations to industry, colleges, professional societies, and civic organizations. Since 1990, Mr. Erikson has been interested in and promoting the concept of Appropriate Technology in the Third World as well as in urban areas around the world. He has worked in Kenya, Bolivia, and Venezuela.

JOHN W. EBY
John Eby is Professor of Sociology and Director of the Agape Center for Service and Learning at Messiah College. He came to Messiah College from Goshen College in Goshen Indiana, where he served as Academic Dean and Chief Academic Officer. Dr. Eby's recent publications explore service as a kind of scholarship. He earned a B.S. in Chemistry from Eastern Mennonite College in Harrisonburg, VA. Dr. Eby earned graduate degrees in Development Sociology from Cornell University, the M.S. in 1970 and the Ph.D. in 1972.